IJCNN 2004 & FUZZ-IEEE 2004 CONFERENCE PROGRAM

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IJCNN 2004 & FUZZ-IEEE 2004

International Joint Conference on Neural Networks & IEEE International Conference on Fuzzy Systems

CONFERENCE PROGRAM

Budapest, Hungary
25–29 July, 2004

President's Welcome

I am very pleased to welcome all participants of the 2004 Joint International Neural Networks Conference (IJCNN), and of the IEEE International Conference on Fuzzy Systems (FUZZ-IEEE). The first conference is sponsored this year by the IEEE Neural Networks Society (NNS) and organized in technical co-sponsorship of the International Neural Networks Society (INNS), while the second is entirely sponsored by the NNS.

I would like to take this opportunity to acknowledge the dedicated efforts of the Organizing and Technical Committees that have worked so hard to put together an exciting technical program. The technical sessions will highlight 10 plenary lectures by leading researchers, and feature regular and special oral sessions (held in parallel in four or five tracks). In addition, plenary poster sessions will provide plenty of opportunities for face-to-face interaction between participants.

One of the pre-conference activities, Welcome Reception and Joint IEEE-INNS Awards Ceremony, will be held on Sunday, July 25 at 7pm, and will be co-hosted by the 2004 IEEE President-Elect, Mr. W. Cleon Anderson, the President of the INNS, Dr. Jose C. Principe, and me. Other, such as the Conference Banquet, will combine an exciting social event with a Danube boat ride. In addition, our venue, the city of Budapest, offers an abundance of remarkable sites, historical monuments, and activities for the attendees and their companions.

NNS is one of thirty eight IEEE Societies. Its focus is the theory, design, application, and development of biologically and linguistically motivated computational paradigms emphasizing neural networks, connectionist systems, genetic algorithms, evolutionary programming, fuzzy systems, and hybrid intelligent systems. Formed in 2002, the Society is actively seeking new members to add to its current membership of over 5,500 and expand its international and local presence. To join NNS and become an active member of our community, please visit www.ieee.org/join.

Our members are encouraged to get involved in Technical Committees, or Chapters. The Society also needs more volunteers to run its business. We need people for our Standing Committees, such as Education, Multimedia Tutorials, Standards and other committees. In addition, the Society members also elect its governing body called Administrative Committee (ADCOM).

As you can see, the Society offers all its members opportunities to get involved, be active and participating at the technical level or in its self-governance. We need your support, time and talent, and I am eagerly awaiting your participation in the Society, your contribution to the field, and the further advancement of the society as a whole. For more information, please check our website at www.ieee-nns.org.

JACEK M. ZURADA
President
IEEE Neural Networks Society
Fellow of IEEE
j.zurada@ieee.org

IEEE COMPUTATIONAL INTELLIGENCE SOCIETY
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IEEE Circuits and Systems Society Representative

Contents

IJCNN 2004

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General Information

Registration and Information Desk

The Registration and Information Desk operates on the Conference level of Hotel Inter-Continental as follows:

Sunday, 25 July	08.00 – 19.00
Monday, 26 July	08.00 – 19.00
Tuesday, 27 July	08.00 – 19.00
Wednesday, 28 July	08.00 – 19.00
Thursday, 29 July	08.00 – 16.30

Badge

Please, note that badges need to be worn at every conference event you participate in, including the social programs.

A/V in Session Rooms

All session rooms are equipped with data projectors and computers for Power Point presentations. Authors are kindly asked to hand in their slides at the Registration Desk or contact the Room Technical Assistants until 08.30 on the day of the presentation at the latest.

Overhead projectors will be provided in the plenary session rooms and may also be provided in other rooms upon request if the registration desk is contacted until 08.30 on the day of the presentation.

Posters

Posters will be displayed in room P.

Posters with No.:

T–nnn:	*Tuesday, 27 July*
W–nnn:	*Wednesday, 28 July*

On each day:

Set up	08.00 – 09.00
Poster Session	16.00 – 19.00
Teardown	19.00 – 20.00

Please note:

- Authors are kindly asked to stay next to their posters during the Sessions
- Members of the local staff will assist the authors in posters set up
- Posters not removed by the end of the teardown time will be thrown away!

Cyber Café and Speakers' Ready Facilities

Wireless internet access is available in the Cyber Café area. Number of computers are also provided for surfing on the web.
Several of the computers are dedicated for "speakers' ready" purposes with absolute priority of authors use.

Book exhibition

Publishers display their journals and books in the coffee break area during the conference hours.

Insurance

The Organizers of the Conference do not provide insurance and do not take responsibility for any loss, accident or illness that might occur during the Conference or in the course of travel to or from the meeting site. It is, therefore, the responsibility of the participants to check their coverage with their insurance provider.

Bank, Currency, Credit Cards

The unit of currency is the Hungarian Forint (HUF), denoted as "Ft" by the Hungarians. International credit cards (AmEx, EC/MC, Visa) are accepted at most hotels, restaurants and shops. ATMs are available at the Airport and all over the city. (1 EUR is approx. 250 HUF).

Voltage

The electricity supply in Hungary is 220 V AC (50 Hz).

Evening Programs

Welcome Reception and Joint IEEE-NNS Awards Ceremony
Sunday, 25 July 19.00 – 21.00
Hotel Inter-Continental, Ballroom (Room A & P)

Banquet
Wednesday, 28 July 20.00
(boarding from 19.30)
Boat "Europa"
From the Hungarian Academy of Sciences, just opposite the Hotel Inter-Continental.

Tours

The buses will leave from Hotel Inter-Continental.

Budapest Sightseeing tour
Sunday, 25 July 09.00 – 13.00

Danube Bend
Tuesday, 27 July 09.00 – 17.00

IEEE Budapest 2004 Secretariat

Dr. Gusztáv Hencsey Head of the Secretariat
Mónika Jetzin FUZZ-IEEE 2004
Mariann Kindl IJCNN 2004

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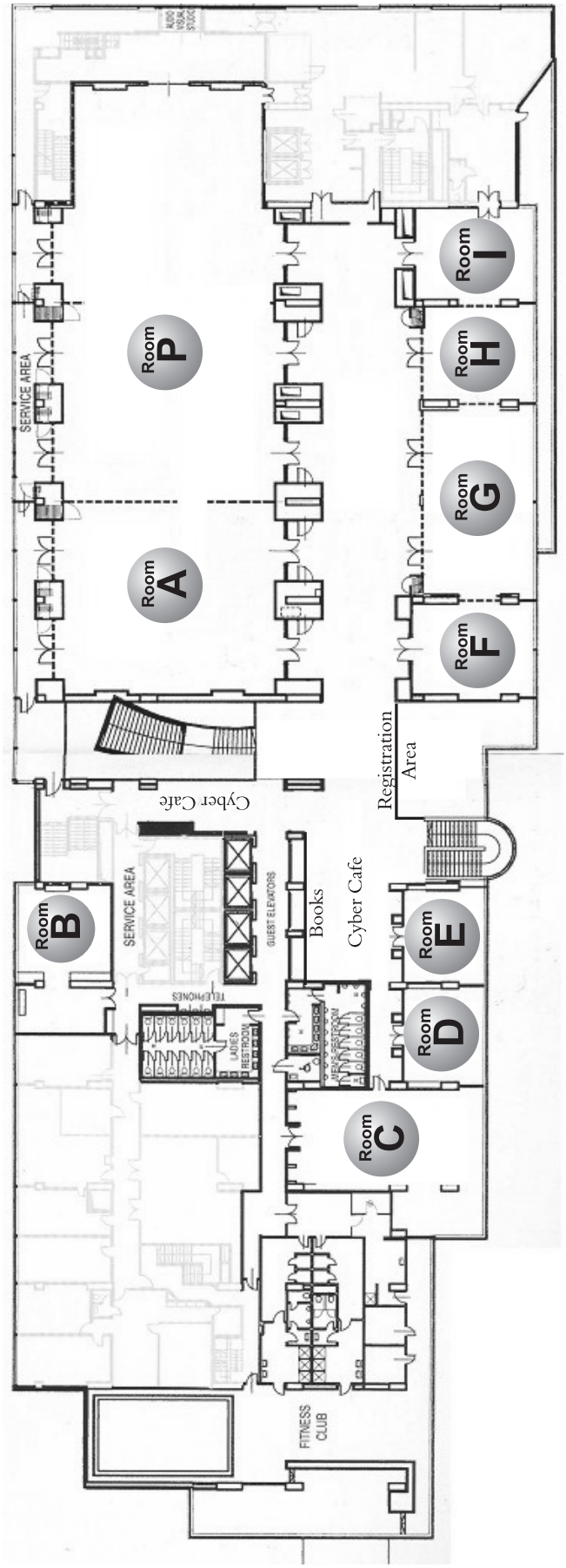
Hotel Inter-Continental Budapest
Conference Floor



IJCNN 2004 & FUZZ-IEEE 2004
SCHEDULE AT-A-GLANCE

Sunday, 25 July, 2004

09.00 – 11.00 Tutorials

IJCNN	Room B	T1: Neural Networks That Actually Work In Prediction and Decision/Control: Common Misconceptions Versus Real-World Success *Paul J. Werbos*
FUZZ-IEEE	Room E	T2: Data Mining, Modeling and Knowledge Discovery in Bioinformatics *Nik Kasabov*

11.15 – 13.15 Tutorials

IJCNN	Room B	T3: Kalman Filter Training of Neural Networks: Methodology and Applications *Danil Prokhorov*
FUZZ-IEEE	Room E	T4: Introduction to Clustering Techniques *Katsuhiro Honda, Francesco Masulli, Stefano Rovetta*

14.30 – 16.30 Tutorials

IJCNN	Room B Room D	T5: Neural Control Systems *Bernard Widrow* T6: Autonomous Mental Development: A New Frontier for Computational Intelligence *Juyang Weng*
FUZZ- IEEE	Room E	T7: Fuzzy Sets for Words: Why Type-2 Fuzzy Sets Should be Used and How They Can be Used *Jerry Mendel*

16.45 – 18.45 Tutorials

IJCNN	Room B Room D	T8: Feature extraction in Computational Intelligence *Evangelia Micheli-Tzanakou* T9: Cellular Visual Microprocessors: Theory, Implementation and Applications *Csaba Rekeczky and Ákos Zarándy*

18.00 – 19.00 Public Lecture

IJCNN	Room C	Clinical Results with the Model 1 IRP implant *Mark Humayun, D. Yanai, R.J. Greenberg, J. Little, B.V. Mech, M. Mahadevappa, J.D. Weiland, G.Y. Fujii, E. deJuan, Jr.*

19.00 – 21.00

IJCNN & FUZZ- IEEE	Room A	Welcome Reception and Joint IEEE-INNS Awards Ceremony

IEEE, IEEE NNS and INNS AWARDS

Joint IEEE NNS/INNS Awards Reception and Ceremony
Intercontinental Hotel, Budapest, Hungary
Sunday, 25 July, 7–9 PM

Hosts

W. CLEON ANDERSON, 2004 IEEE President Elect
Dr. JACEK M. ZURADA, President, IEEE Neural Networks Society
Dr. JOSE C. PRINCIPE, President, International Neural Networks Society

IEEE Awards (presented by Mr. Anderson)

Kiyo Tomiyasu Award to Dr. DAVID B. FOGEL

IEEE NNS Awards (presented by Dr. Zurada)

2004 Neural Networks Pioneer Award to Prof. ANDREW BARTO
2004 Fuzzy Systems Pioneer Award to Prof. RONALD YAGER
2004 Evolutionary Computation Pioneer Award to Prof. RICHARD FRIEDBERG (award received elsewhere)

2004 Meritorious Service Award to Dr. ENRIQUE H. RUSPINI

2004 IEEE Transactions on Neural Networks Outstanding Paper Award to
Drs. M. BAGLIETTO, R. ZOPPOLI, and T. PARISINI

2004 IEEE Transactions on Fuzzy Systems Outstanding Paper Award to Dr. SERGE GUILLAUME

2004 IEEE Fellow Certificate to Dr. PIERO BONISSONE
2004 IEEE Fellow Certificate to Dr. DELIANG WANG

INNS Awards (presented by Dr. Principe)

INNS Hebb Award to JOHN BYRNE
INNS Helmholtz Award to GEORGE SPERLING

INNS Gabor Award to TOMASO POGGIO (2003)
INNS Gabor Award to TEUVO KOHONEN (2004)

INNS Young Investigator Award to DENIZ ERGODMUS and XIUWEN LIU

SCHEDULE AT-A-GLANCE

Monday, 26 July, 2004

09.00 – 09.20 Opening Session, Welcome Addresses

IJCNN & FUZZ-IEEE	Room A	Evangelia Micheli-Tzanakou, Opening Session Chair József Hámori, Vice-President for the Life Sciences, Hungarian Academy of Sciences Jacek M. Zurada, President, IEEE Computational Intelligence Society Tamás Roska, General Chair, IJCNN 2004 László T. Kóczy, General Chair, FUZZ-IEEE 2004

9.20 – 11.00 Key-note Talks I.

IJCNN & FUZZ-IEEE	Room A	9.20 – 10.10	Precisiated Natural Language (PNL) – Toward an Enlargement of the Role of Natural Languages in Scientific Theories *Lotfi A. Zadeh*
		10.10 – 11.00	The CNN: a Brain-like Computer *Leon O. Chua*

11.20 – 13.00 Key-note Talks II.

IJCNN & FUZZ- IEEE	Room A	11.20 – 12.10	Patterns, Clusters, and Components – What Data is Made of *Erkki Oja*
		12.10 – 13.00	Ubiquitous Computing Challenges in Recognizing and Predicting Human Activity *Kenneth Fishkin*

14.30 – 16.30 Parallel Sessions

IJCNN	Room A	Self Organizing Maps
	B	Blind Source Separation (Special Session)
	G	Chaos, Bifurcations and Neural Networks
	C	Information Based Learning
	F	Sensor Array Processing and Cellular Neural Networks
FUZZ-IEEE	Room H	Applications (Invited). 1. Toward Intelligent Human Robot Interface 2. Control
	I	Learning from Data (Invited Track) 1. Inductive Learning
	D	Innovative Trends in Mathematical Models of Imprecision (Invited)
	E	Clustering and Image Processing 1

17.00 – 19.00 Parallel Sessions

IJCNN	Room A	Recurrent Neural Networks
	I	Evolutionary Computing and Neural Networks
	B	Appl. of Blind Source Separation and Independent Comp Anal (ENNS Special Session)
	G	Datamining
	C	Vision and Image Processing
FUZZ-IEEE	Room F	Applications (Invited Track). 3. Information Technology
	H	Models in Learning from Data (Invited Track) 2. Rule-based systems
	D	Imprecision Modeling with Non-Standard Logics (Invited). Fuzzy Algebra
	E	Interaction and Intelligence 1. (Invited)

20.00 – 22.20 Special Session

IJCNN	Room C	Comput. Brain Science & Neuroinformatics in Asian Pacific Countries (Special Session)

Tuesday, 27 July, 2004

08.30 – 09.50 Plenary Sessions

IJCNN	Room A	08.30 – 09.10	Challenges and Opportunities for Analog Neural Processing in the Deep SubMicron SoC Era *Angel Rodriguez Vazquez*
		09.10 – 09.50	Nanoelectronic Neuromorphic Networks (CrossNets): New Results *Konstantin Likharev*
FUZZ-IEEE	Room C	09.00 – 09.50	Structured Learning for Partner Robots *Naoyuki Kubota*

10.10 – 12.10 Parallel Sessions

IJCNN	Room A	Support Vector Machines and Kernel Methods I.
	I	Face Detection and Recognition
	B	Retinal Prosthesis Symposium Part 1
	G	Spiking Neuron Networks
	F	Modeling Attention & Emotion in Humans & Agents (ENNS Special Session)
FUZZ-IEEE	Room H	Applications (Invited Track) 4. Finances, Vision, Biomedical
	C	Learning from Data (Invited Track) 3. Learning from Clustering
	E	Soft Computing in Cyber Security (Invited). Applications
	D	Interaction and Intelligence 2. (Invited)

14.00 – 16.00 Parallel Sessions

IJCNN	Room A	Least Squares Support Vector Machines (Special Session)
	B	Retinal Prosthesis Symposium Part 2
	C	Cognitive Information Processing
	F	Comput. Theories of Hippocampus Behavior and Intellig. (Special Session)
	H	Pattern Recognition Applications
FUZZ-IEEE	Room E	Soft Computing in Fault Diagnosis and Prognosis (Invited)
	G	Learning from Data (Invited Track) 4. Industrial Applications
	D	Fuzzy Mathematics (Invited)
	I	Fuzzy Information Retrieval

16.00 – 19.00 Plenary Poster Sessions

IJCNN	Room P	Plenary Poster Sessions

16.30 – 17.30 Panel Sessions

IJCNN	Room B	Retina Prosthesis Symposium part 3
FUZZ-IEEE	Room C	Soft Computing as a Tool

17.30 – 19.00 Plenary Poster Sessions

FUZZ-IEEE	Room P	Plenary Poster Sessions

20.00 – 22.20 Special Session

IJCNN	Room C	Time Series Prediction Competition (Special Session)

Wednesday, 28 July, 2004

08.30 – 09.50 Plenary Sessions

IJCNN	Room A	08.30 – 09.10	Implantable Biomimetic Microelectronics for the Replacement of Hippocampal Memory Function Lost Due to Damage or Disease *Theodore Berger*
		09.10 – 09.50	Reinforcement Learning in the Real World *Andrew Barto*
FUZZ-IEEE	Room C	09.00 – 09.50	Progressive Sampling Schemes for Approximate Clustering in Very Large Data Sets *James Bezdek and Richard Hathaway*

10.10 – 12.10 Parallel Sessions

IJCNN	Room A	Bioinformatics
	I	Neuromorphic Chips and Hardware
	B	Invited Session
	G	Signal and Image Processing for Intelligent Vehicles
	C	Reinforcement Learning & Approximate Dynamic Progr.
FUZZ-IEEE	Room E	System Architectures and Hardware
	F	Applications of Type 2 Fuzzy Logic 1 (Invited)
	H	Fuzzy Optimization and Design
	D	Fuzzy-Neuro-Evolutionary Hybrids

14.00 – 16.00 Parallel Sessions

IJCNN	Room A	Neural Network Control
	B	Applications in Diagnostics and Quality Control
	G	N N & Kernel Methods for Structured Domains (ENNS Special Session)
	C	Biomedical Applications
	F	Brain Inspired Emerging Nanoarchitectural Design and Techn. Challenges (Spec. Session)
FUZZ-IEEE	Room E	TP Model Transformation in Non-Linear Control (Invited)
	H	Applications of Type 2 Fuzzy Logic 2 (Invited)
	I	Computing with Words
	D	Real World Applications

16.00 – 19.00 Plenary Poster Sessions

IJCNN	Room P	Plenary Poster Sessions

17.30 – 19.00 Plenary Poster Sessions

FUZZ-IEEE	Room P	Plenary Poster Sessions

20.00 – 23.00 Conference Banquet

Thursday, 29 July, 2004

09.00 – 09.50 Plenary Sessions

IJCNN	Room A	09.10 – 09.50 Artificial Neural Networks, Where Do We Go Next? *Dan Hammerstrom*
FUZZ-IEEE	Room C	09.00 – 09.50 Taxonomy-based Soft Similarity Measures *James Keller, Mihail Popescu and Joyce Mitchell*

10.10 – 12.10 Parallel Sessions

IJCNN	Room A	Support Vector Machines and Kernel Methods II.
	B	Noise in N N & Hippoc. Function (ENNS Combined Special Session)
	G	Speech Recognition
	C	Computational Neuroscience
	F	Digital Impl. of Neural Networks (Special Session)
FUZZ-IEEE	Room I	Fuzzy Control and Robotics 1
	H	Advanced Algorithms in Fuzzy Clustering (Invited) + Information Systems
	E	Fuzzy Logic and Mathematics
	D	Philosophy of Soft Computing (Invited)

14.00 – 16.20 Parallel Sessions

IJCNN	Room A	Robotics and Learning
	I	Neurodynamics
	B	Bioinformatics and Biomedical Comp. (ENNS Special Session)
	G	Quantum Computing and Neural Networks
	C	Machine Learning for Text Mining (ENNS Special Session)
FUZZ-IEEE	Room E	Fuzzy Control and Robotics 2
	F	Fuzzy Modeling (Invited)
	H	Database Mining and Decision Making
	D	Clustering and Image Processing 2

16.20 – 16.50 Closing Plenary Session

FUZZ-IEEE	Room C	*Chair:* Kaoru Hirota

Welcome

In the name of the International Neural Network Society (INNS), it is my great pleasure to welcome you to IJCNN'04. INNS and the IEEE Neural Network Society have been collaborating for years to provide researchers in the neural network field with an encompassing, multidisciplinary, and international discussion forum where the full richness of the topic could be captured. Once again, I am very excited with the venue and the program of IJCNN'04. I would like to extend my congratulations to the organizing committee and to you, the author and participant, who really are the ultimate responsible for the success of the event. Next year, I hope to see you again at IJCNN'05 to be held in Montreal, Canada, July 29 to August 5, 2005.

Warmth Regards,

Jose C. Principe
President of INNS

Preface

Welcome to Budapest and Hungary that recently became part of the European Union. Welcome also to the IJCNN conference, that is the joint flagship conference of the IEEE Neural Networks Society and INNS, the former one soon will be called the Computational Intelligence Society. This year the conference has been organized conjointly in time and location with the FUZZ-IEEE 2004. So participants of either conference can move freely from one conference in the other.

As usual, IJCNN has always welcomed your neural networks research contributions, while embracing the proliferation of spin-off and new challenges and opportunities. (See the topic list below). While being an inclusive conference, IJCNN has strict, documented standards for acceptance, including literature review, quality of English, and reproducibility, accuracy and relevance of results. All papers, even special session papers, were subject to a minimum of two reviews – and many papers received up to five. In fact we collected with the beautiful websystem of our web chairman Tom Cholewo 2520 reviews for 785 papers, which is an average of 3.2 reviews per paper. Because of the quality we were able to accept 75% of the submitted papers. The topics cover most of the major areas of research in neural networks, including: self-organizing maps, reinforcement learning, support vector machines, adaptive resonance theory, principal component analysis and independent component analysis, as well as numerous engineering applications, hardware and software designs and detailed biological models of the function of neural circuits.

IJCNN '04 has, at this writing, surpassed expectations in every capacity. We were able to confirm our best choices of plenary speakers: Leon Chua, Erkki Oja, Lotfi Zadeh (jointly with FUZZ-IEEE), and Kenneth Fishkin (jointly with FUZZ-IEEE), Angel Rodriguez Vazquez, Konstantin Likharev, Theodore Berger, Andrew Barto, Dan Hammerstrom. There is an exciting minisymposium on retinal prosthesis organized by Frank Werblin. There is an invited session with stimulating speakers like DeLiang Wang, Bertram Shi, Daryl Kipke, and Armand Tanguay. Special emphasis is also given to physical implementations, including nanotechnology, and neuromorphic models, as well as real life applications. We have an extraordinary

collection of tutorial presenters, and 587 accepted papers for regular and special oral and poster sessions. Let us mention here also a very successful competition on time series prediction and many other exciting special sessions.

An event of this size relies on the solid cooperation of numerous people and societies. We owe a tremendous gratitude to the following:

- The sponsoring societies: IEEE Neural Networks Society (lead society in even-numbered years) and INNS,. We drew on expertise of several past society presidents, conference chairs, program chairs, and numerous other dedicated volunteers. The INNS Board of Governors and IEEE NNS AdCom are listed later in this program.
- The smooth technical cooperation with the European Neural Network Society and the Japanese Neural Network Society
- The generous conference co-supporters: The Computer and Automation Research Institute of the Hungarian Academy of Sciences, the Katholieke Universiteit Leuven, Belgium, the National Communication and Informatics Council of the Republic of Hungary, as well as the Faculty of Information Technology of the Pázmány University, Budapest.
- The International Program Committee, listed later in this program for handling the review of the 785 submitted papers for regular and special sessions.
- The Review Committee, listed later in this program for generating 2520 reviews.
- The Organizing Committee, listed later in this program. Their contributions were so crucial as to justify furtherdetail here:

Program Co-Chairs: Csaba Rekeczky (Budapest), Johan Suykens (K. Univ. Leuven), Shiro Usui (JNNS & RIKEN, Saitama), Robert Kozma (INNS & Univ. Memphis, TN), Peter Erdi (ENNS & Budapest, specialsessions), Anthony Kuh (Hawaii, special sessions) for steering with us the ship of the conference into a safe harbour.

Tutorial Chair: Mary Lou Padgett (Auburn) for attracting many excellent tutorial speakers.

Publicity Chair: Derong Liu (Chicago) for helping out with many critical issues like when the webpage address was discontinued.

Local Organizing Committee and Finance Chair: Gusztáv Hencsey (Budapest)

Publication Chair: P. Szolgay (Budapest)

Web Chair: T. Cholewo (Kentucky) whose webdatabase system really proved to be a robust and cooperative conference management system that reduced considerably our workload.

Last but not least, we would like to thank YOU – the reader. Whether you attended the conference in person, or are just reading these proceedings to enhance your knowledge in the field, it is for your benefit that this information is being disseminated. We encourage you to read and refer to IJCNN papers frequently in your work, and hope to see you at future IJCNN's.

Sincerely,

TAMÁS ROSKA
General Chair IJCNN 2004
Computer and Automation Institute
of the Hungarian Academy of Sciences
and the Pázmány University, Budapest,
Hungary

JOOS VANDEWALLE
Program Chair IJCNN 2004
Katholieke Universiteit Leuven,
Belgium

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Frank Werblin (UC Berkeley)

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(starting with last names)

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YASUI Syozo
YEN Gary
YOSHIZAWA Shuji
ZHANG Huaguang

List of Reviewers for IJCNN 2004

(starting with last names)

We thank the following reviewers for their valuable reviews.
A total of 2520 reviews were made for 785 submitted papers.

ABDELBAR Ashraf
ABOU-NASR Mahmoud
AGARWAL Amit
ALIMI Adel M.
ALIPPI Cesare
AMEYE Lieveke
ANAGNOSTOPOULOS Georgios
ANDONIE Razvan
ANDRAS Peter
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APOLLONI Bruno
ARENA Paolo
ASSADI Amir
AUNET Snorre
AVEDILLO Maria
BALYA David
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BEBIS George
BEGUIN Sophie
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BLOCKEEL Hendrik
BOGER Zvi
BOLLE Desire
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BOUZERDOUM Abdesselam
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ELEUTERI Antonio
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FANG Hai-Tao
FLORES Aaron
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FRANCOIS Damien
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GIELEN Stan
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GOERKE Nils
GORBAN Alexander
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GUNN Steve
GUO Ping
GUO Shengbo
HAINES Karen
HAMMER Barbara
HAN Jun-Hua
HAN Fei
HANSELMANN Thomas
HASSELMO Michael
HEGDE Anant
HILD Kenneth
HO Liangwei
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KAMENETSKY Max
KASABOV Nik
KASSABALIDIS Ioannis
KAYMAK Uzay
KÉK László
KELLY Peter
KENNEDY James
KIM Sung-Phil
KOBUCHI Youichi
KOENIG Andreas
KOPRIVA Ivica
KORUTCHEV Kostadin
KOSTANIC Ivica
KOZMA Robert
KREINOVICH Vladik
KROUT David
KUBOTA Naoyuki
KUH Tony
KUNTANAPREEDA Suwat
KUROGI Shuichi
KUSSUL Ernst
LAINE Sampsa
LARRAÑAGA Pedro
LAZARO Marcelino
LEE Ian
LEE Seok-Beom
LEE Soo-Young
LEE John
LEHN-SCHIØLER Tue
LENDARIS George G.
LENDASSE Amaury
LEVINE Daniel
LI Shuhui
LI Yujian
LIKHAREV Konstantin
LIN Chih-Jen
LIU Derong
LIU Wenxin
LIU Xiuwen
LIU Z.Y.
LIU Hailing
LO James T.
LOZANO José A.
LU Chuan
LUDERMIR Teresa Bernarda
MAGGINI Marco
MANDIC Danilo
MANN Tobias
MARTINEZ Tony R.
MASULLI Francesco
MEER Marius van der
MEESAD Phayung
MEIER Karl-Heinz
MERCADO Eduardo
MILO Marta
MINAI Ali
MITAIM Sanya
MOHAGHEGHI Salman
MORABITO Carlo Francesco
MOREAU Yves
MULDER Samuel
MURPHEY Yi Lu
MYERS Catherine
NAIDOO Bashan
NEWMAN Wyatt
NIEBUR Dagmar
NIKOLAEV Nikolay
NOVOKHODKO Alexander
NUERNBERGER Andreas
NYATHI Jabulani
OELMANN Bengt
OH Se-Young
OJA Erkki
OLIVEIRA Patricia Rufino
OMORI Takashi
ORPONEN Pekka
OZTURK Mustafa Can
PAASIO Ari

PACCANARO Alberto
PACUT Andrzej
PALACIOS Federico
PARK Jung-Wook
PARK Sungjin
PASTEL Mary
PEDRYCZ W.
PELCKMANS Kristiaan
PELS Pieter
PETRAS Istvan
PETRIU Emil
PIURI Vincenzo
POLIKAR Robi
PRIETO A.
PROKHOROV Danil
QUINTANA Jose
RAO Yadunandana
REKECZKY Csaba
RESTREPO Jose
REYNERI Leonardo
RITTER Gerhard
ROSIPAL Roman
ROVETTA Stefano
ROY Sandip
RUBIN Stuart
RUDAS Imre J.
RUECKERT Ulrich
RUNARSSON Thomas
RYNKIEWICZ Joseph
SAAD Emad
SALOMON Ralf
SANCHEZ Justin
SANTAMARIA Ignacio
SANTIAGO Roberto
SATO Naoyuki
SATYADAS Antony
SAVARESI Sergio
SCARSELLI Franco
SCASSELLATI Brian
SERPEN Gursel
SERRANO Eduardo
SHANNON Tad
SHAO Yang
SHI Bertram
SHIN Hyunjung
SHUKLA Sandeep
SILVA Alexandre da
SIMON Geoffroy
SIMPSON Patrick K.
SIMULA Olli
SINDHWANI Vikas
SMITH Scott
SOLÉ Jordi
SPERDUTI A.
SUÁREZ Alberto
SUN Bing-Yu
SUN Zhan-Li
SUYKENS Johan
SWARUP K. Shanti
TAGLIAFERRI Roberto
THOMPSON Benjamin
TÍMÁR Gergely
TÖRÖK Levente
TOURASSI Georgia
TRAFALIS Theodore
TUMER Kagan
USUI Shiro
VACHKOV Gancho
VAN DER SMAGT Patrick
VAN HULLE Marc
VANDEWALLE Joos
VEMURI Rao
VENAYAGAMOORTHY Ganesh Kum
VERDES Pablo F.
VERLEYSEN Michel
VERSACI Mario
VIGNERON Vincent
VISNEVSKI Nikita
VRINS Frederic
WANG Hong-Qiang
WANG Hui-Jing
WANG Lipo
WANG Rubin
WANG Xin
WANG Jeen-Shing
WEINSCHENK Jeff
WENG Juyang
WERTZ Vincent
WESOLKOWSKI Slawo
WHITE Allan
WIDROW Bernard
WONG Hau San
WUNSCH Don
XU Lei
XU Rui
XU Yong
YAMAGUCHI Yoko
YAMAUCHI Koichiro
YAN Rui
YANG Simon X.
YAO Li
YASUI Syozo
YEN Gary
YOSHIZAWA Shuji
ZAKNICH Anthony
ZANGHIRATI Gaetano
ZENG Zhigang
ZHANG Huaguang
ZHANG Nian
ZHANG Qiang
ZHANG Yi
ZHANG Guang-Zheng
ZHAO Qiangfu
ZHAO Xing-Ming
ZHAO Wen-Bo
ZHENG Chunhou
ZHU Daqi
ZUFIRIA Pedro

IJCNN2004 Program

(Page numbers for Abstracts listed on the right)

Monday, 26 July, 17.00–19.00

Appl. of Blind source separation and Independent Comp Anal (ENNS special session), Chair: Yannick Deville and Roberto Tagliaferri, Room: B **54**

17.00 *Analysis of Auditory fMRI Recordings via ICA: A Study on Consistency*
Jarkko Ylipaavalniemi and Ricardo Vigario

17.20 *Time-frequency Blind Signal Separation: Extended Methods, Performance Evaluation for Speech Sources*
Yannick Deville, Matthieu Puigt and Benoit Albouy

17.40 *ICA for Modelling and Generating Organ Pipes Self-sustained*
Angelo Ciaramella, Enza De Lauro, Salvatore De Martino, Mariarosaria Falanga and Roberto Tagliaferri

18.00 *Blotch Removal in Degraded Digital Video Using Independent Component Analysis*
Michele Ceccarelli and Alfredo Petrosino

18.20 *Comparative performance analysis of eight blind source separation methods on radiocommunications signals*
Pascal Chevalier, Laurent Albera, Pierre Comon and Anne Ferreol

18.40 *Linguistic Feature Extraction using Independent Component Analysis*
Timo Honkela and Aapo Hyvarinen

Vision and Image processing, Chair: Kunihiko Fukushima, Room: C **55**

17.00 *Extracting Symmetry Axes: A Neural Network Model*
Kunihiko Fukushima and Masayuki Kikuchi

17.20 *Neural Coding Model of Perceptual Reconstruction Using the Morphoelectrotonic Transform Theory*
Norifumi Watanabe and Shun Ishizaki

17.40 *A Virtual Exploring Mobile Robot for Left Ventricle Contour Tracking*
Faiza Admiraal-Behloul, Boudewijn .P.F. Lelieveldt, Luca Ferrarini, Hans Olofsen and Rob van der Geest

18.00 *Influences of target discrimination capability on hand tracking*
Yasuhiro Takachi, Fumihiko Ishida and Yasuji Sawada

18.20 *Active Learning System for Object Fingerprinting*
Swarup Medasani, Narayan Srinivasa and Yuri Owechko

18.40 *Connectionist Based Dempster-Shafer Evidential Reasoning for Data Fusion*
Hongwei Zhu and Otman Basir

Datamining, Chair: Anthony Kuh, Room: G **56**

17.00 *Value Estimation Based Computer-Assisted Data Mining for Surfing the Internet*
Bálint Gábor, Zsolt Palotai and András Lőrincz

17.20 *Extracting the Knowledge Embedded in Support Vector Machines*
Xiuju Fu, ChongJin Ong, S. Sathiya Keerith, Gih Guang Hung and Liping Goh

17.40 *Initialization of Cluster Refinement Algorithms: A Review and Comparative Study*
Ji He, Man Lan, Chew-Lim Tan, SAM–Yuan Sung and Hwee-Boon Low

18.00 *AMIFS: Adaptive Feature Selection by Using Mutual Information*
Michel Tesmer and Pablo A. Estevez

18.20 *An Adaptable Connectionist Text Retrieval System with Relevance Feedback*
Mahmood Azimi-Sadjadi, Jaime Salazar, SaravanaKumar Srinivasan and Sassan Sheedvash

18.40 *Fuzzy Hidden Markov Predictor in Electric Load Forecasting*
Marcelo Andrade Teixeira and Gerson Zaverucha

Evolutionary Computing and Neural Networks, Chair: Michael Georgiopoulos, Room: I **56**

17.00 *Studying the Capacity of Cellular Encoding to generate Feedforward Neural Network Topologies*
Gutierrez German, Galvan Ines, Molina Jose M and Sanchis Araceli

17.20 *A Relational Multi-Objective Genetic Algorithm*
Sum Wai Lee and Hung-Tat Tsui

17.40 *Using Support Vector Machines in Multi-Objective Optimization*
Yeboon Yun, Hirotaka Nakayama and Masao Arakawa

18.00 *Bayesian Evolution of Rich Neural Networks*
Matteo Matteucci and Dario Spadoni

18.20 *Generic Neural Markup Language: Facilitating the Design of Theoretical Neural Network Models*
Talib Hussain

18.40 *Co-Evolutionary Particle Swarm Optimization Applied to the 7x7 Seega Game*
Ashraf Abdelbar, Sherif Ragab and Sara Mitri

Monday, 26 July, 20.00–22.00

Comput. Brain Science & Neuroinformatics in Asian Pacific Countries (special session), Chairs: Syozo Yasui and Shiro Usui, Room: A **57**

20.00 *Japanese Neuroinformatics Project in Vision and RIKEN Brain Science Institute*
Shiro Usui and Shun-ichi Amari

20.20 *Neuroinformatics: the development of shared neuroscience databases and tools at the Australian National Neuroscience Facility*
Gary Egan

20.40 *Excerpts of Research in Brain Sciences and Neural Networks in Singapore*
Jagath C. Rajapakse, Dipti Srinivasan, Meng Joo Er, Guang-Bin Huang and Lipo Wang

21.00 *Korean Brain Neuroinformatics Research Program: The 3rd Phase*
Soo-Young Lee

21.20 *Japan's Center-Of-Excellence Program: Two COE's for Brain Science/Technology*
Minoru Tsukada, Takeshi Yamakawa and Syozo Yasui

Tuesday, 27 July, 8.30–9.50

Plenary IJCNN, Chair: Anthony Kuh, Room: A **58**

8.30 *Challenges and Opportunities for Analog Neural Processing in the Deep SubMicron SoC Era*
Angel Rodriguez Vazquez

9.10 *Nanoelectronic Neuromorphic Networks (CrossNets): New Results*
Ozgur Turel, Jung Hoon Lee, Xiaolong Ma and Konstantin Likharev

Tuesday, 27 July, 10.10–12.10

10.10 *Comparison of Loss Functions for Linear Regression*
Vladimir Cherkassky and Yunqian Ma

10.30 *Non-crossing Quantile Regressions by SVM*
Ichiro Takeuchi and Takeshi Furuhashi

10.50 *A New Method for Multiclass Support Vector Machines*
Davide Anguita, Sandro Ridella and Dario Sterpi

11.10 *Spatially Chunking Support Vector Clustering Algorithm*
Tao Ban and Shigeo Abe

11.30 *Exploiting Diversity of Margin-based Classifiers*
Enrique Romero, Xavier Carreras and Lluis Marquez

11.50 *Scaling up Support Vector Data Description by Using Core-Sets*
Calvin Chu, Ivor Tsang and James Kwok

Special Track: Retinal Prothesis Symposium Part 1, Room: B, Chair: Frank S. Werblin, ... **59**

10.10 *Information Transmission from a Retina Implant to the Cat Visual Cortex*
Reinhard Eckhorn, Marcus Eger, Marcus Wilms and Thomas Schanze

10.50 *Concerning the Mapping of ambiguous Retinal Output Vectors onto unambiguous Visual Percepts*
Rolf Eckmiller, Dirk Neumann, and Oliver Baruth

11.30 *Complex synaptic activation of bipolar, amacrine and ganglion cells is elicited with biphasic electrical stimulation.*
Shelley Fried, Tim Kubow, Frank Werblin

Modeling attention & emotion in humans & agents (ENNS special session), Chair: John Taylor, Room: F **60**

10.10 *Modelling Human Attention and Emotions*
John Taylor and Nickolaos Fragopanagos

10.30 *The Effect of Emotional Bias in Attentional Processes*
Nickolaos Fragopanagos and John Taylor

10.50 *Adaptation of Facial Feature Extraction and Rule Generation in Emotion-Analysis Systems*
Spiros Ioannou, Amaryllis Raouzaiou, Kostas Karpouzis and Stefanos Kollias

11.10 *Knowing What and Where: A Computational Model for Visual Attention*
Kaustubh Chokshi, Christo Panchev, Stefan Wermter and John Taylor

Tuesday, 27 July, 14.00–16.00

15.20 *Hidden Markov Model Finds Behavioral Patterns of Users Working with a Headmouse Driven Writing Tool*
György Hévízi, Mihály Biczó, Barnabás Poczos, Zoltán Szabó and Bálint Takács

15.40 *Evolving Fuzzy Neural Networks Applied to Odor Recognition in an Artificial Nose*
Cleber Zanchettin and Teresa B. Ludermir

Special Track: Retinal Prothesis Symposium Part 2 Chair: Frank S. Werblin, Room: B 63

14.00 *In vivo evaluations of retinal prostheses*
DJ. Salzmann, P. Linderholm, M. Paques, M. Simonutti, J. A. Chiappore, A. B. Safran, P. Renaud, J. Sahel, S. Picaud

14.40 *Design of a new subretinal implant for prosthetic vision*
John Wyatt

15.20 *From passive to active subretinal implants, serving as adapting electronic substitution of degenerated photoreceptors*
E. Zrenner, V.P. Gabel, F. Gekeler, H.G. Graf, H. Gruber, H. Hämmerle, K. Kohler, W. Nisch, H. Sachs, H. Sailer, K. Shinoda, A. Stett, B. Wilhelm

Cognitive Information Processing, Chair: John Taylor, Room: C 64

14.00 *``Object Permanence'': Results From Developmental Robotics*
Yi Chen, Weng Juyang and Huang Xiao

14.20 *Estimating Driving Performance Based on EEG Spectrum and Fuzzy Neural Network*
Ruei Cheng Wu, Chin Teng Lin, Sheng Fu Liang, Te Ying Huang, Yu Chieh Chen and Tzyy Ping Jung

14.40 *An Associator Network Approach to Robot Learning by Imitation through Vision, Motor Control and Language*
Mark Elshaw, Cornelius Weber, Alex Zochios and Stefan Wermter

15.00 *Assessing similarity of emergent representations based on unsupervised learning*
Juha Raitio, Ricardo Vigario, Jaakko Sarela and Timo Honkela

15.20 *Combining Visual and Proprioceptive Information in a Model of Spatial Learning and Navigation*
Ricardo Chavarriaga and Wulfram Gerstner

15.40 *Deep sleep: Understanding the process of hippocampal playback and plasticity*
Matthew Hartley, Neill Taylor and John Taylor

Comput. theories of Hippocampus behavior and intellig. (special session), Chair: Edmund Rolls and Péter Érdi, Room: F.....65

14.00 *Dendritic Processing in Hippocampal Pyramidal Cells and its Modulation by Inhibitory Interneurons*
Szabolcs Kali and Tamás Freund

14.20 *Functional Role of Entorhinal Cortex in Working Memory and Information Processing of the Medial Temporal Lobe*
Erik Fransen

14.40 *Computing with oscillations by phase encoding and decoding*
Ole Jensen

15.00 *Neurophysiology of the primate hippocampus leading to a model of its functions in episodic and spatial memory*
Edmund Rolls and Simon Stringer

15.20 *Memory Encoding of Object Relocation in a Hierarchical Associative Network with Theta Phase Coding*
Naoyuki Sato and Yoko Yamaguchi

15.40 *An Hypothesis on the Origin of Variable Spatial Scaling Along the Septo-Temporal Axis of the Rodent Hippocampus*
Bruce McNaughton, Carol Barnes, Alejandro Terrazas and Francesco Battaglia

Tuesday, 27 July, 16.00–19.00

Plenary Poster Session: Support Vector Machines and Kernel Methods (incl. special session S7), Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 65

T001 *Kernel CMAC with Improved Capability (special session S7)*
Gábor Horváth

T002 *Direct Kernel Least-squares Support Vector Machines with Heuristic Regularization (special session S7)*
Mark Embrechts

T003 *Why Pairwise Is Better than One-against-All or All-at-Once(special session S7)*
Daisuke Tsujinishi, Yoshiaki Koshiba and Shigeo Abe

T004 *Regularization Constants in LS-SVMs: a Fast Estimate via Convex Optimization (special session S7)*
Kristiaan Pelckmans, Johan A. K. Suykens and De Moor Bart

T005 *Fast Bootstrap applied to LS-SVM for Long Term Prediction of Time Series (special session S7)*
Amaury Lendasse, Vincent Wertz, Geoffroy Simon and Michel Verleysen

T006 *Support Conformal Vector Machine with Optimal Bayes Point*
Eduardo (Edu) Bayro-Corrochano, Refugio Vallejo-Gutierrez and Nancy Arana-Daniel

T007 *Kernel-Based Subpixel Target Detection in Hyperspectral Images*
Heesung Kwon and Nasser M. Nasrabadi

T008 *Non-stationary Data Domain Description using Weighted Support Vector Novelty Detector*
Fatih Camci and Ratna Babu Chinnam

T009 *Cluster-based Support Vector Machines in Text-Independent Speaker Identification*
Sheng-Yu Sun, C. L. Tseng, Y. H. Chen, H. C. Chuang and H. C. Fu

T010 *A part-versus-part method for massively parallel training of support vector machines*
Bao-Liang Lu, Kai-An Wang, Masao Utiyama and Hitoshi Isahara

T011 *Kernel-Based Associative Memory*
Dimitri Nowicki and Oleksiy Dekhtyarenko

Plenary Poster Session: Self Organizing Maps, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P.....67

T012 *Learning and Forgetting - How They Should be Balanced in SOM Algorithm*
Youichi Kobuchi and Masataka Tanoue

T013 *Cross-Language Information Retrieval using Latent Semantic Indexing and Self-Organizing Maps*
Nikolaos Ampazis and Helen Iakovaki

T014 *A New Visualization Scheme for Self-Organizing Neural Networks*
Cristian Figueroa and Pablo A. Estevez

T015 *M-SOM: Matricial Self Organizing Map for sequence clustering and classification*
Farida Zehraoui and Younes Bennani

T016 *Generational Trends in Obesity in the United States: Analysis with a Wavelet Coefficient Self-Organizing Map*
Susan Garavaglia

T017 *Adaptive Second Order Self-Organizing Mapping for 2D Pattern Representation*
Banchar Arnonkijpanich and Chidchanok Lursinsap

T018 *SOM-based Optimization*
Mu-Chun Su, Yu-Xiang Zhao and Jonathan Lee

T019 *Superposition-Based Order Analysis in Self-Organizing Maps*
Laurentiu Hetel, Jean-Luc Buessler and Jean-Philippe Urban

T020 *Regional and Online Learnable Fields*
Rolf Schatten, Nils Rolf Goerke and Rolf Eckmiller

T021 *Non-Euclidean Self-Organizing Classification Using Natural Manifold Distance*
Saichon Jaiyen and Chidchanok Lursinsap

T022 *Surface reconstruction using neural networks and adaptive geometry meshes*
Agostinho de Medeiros Brito Junior, Adriao Duarte Doria Neto and Jorge Dantas de Melo

T023 *Generalization of Topology Preserving Maps: A Graph Approach*
Arpad Barsi

Plenary Poster Session: Recurrent Neural Networks, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 68

T024 *On Stable Learning of Block-Diagonal Recurrent Neural Networks - Part I: The RENNCOM Algorithm*
Paris Mastorocostas and John Theocharis

T025 *On Stable Learning of Block-Diagonal Recurrent Neural Networks - Part II: Application to the Analysis of Lung Sounds*
Paris Mastorocostas and John Theocharis

T026 *On Global Exponential Periodicity of Dynamical Neural Systems*
Changyin Sun, Dequan Li, Liangzheng Xia and Chun-Bo Feng

T027 *Flow Estimation Using Elman Networks*
Pedro Coelho, Luiz Biondi Neto, Joao Mello, Lidia Meza and Maria Velloso

T028 *A Comparison of First- and Second-Order Training Algorithms for Dynamic Neural Networks*
Ferid Bajramovic, Christian Gruber and Bernhard Sick

T129 *Energy Generalized LVQ with Relevance Factors*
Angel Cataron and Razvan Andonie

T130 *A Self-Regulating Clustering Algorithm for Identification of Minimal Cluster Configuration*
Jiun-Kai Wang and Jeen-Shing Wang

T131 *Design Interpretable Neural Network Trees Through Self-organized Learning of Features*
Qinzhen Xu, Qiangfu Zhao, Wenjiang Pei, Luxi Yang and Zhenya He

T132 *Pruning The Vocabulary For Better Context Recognition (special session S6)*
Rasmus Madsen, Sigurdur Sigurdsson, Lars Hansen and Jan Larsen

T133 *An Approach for Generalizing Knowledge Based on Rules with Priority Orders*
An Zeng, Qi-Lun Zheng, Dan Pan and Hong Peng

T134 *Distributed mining of the Internet for novel news: Evolutionary community of news foragers*
Zsolt Palotai, Sándor Mandusitz and András Lőrincz

Plenary Poster Session: Computational neuroscience, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 81

T135 *Thematic Role Assignment through a Biologically Plausible Symbolic-connectionist Hybrid System*
Joao Luis Garcia Rosa and Alberione Braz da Silva

T136 *Self-Organized Function Localization Neural Network*
Takafumi Sasakawa, Jinglu Hu and Kotaro Hirasawa

T137 *Using Latent Attractors to Discern Temporal Order*
Simona Doboli and Ali A. Minai

T138 *Information Transformation from a Spatiotemporal Pattern to Synchrony through STDP Network*
Ryosuke Hosaka, Hikoichiro Nakamura, Tohru Ikeguchi and Osamu Araki

T139 *Desynchronization in networks of globaly coupled neurons: effects of inertia*
Milan Majtanik, Kevin Dolan and Peter A. Tass

T140 *Electrode-cell Distance Estimation Method, Based on Spatial Potential Patterns of Spiking Cells*
Zoltán Somogyvári, Gábor Borbáth, László Zalányi, István Ulbert and Péter Érdi

T141 *Hippocampal and prefrontal mechanisms for goal-directed and memory guided behavior (special session S9)*
Michael E. Hasselmo

T142 *Spatial Representation versus Navigation through Hippocampal, Prefrontal and Ganglio-basal Loops*
Jean-Paul Banquet, Yves Burnod, Philippe Gaussier, Mathias Quoy and Arnaud Revel

Plenary Poster Session: Neurodynamics, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 82

T143 *Stability Analysis of a Self-Organizing Neural Network with Feedforward and Feedback Dynamics*
Anke Meyer-Baese, Sergei Pilyugin and Axel Wismueller

T144 *Studies on the Conditions of Limit Cycle Oscillations in the KII Models of Neural Populations*
Roman Ilin, Robert Kozma and Walter J. Freeman

T145 *Applying KIV Dynamic Neural Network Model for Real Time Navigation by Mobile Robot Aibo*
Sangeeta Muthu, Robert Kozma and Walter J. Freeman

T146 *Neural communication systems*
Petér András

T147 *Theta Rhythm Selection of a Dentate Gyrus Network Model*
Katsumi Tateno, Takahiro Hashimoto, Satoru Ishizuka, Koushi Nakashima and Hatsuo Hayashi

T148 *A new hybrid neural architecture (MLP+RPE) for hetero association: Multi Layer Perceptron and coupled Recursive Processing Elements Neural Networks*
Emilio Del Moral Hernandez and Leandro Silva

T149 *Segregation of Motion Aftereffect Following Adaptation to Transparent Motion*
Makoto Hirahara, Naoki Fukushima and Takashi Nagano

Plenary Poster Session: Communications and security, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 82

T150 *Reinforced Snap-Drift Learning for Proxylet Selection in Active Computer Networks*
Dominic Palmer-Brown, Sin Wee Lee and Chris Roadknight

T151 *Convolutional Decoders Based on Artificial Neural Network*
Stevan Berber and Vojislav Kecman

T152 *Neural Network Approach for User Activity Monitoring in Computer Networks*
Natalia Kussul and Serhiy Skakun

T153 *Feature Selection for Intrusion Detection: An Evolutionary Wrapper Approach*
Alexander Hofmann, Timo Horeis and Bernhard Sick

T154 *A Neural Network Application for Attack Detection in Computer Networks*
Adriana Cristina Santos, Lilia de Sa Silva, Jose Demisio S. Silva and Antonio Montes

T155 *Feature Extraction for Neural Network Equalizers Trained with Multi-gradient*
Chulhee Lee, Jinwook Go and Byungjoon Baek

Plenary Poster Session: Time series prediction competition, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P.....83

T156 *Time Series Prediction with Evolvable Block-based Neural Networks (special session Sf)*
Seong G. Kong

T157 *A hierarchical Bayesian learning scheme for autoregressive neural networks: application to the CATS benchmark (special session Sf)*
Antonio Eleuteri, Fausto Acernese, Leopoldo Milano and Roberto Tagliaferri

T158 *Batch Learning Competitive Associative Net and Its Application to Time Series Prediction (special session Sf)*
Shuichi Kurogi, Takamasa Ueno and Miho Sawa

T159 *A Hybrid Predictor for Time Series Prediction (special session Sf)*
Chen Yen-Ping, Wu Sheng-Nan and Wang Jeen-Shing

T160 *MultiGrid-Based Fuzzy Systems for Time Series Forecasting: CATS Benchmark IJCNN Competition (special session Sf)*
Luis Javier Herrera Maldonado, Hector Pomares, Ignacio Rojas, Jesus Gonzalez, Mohammed Awad and Ana Maria Herrera Maldonado

T161 *Time Series Prediction Using Chaotic Neural Networks: Case Study of IJCNN CATS Benchmark Test (special session Sf)*
Robert Kozma and Igor Beliaev

Tuesday, 27 July, 16.30–18.30

Special Track: Retinal Prothesis Symposium Part 3, Chair: Frank S. Werblin, Room: B 84

Panel Discussion

Tuesday, 27 July, 8.00–10.40

Time Series Prediction Competition (special session), Chair: Amaury Lendasse, Room: A.....84

20.00 *Time Series Prediction Competition: The CATS Benchmark*
Amaury Lendasse, Erkki Oja, Olli Simula and Michel Verleysen

20.20 *Multi-resolution Time-Series Prediction Using Fuzzy Inductive Reasoning*
Francois E, Cellier and Angela Nebot

20.40 *Time Series Prediction with Ensemble Models*
Joerg Wichard and Maciej Ogorzalek

21.00 *Prediction of the CATS benchmark exploiting time-reversal symmetry*
Pablo F. Verdes, Pablo M. Granitto, Maria Ines Szeliga, Alejandro Rebola and H. Alejandro Ceccatto

21.20 *Double Quantization Forecasting Method for Filling Missing Data in the CATS Time Series*
Geoffroy Simon, John A. Lee, Michel Verleysen and Marie Cottrell

21.40 *IJCNN 2004 Challenge Problem: Time Series Prediction with a Weighted Bidirectional Multi-stream Extended Kalman Filter*
Xiao Hu and Donald Wunsch

22.00 *Time Series Prediction with Recurrent Neural Networks Using a Hybrid PSO-EA Algorithm*
Xindi Cai, Nian Zhang, Ganesh K. Venayagamoorthy and Donald Wunsch

22.20 *Time Series Prediction by Kalman Smoother with Cross Validated Noise Density*
Simo Sarkka, Aki Vehtari and Jouko Lampinen

Wednesday, 28 July, 8.30–9.50

Special Track: Plenary IJCNN, Chair: Joel Davis, Room: A 85

8.30 *Implantable Biomimetic Microelectronics for the Replacement of Hippocampal Memory Function Lost Due to Damage or Disease*
Theodore Berger

9.10 *Reinforcement Learning in the Real World*
Andrew Barto

Wednesday, 28 July, 10.10–12.10

Wednesday, 28 July, 14.00–16.00

Brain inspired emerging nanoarchitectural design and techn. challenges (special session
Chair: Valeriu Beiu and Ulrich Rueckert, Room: F 91

14.00 *Fault-Tolerant PLA-styleCircuit Design for Failure-Prone Nanometer CMOS and Quantum Devices Technologies*
Alexandre Schmid and Yusuf Leblebici

14.20 *Emergence of Computational Chaos in Asynchronous Neurocomputing*
Sarit Barhen, Vladimir Protopopescu, Jack Wells, Neena Imam and Jacob Barhen

14.40 *Architectural Requirements for Threshold Logic Gates based on Resonant Tunneling Devices*
Peter Kelly, Martin Mcginnity and Liam Maguire

15.00 *Reconfigurable Subthreshold CMOS Perceptron*
Snorre Aunet, Bengt Oelmann, Suliman Abdalla and Yngvar Berg

15.20 *CHIMERA: Creating a New Generation Chip by Brain Guidance*
John Taylor

15.40 *A Charge Recycling Differential Noise Imune Perceptron*
Jabulani Nyathi, Valeriu Beiu, Suryanarayana Tatapudi and David J. Betowski

N N & Kernel methods for structured domains (ENNS special session), Chair: Alessandro Sperduti, Room: G 92

14.00 *Recursive PCA and the Structure of Time Series*
Thomas Voegtlin

14.20 *On the Role of Long-Range Dependencies in Learning Protein Secondary Structure*
Alessio Ceroni and Paolo Frasconi

14.40 *A mutual information kernel for sequences*
Marco Cuturi and Jean-Philippe Vert

15.00 *Recursive neural networks for object detection*
Monica Bianchini, Marco Maggini, Lorenzo Sarti and Franco Scarselli

15.20 *Fisher Kernel for Tree Structured Data*
Luca Nicotra, Alessio Micheli and Antonina Starita

15.40 *A Supervised Self-Organizing Map for Structures*
Markus Hagenbuchner and Ah Chung Tsoi

Wednesday, 28 July, 16.00–19.00

Plenary Poster Session: Support Vector Machines and Kernel Methods,
Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 93

W001 *A New Momentum Minimization Method for Support Vector Machines*
Daniel Lai, Mani Nallasamy and Palaniswami Marimuthu

W002 *Learning Probabilistic Kernel Feature Subspace with Side-information for Classification*
Jianguo Lee, Changshui Zhang and Zhaoqi Bian

W003 *Least Squares Support Vector Machine Ensemble*
Bing-Yu Sun and De-Shuang Huang

W004 *Robust Outlier Detection using SVM for Regression*
Elsa Jordaan and Guido Smits

W005 *Unsupervised Clustering and the Capacity of Support Vector Machines*
Davide Anguita, Sandro Ridella, Fabio Rivieccio and Rodolfo Zunino

W006 *SVM-Based Blind Beamforming of Constant Modulus Signals*
Ignacio Santamaria, Javier Via and Javier Merino

W007 *Model Selection of SVMs Using GA Approach*
Peng-Wei Chen, Jung-Ying Wang and Hahn-Ming Lee

W008 *Feature Subset Selection for Support Vector Machines by Incremental Regularized Risk Minimization*
Holger Froehlich and Andreas Zell

W009 *Multi-class SVM with Negative Data Selection for Web Page Classification*
Chen Chih-Ming, Lee Hahn-Ming and Kao Ming-Tyan

W010 *Kernel Principal Component Analysis and Support Vector Machines for Stock Price Prediction*
Huseyin Ince and Theodre B. Trafalis

W011 *Model Selection in Top Quark Tagging with a Support Vector Classifier*
Davide Anguita, Sandro Ridella, Fabio Rivieccio, Rodolfo Zunino, Silvia Amerio and Ignazio Lazzizzera

Plenary Poster Session: Adaptive resonance theory, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 100

W061 *Integrating Phrases to Enhance HSOMART-based Document Clustering*
Mahmoud Hussin and Mohamed Kamel

W062 *Mahalanobis Distance-Based ARTMAP Network*
Hongyu Xu and Marko Vuskovic

W063 *MS-TSKfnn: Novel Takagi-Sugeno-Kang Fuzzy Neural Network Using ART Like Clustering*
Di Wang, Chai Quek and Geok-See Ng

W064 *A Data Partitioning Approach to speed up the Fuzzy ARTMAP algorithm using the Hilbert space-filling Curve*
Jose Castro, Michael Georgiopoulos, Ronald DeMara and Avelino Gonzalez

W065 *A Comparative Investigation of the RePART Neural Network in Pattern Recognition Tasks*
Anne Canuto and Araken Medeiros

Plenary Poster Session: Neuro-fuzzy systems, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P.....100

W066 *A Hybrid n-tuple Neuro-Fuzzy Classifier for handwritten Numerals Recognition*
Raida Al-Alawi

W067 *Improving the Interpretability of Takagi-Sugeno Fuzzy Model by Using Linguistic Modifiers and a Multiple Objective Learning Scheme*
Shang-Ming Zhou and John Q. Gan

W068 *Fourier fuzzy neural network for clustering of visual objects based on their gross shape and its appliation to handwritten character recognition*
Pradeep Patil, Manish Deshmukh, P.v Bonde, Priyadarshan Dhabe and Trimbak Sontakke

W069 *The Dynamic Fuzzy Method to Tune the Weight Factors of Neural Fuzzy PID Controller*
Yongquan Yu, Ying Huang and Bi Zeng

W070 *A Fuzzy Inference Neural Network Based Method for Short-term Load Forecasting*
Hiroyuki Mori and Tadahiro Itagaki

W071 *Dynamic Bandwidth Allocation Using A Two-Stage Fuzzy Neural Network Based Traffic Predictor*
Nayera Sadek and Alireza Khotanzad

W072 *Prior Knowledge for Fuzzy Knowledge-Based Artificial Neural Networks from Fuzzy Set Covering*
Jacobus van Zyl and Ian Cloete

W073 *Map Building and Localization on Autonomous Mobile Robot Using Graph and Fuzzy Inference System*
Gyu-Jong Choi and Doo-Sung Ahn

W074 *The Challenge of using Unsupervised Learning Algorithms for Fuzzy Cognitive Maps*
Elpiniki Papageorgiou, Chrysostomos Stylios and Peter Groumpos

W075 *Determining In-Situ Stress Profiles of Hydrocarbon Reservoirs from Geophysical Well Logs Using Intelligent Systems*
Shahab Mohaghegh, Andrei Popa, Razi Gaskari, Steve Wolhart and Robert Siegfried

Plenary Poster Session: Biomedical applications, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 101

W076 *Neural Network Fusion Strategies for Identifying Breast Masses*
Yunfeng Wu, Jingjing He, Yi Man and Juan Ignacio Arribas

W077 *Analysis of features for efficient ECG signal classification using neuro-fuzzy network*
Stanislaw Osowski and Linh Tran Hoai

W078 *Breast MRI data analysis by LLE*
Claudio Varini, Tim Nattkemper, Andreas Degenhard and Axel Wismueller

W079 *Classification of Magnetic Resonance Spectra using Parallel Randomized Feature Selection*
Nicolino Pizzi and Witold Pedrycz

W080 *Nonlinear analysis and selection of relevant parameters in assesing the treatment results of reducing tremor, using DBS procedure*
Oana Voroneanu, Horia-Nicolai Teodorescu and Ciprian Zamfir

W081 *Characterization of the Temporal Pattern of Cerebral Blood Flow Oscillations*
Balázs Benyő, Gábor Lenzser and Béla Palancz

W082 *Classification of Fetal Heart Rate during labour using Hidden Markov Models*
George Georgoulas, George Nokas, Chrysostomos Stylios and Peter Groumpos

W083 *An Efficient Sequential RBF Network for Bio-Medical Classification Problems*
Runxuan Zhang, Narasimhan Sundararajan, Guang-Bin Huang and Paramasivan Saratchandran

W084 *Classification of Medical Data with a Robust Multi-Level Combination Scheme*
Georgios Tsirogiannis, Dimitris Frossyniotis, Ioannis Stoitsis, Spyretta Golemati, Andreas Stafylopatis and Konstantina Nikita

W085 *Neural Network Based Light Attenuation Model for Monitoring Seagrass Health*
Habtom Ressom, Padma Natarajan, Siva Srirangam, Mohamad Musavi and Robert Virnstein

W086 *3D Spatial Analysis of fMRI Data - A Comparison of ICA and GLM Analysis on a Word Perception Task*
Ingo R. Keck, Fabian J. Theis, Peter Gruber, Elmar W. Lang, Karsten Specht and Carlos G. Puntonet

Plenary Poster Session: Vision and image processing, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P.....103

W087 *Self Organising Neural Place Codes for Vision Based Robot Navigation*
Kaustubh Chokshi, Stefan Wermter, Christo Panchev and Kevin Burn

W088 *Homomorphic Processing System And Ratio Rule For Color Image Enhancement*
Vijayan Asari and Ming-Jung Seow

W089 *A New Accelerated EM Based Learning of the Image Parameters and Restoration*
Faruk Sari and Mehmet Celebi

W090 *Feature Extraction and Coding-Reconstruction of the Images Using Neuron-Like Algorithms*
Vladimir G. Yakhno and Irina Nuidel

W091 *Design and Optimization of Amari Neural Fields for Early Auditory-Visual Integration*
Carsten Schauer and Horst-Michael Gross

W092 *Sparse coding and NMF*
Julian Eggert and Edgar Koerner

W093 *Transformation-invariant representation and NMF*
Julian Eggert, Heiko Wersing and Edgar Koerner

W094 *A Novel Mixed Pixels Unmixing Method for Multispectral Images*
Jun-Hua Han, De-Shuang Huang, Zhan-Li Sun and Yiu-ming Cheung

W095 *Multiple Regression Estimation for Motion Analysis and Segmentation*
Vladimir Cherkassky, Yunqian Ma and Harry Wechsler

W096 *A Novel Self-Organizing Neural Network for Defect Image Classification*
Jussi Pakkanen and Jukka Iivarinen

W097 *Histogram Coding For Recognition Of Contours Presented By Bezier Curves*
Michael Kussul and Alla Galinskaya

W098 *Recognizing Objects in Non-Controlled Backgrounds by an Appearance Two-Step Approach*
M. Asuncion Vicente, Cesar Fernandez and Oscar Reinoso

W099 *A face detection system using shunting inhibitory convolutional neural networks*
Fok Hing Chi Tivive and Abdesselam Bouzerdoum

W100 *Image Enlargement as an Edge Estimation*
Chi-kin Chow and Hung-Tat Tsui

W101 *Unsupervised NN and Graph Matching Approach to Compare Data Sets*
Giuseppe Acciani, Girolamo Fornarelli and Luciano Liturri

W102 *Iris Recognition by a Rotation Spreading Neural Network*
Hironobu Takano, Maki Murakami and Kiyomi Nakamura

W103 *Effect of Noise on the Performance of Temporally-Sequenced Intelligent Block-Matching and Motion-Segmentation Algorithm*
Xiaofu Zhang and Ali A. Minai

W104 *Video Summarization and Browsing Using Growing Cell Structures*
Irena Koprinska and James Clark

Plenary Poster Session: Hardware implementations, Chair: Joos Vandewalle and Gusztáv Hencsey, Room: P 105

W105 *Pulsed Neural Networks Based on Delta-Sigma Modulation Suitable for Hardware Implementation*
Yoshimitsu Murahashi, Hirohisa Hotta, Shinji Doki and Shigeru Okuma

W106 *FPGA Implementation of Bayesian Neural Networks for a Stand Alone Predictor of Pollutants Concentration in the Air*
Salvatore Marra, Francesco Carlo Morabito, Pasquale Corsonello and Mario Versaci

W107 *A MOS Circuit for Depressing Synapse and its Application to Contrast-Invariant Pattern Classification and Synchrony Detection*
Tetsuya Asai, Yusuke Kanazawa, Tetsuya Hirose and Yoshihito Amemiya

W108 *An FPGA Implementation of 1,024-Neuron System for PAPR Reduction of OFDM Signal*
Masaya Ohta, Atsushi Mori and Katsumi Yamashita

Thursday, 29 July, 9.10–9.50

Thursday, 29 July, 10.10–12.10

Noise in N N & Hippoc. Function (ENNS combined special session), Chair: Allesandro Villa, Laura Sacerdote Roman Borysuk and Yamaguchi Yoko, Room: B 113

10.10 *Noise induced phenomena in jump diffusion models for single neuron spike activity (special session S4)*
Roberta Sirovich and Laura Sacerdote

10.30 *Nonlinear oscillation models for the spike sorting of single units recorded extracellularly (special session S4)*
Tetyana Aksenova, Olga K. Chibirova and Alessandro E. P. Villa

10.50 *Stochastic Dynamics and Partial Synchronization of Stimulus-Driven Neural Activity (special session S4)*
Roman Borisyuk

11.10 *On Noise Induced Resonances in Neurodynamic Models*
Robert Kozma and Derek Harter

11.30 *Structural Hierarchies, Theta Rhythm, Hippocampal Function (special session S9)*
Érdi Péter

11.50 *Hippocampal Theta Phase Coding for Instantaneous Acquisition of Experienced Events (special session S9)*
Yoko Yamaguchi, Aota Yoshito, Naoyuki Sato, Hiroaki Wagatsuma and Zhihua Wu

Computational Neuroscience, Chair: Shiro Usui, Room: C 114

10.10 *Extracting information in a graded manner from a neural-network system with continuous attractors*
Yukihiro Tsuboshita and Hiroshi Okamoto

10.30 *Design of Spatially Extended Neural Networks for Specific Applications*
Rod Adams, Rene teBoekhorst, Alistair Rust, Maria Schilstra and Paul Kaye

10.50 *Influence of dendritic spines shape changes by learning*
Vadym Spravedlyvyy, Andreas Herzog, Karsten Kube, Bernd Michaelis, Katharina Braun and R. Schnabel

11.10 *Clustering with Minicolumnar Receptive Field Self-Organization*
Jorg Lucke

11.30 *Synchronized Subthreshold Oscillations and Phase Coding in a Network Model of the Entorhinal Cortex*
Jun Igarashi, Motoharu Yoshida, Katsumi Tateno and Hatsuo Hayashi

11.50 *Dendritic Spiking Accounts for Rate and Phase Coding in a Biophysical Model of a Hippocampal Place Cell*
Zsófia Huhn, Máté Lengyel, Gergő Orbán and Péter Érdi

Digital Impl. of Neural Networks (special session), Chair: Lambert Spaanenburg, Room: F 114

10.10 *Trends in Design of Massively Parallel Coprocessors Implemented in ASICs*
Péter Földesy

10.30 *Emulated Digital CNN-UM Implementation of a Barotropic Ocean Model*
Zoltán Nagy and Péter Szolgay

10.50 *FPGA Implementation of the Kernel CMAC*
Gábor Horváth and Zsolt Csipak

11.10 *The Impact of Modern FPGA Architectures on Neural Hardware: A Case Study of the TOTEM Neural Processor*
Stephanie McBader, Peter Lee and Alvise Sartori

11.30 *Neural Vision Sensors for Surface Defect Detection*
Suleyman Malki, Lambert Spaanenburg and Nick Ray

11.50 *Hw-Sw codesign of a Flexible Neural Controller through a FPGA-based neural network programmed in VHDL*
Eros Pasero and Massimiliano Perri

Speech Recognition, Chair: Nik Kasabov, Room: G 115

10.10 *Efficient Training of Large Neural Networks for Language Modeling*
Holger Schwenk

10.30 *Acoustic Model Combination for Recognition of Speech in Multiple Languages using Support Vector Machines*
Suryakanth V. Gangashetty, Chandra Sekhar Chellu and Yegnanarayana Bayya

10.50 *Speech Recognition Based on Fundamental Functional Principles of the Brain*
Alireza A. Dibazar, Dong Song, Walter Yamada and Theodore W. Berger

11.10 *The Application of Polynomial Discriminant Function Classifiers to Isolated Arabic Speech Recognition*
Mohammed Khasawneh, Khaled Assaleh, Wesam Sweidan and Monther Haddad

11.30 *An Adaptive Recurrent Neuro-Fuzzy Filter for Noisy Speech Enhancement*
Sheng-Nan Wu and Jeen-Shing Wang

11.50 *Two Neural Network Paradigms of Phoneme Transcription - a Comparison*
Terje Kristensen

Thursday, 29 July, 14.00–15.40

Robotics and learning, Chair: Jeen-Shing Wang, Room: A **116**

14.00 *Developmental Learning on a Humanoid Robot*
Artur Arsenio

14.20 *Evolving Adaptive, High-Dimensional, Camera-Based Speed Sensors*
Ralf Salomon

14.40 *Locomotion of a Quadruped Robot Using CPG*
Takayuki Ishii, Seiji Masakado and Kazuo Ishii

15.00 *More Effective Reinforcement Learning by Introducing Sensory Information*
Keiji Kamei and Masumi Ishikawa

15.20 *Biased Support Vector Machine for Relevance Feedback in Image Retrieval*
Chu-Hong Hoi, Chi-Hang Chan, Kaizhu Huang, Michael Lyu and Irwin King

Bioinformatics and Biomedical Comp. (ENNS special session), Chair: Francesco Masulli and RobertoTagliaferri, Room: B **117**

14.00 *Neural-ICA and Wavelet Transform for Artifacts Removal in surface EMG*
Francesco Carlo Morabito, Bruno Azzerboni, Mario Carpentieri and Fabio La Foresta

14.20 *An Information Geometric Approach to Survival Analysis and Feature Selection by Neural Networks*
Antonio Eleuteri, Roberto Tagliaferri, Leopoldo Milano and Michele De Laurentiis

14.40 *HLA Typing Using a Fuzzy Approach*
Giovanni Battista Ferrara, Francesco Masulli and Stefano Rovetta

15.00 *Estimation of Bone Mineral Density Data Using MoG Neural Networks*
Antonello Rizzi, Massimo Panella, Maurizio Paschero and Fabio Massimo Frattale Mascioli

15.20 *Neuro-Fuzzy Analysis of Dermatological Images*
Ciro Castiello, Giovanna Castellano and Anna Maria Fanelli

Machine learning for text mining (ENNS special session), Chair: Samuel Kaski, Room: C **117**

14.00 *On Text-Based Estimation of Document Relevance*
Eerika Savia, Samuel Kaski, Ville Tuulos and Petri Myllymaki

14.20 *Topic Based Language Models for ad hoc Information Retrieval*
Leif Azzopardi, Mark Girolami and Keith van Rijsbergen

14.40 *Context Based Identification of User Communities from Internet Chat*
Ata Kaban and Xin Wang

15.00 *Modelling the Connectivity Between Terms in the Neuroscience Literature*
Filip Deleus and Marc M. Van Hulle

15.20 *FALCON: A Fusion Architecture for Learning, COgnition, and Navigation*
Ah-Hwee Tan

Quantum Computing and Neural Networks, Chair: Valeriu Beiu, Room: G **118**

14.00 *A Study on Neuromorphic Quantum Computation*
Shigeo Sato, Mitsunaga Kinjo, Osamu Takahashi, Yuuki Nakamiya and Koji Nakajima

14.20 *Vector Quantization Complexity and Quantum Computing*
Paolo Gastaldo, Sandro Ridella and Rodolfo Zunino

14.40 *A Self-Adaptive Quantum Radial Basis Function Network for Classification Applications*
Cheng-Jian Lin, Cheng-Hung Chen and Chi-Yung Lee

15.00 *Turing Machine Simulation Using Hard-limiter Neurons*
Narendra S. Chaudhari and Nirmal Dagdee

Neurodynamics, Chair: Desire Bolle, Room: I **118**

14.00 *Self-control Dynamics for Sparsely Coded Networks with Synaptic Noise*
Desire Bolle and Rob Heylen

14.20 *Response Space Construction for Neural Error Correction*
Michael Stiber and Mark Pottorf

14.40 *Modified Freeman Model: A Stability Analysis and Application to Pattern Recognition*
Mustafa Ozturk, Dongming Xu and Jose Principe

15.00 *Cholinergic Effects on Spectral Properties of Spike Trains in Rat Cortical Neurons*
Takashi Tateno, Yasuhiko Jimbo and Hugh Robinson

DETAILED PROGRAM & ABSTRACTS

Sunday, 25 July, 18.00–19.00

Public Lecture

Sunday, 25 July, 18.00–19.00, Room: C, Chair: Tamás Roska

18.00 *Clinical Results with the Model 1 IRP Implant*

M. Humayun[1], D. Yanai1, R.J. Greenberg[2], J. Little[2], B.V. Mech[2], M. Mahadevappa[1], J.D. Weiland[1], G.Y. Fujii[1], E. deJuan, Jr[1]. , [1]Ophthalmology, Keck School of Medicine of the University of Southern California, Doheny Retina Institute, Doheny Eye Institute, Los Angeles, CA; [2]Second Sight, LLC, Sylmar, CA.

Purpose: To study the feasibility of implanting an epiretinal prosthesis in humans with bare or no light perception vision from retinitis pigmentosa (RP).
Methods: The FDA granted an IDE and USCIRB approved the study protocol (HIPPA compliant). After obtaining informed consent, the patients were screened using visual psychophysical testing, electrophysiology, ophthalmic photography, and scanning laser ophthalmoscopy. Three patients who met the study criteria were implanted with a Second Sight intraocular epiretinal prosthesis in the eye with worse vision. The implant consisted of an extraocular microelectronic device and an intraocular electrode array, connected by a multiwire cable. The electrode array consisted of a 4x4 grid of 500um platinum electrodes embedded in silicone rubber. The implant was wirelessly activated using an external controller. Electrical stimulus pattern was determined by a custom computer interface or video camera.
Results: All the subjects had non-recordable preoperative ERGs and VEPs. As of January 2004 Subject 1 (S1) has been implanted for 23 months, subject 2 (S2) 18 months and subject 3 (S3) for 10 months. All subjects reported the perception of light on all 16 electrodes under proper stimulation. The average stimulus thresholds in S1 was 575uA (18months), S2 was 61uA (15 months) and S3 was 59uA (7 months). During stimulation different colors were reported (white and yellow were the most frequent). Using a head mounted video camera as a source for the stimulus, all the subjects detected room lights on/off with 97% accuracy. Other camera testings: finding objects (three forced choices) 84% ($p < .001$); counting objects (four forced choices) 74% ($p < .001$); objects recognition (three forced choices) 63% ($p < .001$); tumbling L (four forced choices) 61% ($p < .001$). There was a trend in achieving better results with multi-pixel compare to a single-pixel stimulation. In S1 and S2, despite of the small area covered by the array, evoked potentials were recorded in different sessions. No improvement in the VA was noted when the device was electrically inactive.
Conclusions: All the subjects could see visual perceptions that correlate to electrical stimulus from a chronically implanted retinal prosthesis. Patients used a camera driven stimulus to perform simple tasks.

Monday, 26 July, 9.00–11.00

Opening Session and Key-note Talks

Monday, 26 July, 9.00–11.00, Room: A, Chairs: Enrique Ruspini, Tamás Roska and Evangelia Micheli-Tzanakou

11.00 *The CNN: a brain-like computer*

Leon O. Chua, EECS Dept. Univ. of Calif. Berkeley, United States

The Cellular Neural/nonlinear Network (CNN) and the CNN based Cellular Nonlinear Wave Computer concepts are introduced. It is motivated why we call it a brain-like computer. The summary of a multilayer CNN retina model is presented. Physical implementations are reviewed, including emulated digital as well as mixed mode and optical implementations. Using the single chip Visual Microprocessors the highest speed Camera Computer, the Bi-i is described. Practical applications will be highlighted.

Monday, 26 July, 11.20–12.10

Key-note Talks

Monday, 26 July, 11.20–12.10, Room: A, Chairs: Tamás Roska, Evangelia Micheli-Tzanakou and László T. Kóczy

11.20 *Patterns, clusters, and components – what data is made of*

Erkki Oja, Helsinki University of Technology, Finland

Learning the implicit structure of data in large-scale applications like document and image mining or multivariate signal analysis helps in understanding the underlying causes and phenomena. The result of learning is a new explanation or compressed representation of the observation data, which will lead to improved decisions. In artificial neural networks, the representation is usually a clustering of the data, a discrete map, or a lower-dimensional manifold in the observation space. The talk will cover some of the recent paradigms of artificial neural learning based on self-organization, principal, and independent component analysis, and efficient algorithms for their computation. Many examples from the author's research group are used to illuminate the concepts and methods.

Monday, 26 July, 14.30–16.30

Self Organizing Maps

Monday, 26 July, 14.30–16.30, Room: A, Chair: Péter András

14.30 *Self-Organizing Documentary Maps for Information Retrieval [#1173]*
Qing Ma, Kousuke Enomoto and Masaki Murata, Ryukoku University, Japan; National Institute of Information and Communicat, Japan

This paper presents a neural-network-based approach for information retrieval, an important issue in natural language processing. We first describe a method for creating self-organizing documentary maps --- visible and continuous representations in which all queries and documents are mapped in topological order according to their similarities. We then show that documents related to queries can be retrieved by merely calculating the Euclidean distances between the positions at which queries and documents are placed and choosing the N closest documents in the ranking order for each query. Small-scale computer experiments have demonstrated that the proposed method is capable of high precision.

14.50 *A Self-organized Growing Network for On-line Unsupervised Learning [#1470]*
Furao Shen and Osamu Hasegawa, Tokyo Institute of Technology, Japan

An on-line unsupervised learning method is proposed for unlabeled data which is polluted by noises. The combination of similarity threshold and a local accumulated error makes the algorithm fit for non-stationary data distribution. A novel criterion for removals of nodes is proposed to classify the data set well and eliminate noises periodically. The usage of a utility parameter ``error-radius" is able to judge if the insertion is successful and control the increasing of nodes. The system can represent the topological structure of unsupervised on-line data, report the reasonable number of clusters and give typical prototype patterns of every cluster without any priori conditions such as suitable number of nodes or a good initial codebook.

15.10 *A Time-Based Self-Organising Model for Document Clustering [#1531]*
Chihli Hung and Stefan Wermter, University of Sunderland, United Kingdom

Most current approaches for document clustering do not consider the non- stationary feature of real world document collection. In this paper, in a non- stationary environment, we propose a new self-organising model, namely the dynamic adaptive self-organising hybrid (DASH) model. The DASH model runs continuously since the new document set is formed consecutively for training while the old document set is still at the training stage. Knowledge learned from the old data set is adjusted to reflect the new data set and therefore document clusters are up-to-date. We test the performance of our model using the Reuters-RCV1 news corpus and obtain promising results based on the criteria of classification accuracy and average quantization error.

15.30 *Analysis of Equine Gaitprint and Other Gait Characteristics using Self-Organizing Maps (SOM) [#1207]*
Ellen Bajcar, David Calvert and Jeff Thomason, University of Guelph, Canada

Detection and evaluation of lameness by visual assessment requires the examiner to consider several different and rapidly changing body movement patterns. When the patterns become too complex, tools like Artificial Neural Networks (ANN) can be useful. ANNs can be gainfully applied to gait analysis to distinguish stride characteristics and to identify pathological measurement data collected from a single hoof of moving horses. An analysis of the characteristics of the data and the effects of testing different data elements is examined. The method was successful in differentiating certain stride characteristics such as shoeing, gait, speed, and direction of movement, and produced a unique model for each horse's gait.

15.50 *An Attempt in Modelling Early Intervention in Autism Using Neural Networks [#1665]*
Andrew P. Paplinski and Lennart Gustafsson, Monash University, Australia; Lulea University of Technology, Sweden

We present a solution to a problem of early intervention in autistic learning. This is an addition to our model of autism which is based on Kohonen Self-Organizing Maps extended with the Source Familiarity Filter and the Attention Shift Mechanism. In particular we study the feature map formation when attention shift is restricted by familiarity preference. The network learns the stimuli from the source with the lowest variability in great detail at the expense of the other source. The early intervention neural controller modifies the probabilities of presenting stimuli from a given source in response to the attention shift acceptance/rejection signals.

16.10 *Neural Network Models based on Regularization Techniques for off-line Robot Manipulator Path Planning [#1772]*
Dimitrios Karras, Chalkis Institute of Tech, Hellenic Open Univ, Greece

A novel approach for function approximation using a two-stage neural network model, involving regularization techniques, is herein presented. It can be applied to real functions of many variables as in robot path planning problems. It involves a regularized Kohonen feature map (SOFM) and a set of regularized SVMs. This methodology is applied to the design of a neural-adaptive controller, involving the computer-torque approach, which combines the regularized two-stage neural network model with a servo PD feedback controller. The regularization technique aims at filtering SVMs outputs so that their values become closer to that of a PD feedback controller, while compensating the nonlinear terms of the PD controller induced torque error.

Blind source separation (special session)

Monday, 26 July, 14.30–16.30, Room: B, Chair: Danilo Mandic

14.30 *Trust-Region Learning for ICA [#1084]*
Heeyoul Choi, Sookjeong Kim and Seungjin Choi, Pohang University of Science and Technology, Korea (South)

A trust-region method is a quite attractive optimization technique, which finds a direction and a step size in an efficient and reliable manner with the help of a quadratic model of the objective function. It is, in general, faster than the steepest descent method and its stability is always guaranteed, in contrast to the Newton's method. In this paper, we present an efficient implementation of the maximum likelihood independent component analysis (ICA) using the trust- region method, which leads to trust-region-based ICA (TR-ICA) algorithms. The useful behavior of our TR-ICA algorithms is confirmed through numerical experimental results.

14.50 *Nonlinear Independent Component Analysis by Homomorphic Transformation of the Mixtures [#1205]*
Deniz Erdogmus, Yadunandana Rao and Jose Principe, University of Florida, Gainesville, FL-32611, United States; University of Florida, Gainesville, United States; University of Florida, United States

Independent component analysis is often approached from an information theoretic perspective employing specific sample estimates for the mutual information between the separated outputs. n contrast, in this paper, we propose a Gaussianization-based approach, where the separation is performed in two stages: Gaussianization of the mixtures using a homomorphic nonlinearity and separation of the independent components using principal component analysis (both stages possibly adaptive). The proposed ICA methodology is applicable to instantaneous linear and nonlinear mixtures. The idea also generalizes easily to complex-valued nonlinear ICA.

15.10 *Independent Component Analysis for Semi-blind Signal Separation in MIMO Mobile Frequency Selective Communication Channels [#1309]*
Dragan Obradovic, Nilesh Madhu, Andrei Szabo and Chiu Shun Wong, Siemens AG, Germany; Ruhr University Bochum, Germany; Munich University of Technology, Germany; Infineon Technologies, Germany

In this paper we address the problem of Semi- Blind Source Separation (SBSS) in frequency selective MIMO mobile communication channels. Semi-blindness stems from the fact that some average properties of the time-varying channel (mixing domain) are available at the transmitter. In this paper we first analytically show that when Orthogonal Frequency Division Multiplexing (OFDM) is employed, the original BSS problem is transformed into a set of standard ICA problems with complex mixing matrices. Our approach has been tested on a realistic channel model and the results are presented.

15.30 *A Novel Adaptive Algorithm for the Blind Separation of Periodic Sources [#1327]*
Maria Jafari and Jonathon Chambers, King's College London, United Kingdom; University of Cardiff, United Kingdom

An adaptive algorithm for the blind separation of periodic sources is proposed in this paper. The method uses only the second order statistics of the data, and exploits the periodic nature of the source signals. Simulation results show that the proposed approach has the ability to restore statistical independence, and its performance is comparable to that of a well established, higher order, blind source separation method.

15.50 *Single Channel Speech Recovery by Independent Component Analysis [#1151]*
Allan Barros, Edson Nascimento and Noboru Ohnishi, Fundacao de Amparo a Pesquisa do Maranhao, Brazil; Nagoya University, Japan

Different approaches have been proposed to extract a given speech from mixtures of sounds. The speech extraction can be carried out by either using single or multiple channel measurements. Some of those approaches explore the harmonicity of speech, and others make use of the redundancy among the channels, usually by independent component analysis. To extract one speech from a single channel, we propose here to use the characteristics of speech through the concept of efficient coding, which mimics the way the auditory cortex code information. Simulations show that this technique can be used efficiently both to extract a single speech, as well as highlights a new way of approaching the speech/speaker recognition problem.

Information based learning

Monday, 26 July, 14.30–16.30, Room: C, Chair: Seungjin Choi

14.30 *Vector-Quantization by density matching in the minimum Kullback-Leibler divergence sense [#1362]*
Anant Hegde, Deniz Erdogmus, Tue Lehn-Schioler, Yadunandana Rao and Jose Principe, University of Florida, United States; University of Florida, Gainesville, FL-32611, United States; Technical University of Denmark, Denmark; University of Florida, Gainesville, United States

Representation of a large set of high-dimensional data is a fundamental problem in many applications such as communications and biomedical systems. The problem has been tackled by encoding the data with a compact set of code vectors called processing elements. In this study, we propose a vector quantization technique that encodes the information in the data using concepts derived from information theoretic learning. The algorithm minimizes a cost function based on the Kullback-Leibler divergence to match the distribution of the processing elements with the distribution of the data. The performance of this algorithm is demonstrated on synthetic data as well as on an edge-image of a face.

14.50 *Information Theoretic Spectral Clustering [#1123]*
Robert Jenssen, Torbjorn Eltoft and Jose Principe, University of Tromso, Norway; University of Florida, United States

We discuss a new information-theoretic framework for spectral clustering that is founded on the recently introduced Information Cut. A novel spectral clustering algorithm is proposed, where the clustering solution is given as a linearly weighted combination of certain top eigenvectors of the data affinity matrix. The Information Cut provides us with a theoretically well defined graph-spectral cost function, and also establishes a close link between spectral clustering, and non-parametric density estimation. As a result, a natural criterion for creating the data affinity matrix is provided. We present preliminary clustering results to illustrate some of the properties of our algorithm, and we also make comparative remarks.

15.10 *Mimimum Entropy, k-Means, Spectral Clustering [#1399]*
Yongjin Lee and Seungjin Choi, Electronics and Telecommunications Research Inst, Korea (South); Pohang University of Science and Technology, Korea (South)

This paper addresses an information-theoretic aspect of k-means and spectral clustering. First, we revisit the k-means clustering and show that its objective function is approximately derived from the minimum entropy principle when the Renyi's quadratic entropy is used. Then we present a maximum within-clustering association that is derived using a quadratic distance measure in the framework of minimum entropy principle, which is very similar to a class of spectral clustering algorithms that is based on the eigen- decomposition method.

15.30 *Fast Stochastic Neighbor Embedding: A Trust-Region Algorithm [#1476]*
Kijeong Nam, Hongmo Je and Seungjin Choi, Postech, Korea (South); Pohang University of Science and Technology, Korea (South)

Stochastic neighbor embedding (SNE) is a probabilistic method of embedding objects described by high-dimensional vectors, into a low- dimensional space, in a way that preserves neighbor identities. Although several useful properties of SNE are attractive, the orginal SNE algorithm suffers from its slow convergence. In this paper we present a fast SNE algorithm which is approximately 4-6 times faster than the gradient-based SNE algorithm. Our fast SNE algorithm, named TR-SNE, employs a trust-region (TR) method which finds a direction and a step size in an efficient and reliable manner with the help of a quadratic model of the objective function. Extensive numerical experimental results confirm the high performance of the TR-SNE algorithm.

15.50 *The e-PCA and m-PCA: Dimensional Reduction of Parameters by Information Geometry [#1226]*
Shotaro Akaho, AIST Neuroscience Research Institute, Japan

We propose a method for extracting a low dimensional structure from a set of parameters of probability distributions. By an information geometrical interpretation, we show that there exist two kinds of possible flat structures for fitting (e-PCA and m-PCA). We derive alternating procedures to find the low dimensional structures. Each alternating procedure can be written in a nonlinear equation. It can be solved analytically in some special cases. Otherwise, we need to apply gradient type methods that we also derive. Since the overall algorithm may converge to a local optimum, we propose a method to find a good initial solution by using metric information.

16.10 *Information Maximization with Gaussian ActivationFunctions to Generate Explicit Self-Organizing Maps [#1346]*
Ryotaro Kamimura and Yukiko Maruyama, Tokai University, Japan

In this paper, we propose a new information-theoretic method to produce explicit self-organizing maps. Competition is realized by maximizing mutual information between input patterns and competitive units. Cooperation processes are realized by taking into account the firing rates of neighboring neurons. We applied our method to uniform distribution learning and road classification. Experimental results confirmed that cooperation processes can significantly increase information content in input patterns. When cooperative operations are not effective in increasing information, mutual information as well as entropy maximization is used to increase information.

Sensor array processing and Cellular Neural Networks

Monday, 26 July, 14.30–16.30, Room: F, Chair: Ákos Zarándy

14.30 *An MOS Cell Circuit for Compact Implementation of Reaction-Diffusion Models [#1222]*
Koray Karahaliloglu and Sina Balkir, Dept. of EE, University of Nebraska-Lincoln, United States

A bio-inspired MOS cell design which can be used in reaction-diffusion systems and the corresponding implementation of a test reaction-diffusion CNN (RD-CNN) layer is presented. The network architecture and an approximate analysis of its certain D.C. characteristics are given. A test chip which includes an array of the connected cells is implemented. The chip also has separate test cells which employ thickoxide MOSFETs. The wave propagation in the network and I-V characteristics of the cells using thick-oxide MOSFETs are demonstrated and verified with measured results. The cell circuits and the resulting network are very compact and easily implementable with available technologies.

14.50 *Feature Extraction CNN Algorithms for Artificial Immune Systems [#1762]*
György Cserey, András Falus, Wolfgang Porod and Tamás Roska, Péter Pázmány University, Hungary; Semmelweis University of Medicine, Hungary; University of Notre Dame, United States

In this paper, we introduce some CNN and analogic feature extraction algorithms for artificial immune systems, which are able to convert grayscale or color to binary images storing as much information as possible for further processing. We define a statistical property called immune histogram based on sub-patterns of these images. Our results and measurements show that these algorithms can be implemented in real-time applications. A sample application, which detects new textures in a familiar environment, is also presented.

15.10 *A CNN-Gabor Filter with Neural PCA Kernels for Rotation and Scale Invariant Texture Cassification [#1779]*
Chin Teng Lin, Shi-An Chen and Chao-Hui Huang, National Chiao-Tung University, Taiwan

In this paper, we proposed a new index which can be used to classify the texture image. Because of the adjustment of image capture device or the distortion of image capture, the texture image may be transformed. Usually those transformations included rotation and scale. The proposed method provides an algorithm to avoid those effects respectively. This approach is the combination of Cellular Neural Networks and Principle Component Analysis Neural Networks. This fact implies it is a feed-forward neural networks, and it does not need any training set.

15.30 *Adaptive Perception with Locally-Adaptable Sensor Array [#1755]*
Robert Wagner, Ákos Zarándy and Roska Tamás, Péter Pázmány Catholic University, Hungary; Analogic and Neural Computing. Lab. MTA-SZTAKI, Hungary

In this paper we propose some biologically motivated local image sensor adaptation methods. The special feature of these methods is that they change the integration time of the imager on the pixel level. Using these methods, low dynamic range integration type CMOS sensors will be able to perceive high dynamic range scenes, and at the same time, compress their dynamic range by keeping high contrast and without introducing non-existing edges.

15.50 *Pattern detection by Cellular Neuronal Networks (CNN) in long-term recordings of a brain electrical activity in epilepsy [#1732]*
Philipp Fischer and Ronald Tetzlaff, Frankfurt University, IAP, Germany

About 0.5 percent of the world population is suffering from a focal epilepsy, which is a wideley spread disease. The goal of the investigations discussed in this paper is an early detection of precursors of an impending epileptic seizure by the analysis of brain electrical activity of multi-electrode EEG recordings. Therefore, methods of nonlinear signal processing were used in CNN simulations. This investigation is based on long-term recordings of approximately one week length, where analysis algorithms proposed in previous investigations have been generalised toward new feature extraction methods which will be presented in this paper.

16.10 *Efficient Off-line Feature Selection Strategies for On-line Classifier Systems [#1753]*
Dávid Bálya, Gergely Tímár, István Szatmári and Csaba Rekeczky, Computer and Automation Institute of the HAS, Hungary

In this work we discuss feature/signature selection strategies for on-line classifier systems, implemented on a common stand-alone HW/SW vision system. To develop an efficient real-time classification algorithm the dimensionality of the extracted features has to be significantly reduced. In this paper we analyze different signature selection strategies for various classifiers with given performance criteria and system-level time performance constraints. Two blind signature selection techniques are described: variance maximization and a factor-based analysis. We also discuss supervised selection mechanisms: class-based statistical and decision-tree-based approaches.

Chaos, Bifurcations and Neural Networks

Monday, 26 July, 14.30–16.30, Room: G, Chair: Robert Kozma

14.30 *Associative Memory by Hopfield NN with Chaos Injection [#1535]*
Yoko Uwate, Yoshifumi Nishio and Tohru Ikeguchi, Tokushima University, Japan; Saitama University, Japan

Several people point out that the Hopfield NN with chaos injection gains the good performance for solving traveling salesman problems, which is one of combinatorial optimization problems. In this study, we investigate the performance of the intermittency chaos injected to the Hopfield NN working as an associative memory. By computer simulations, the rate and the speed of the convergence to an embedded pattern are evaluated. Furthermore, in order to confirm the reason of the good ability of intermittency chaos, we carry out the same simulation using the time series produced by the Markov chain model. Simulated results show that the Markov chain model is good enough to gain similar performance of the intermittency chaos.

14.50 *How chaos boosts the encoding capacity of small Recurrent Neural Networks: learning consideration [#1600]*
Colin Molter, Utku Salihoglu and Hugues Bersini, Education, Belgium; Universite Libre de Bruxelles, Belgium

So far, recurrent nets, when adopting fixed point dynamics, show a very poor encoding capacity. However, when preferentially maintained in their chaotic regimes, they can encode an enormous amount of information. It has been described in a previous paper one simple way to encode such information. The main message was the monotonous increase of chaotic spontaneous regimes as a function of the number of attractors to learn. However, no algorithm was provided. This paper revisits the classical gradient-based BPTT learning algorithm. It shows that this algorithm gives poor results and furthermore that by using such algorithms, the "chaoticity" of the network dampens strongly, as well as the network's encoding capacity.

15.10 *Synthesis Method of Neural Oscillators by Network Learning [#1770]*
Yasuaki Kuroe, Kei Miura and Takehiro Mori, Kyoto Institute of Technology, Japan

In the biological systems there are numerous examples of autonomously generated periodic activities. This paper proposes a synthesis method of neural oscillators by neural-network learning. The problem is formulated as determining the weights of the synaptic connections of neural networks such that, the neural networks generate desired autonomous limit cycles. We introduce a new architecture of neural networks, hybrid recurrent neural networks, in order to enhance the capability of implementing neural oscillators. To generate autonomous limit cycles in the neural networks we make use of the bifurcation theory. Efficient learning methods for synthesizing neural oscillators are derived.

15.30 *Global Behavior of Neural Error Correction [#1107]*
Michael Stiber and Thomas Holderman, University of Washington, Bothell, United States

Neural coding is often characterized as unreliable because spike trains are irregular in appearance and experimental stimuli presented at different times produce different responses. We investigate the effects of errors in spike trains, testing the dependence of error correction in neural coding on a postsynaptic neuron's extant behavior, described in nonlinear dynamical terms. We show that the time for a neuron to recover from an error varies significantly, depending on its preceding stationary behavior and that behavior's position within the cell's global bifurcation structure. This implies a model of neural computation based not solely on attractors or motion within a state space, but rather motion within a global response space.

15.50 *Pattern Recovery in Networks of Recursive Processing Elements with Continuous Learning [#1745]*
Emilio Del Moral Hernandez, Humberto Sandmann and Leandro Silva, University of Sao Paulo - Polytechnic School, Brazil; Polytechnic School of University of Sao Paulo, Brazil

This paper addresses a continuous learning method using associative memories based on recursive processing elements (RPEs). In order to decide if a pattern recovered by the associative RPEs is known or unknown, we are using two discriminators: a network stabilization criterion and a Hamming distance criterion. The network stabilization criterion is based on the disagreement between the current and the next state, and the Hamming distance criterion checks the number bits flipped between the prompting pattern and the pattern recovery. Experiments for the performance of continuous learning when the prompting patterns are exposed to digital noise and for the evaluation of the capacity of network storage are presented and analyzed.

16.10 *On Stability and Tuning of Neural Oscillators: Application to Rhythmic Control of a Humanoid Robot [#1740]*
Artur Arsenio, Massachusetts Institute of Technology, United States

Neural oscillators offer a natural tool for exploiting and adapting to the dynamics of the controlled system. The capability of entraining the frequency of the input signal or resonance modes of dynamical systems have been increasingly used in robotics' mechanisms, to accomplish complex tasks. However, the application of Matsuoka neural oscillators as controllers requires the knowledge of the range of values for the parameters for which the system oscillates, and the warranty of stability. Thus, this paper studies in depth the stability and tuning of Matsuoka neural oscillators, and presents a careful analysis of its behavior on the time-domain. The method is applied on a Humanoid Robot for playing musical instruments.

Monday, 26 July, 17.00–19.00

Recurrent Neural Networks

Monday, 26 July, 17.00–19.00, Room: A, Chair: Johan Suykens

17.00 *High Capacity Associative Memories and Small World Networks [#1276]*
Neil Davey, Rod Adams and Bruce Christianson, University of Hertfordshire, United Kingdom

Models of associative memory usually have full connectivity or if diluted, random symmetric connectivity. In contrast real neural systems have predominantly local, non-symmetric connectivity. Here we investigate sparse networks of threshold units, trained with the perceptron learning rule. The units are arranged in a small world network, with short path-lengths but cliquish connectivity. The connectivity may be symmetric or non-symmetric. The results show that the small-world networks with non-symmetric weights perform well as associative memories. It is also shown that in highly dilute networks with random connectivity, it is symmetry of the weights, rather than symmetry of the connectivity matrix, that causes poor performance.

17.20 Simple Algorithm for Recurrent Neural Networks That Can Learn Sequence Completion [#1101]
István Szita and András Lőrincz, Eötvös Loránd University, Hungary

We can memorize long sequences like melodies or poems and it is intriguing to develop efficient connectionist representations for this problem. Recurrent neural networks have been proved to offer a reasonable approach here. We start from a few axiomatic assumptions and provide a simple mathematical framework that encapsulates the problem. A gradient-descent based algorithm is derived in this framework. Demonstrations on a benchmark problem show the applicability of our approach.

17.40 *Context Discerning Multifunction Networks: Reformulating Fixed Weight Neural Networks [#1743]*
Roberto Santiago, Portland State University, United States

Research in recurrent neural networks has produced a genre of networks referred to as Fixed Weight Neural Networks (FWNNs) which have the ability to adapt without changing explicit weights. FWNNs are unique in that they adapt their processing based on the spatiotemporal characteristics of the incoming signal without need for weight change. As a result, a single FWNN is able to model and control many families of disparate systems without weight changes. FWNNs pose an interesting model for contextual memory in neural systems. The work reported takes a FWNN, decomposes it and analyzes its internal workings. Using new insight, FWNNs are reformulated into a simpler structure, Context Discerning Multifunction Networks (CDMN).

18.00 *Training of the dynamic neural networks via constrained optimisation [#1598]*
Krzysztof Patan, University of Zielona Gora, Poland

The paper deals with training of a dynamic neural network by using an algorithm which takes into account constraints on network parameters. A neural network considered is composed of dynamic neurons, which contain inner feedbacks. To train this network, a stochastic approximation method is applied. The stability analysis during training is also investigated. As a result of this analysis, a learning algorithm based on a constrained optimization has been elaborated. Efficiency of a proposed approach is presented using an example of modelling of an unknown non-linear dynamic system.

18.20 *A New condition for global robust exponential periodicity of interval neural networks with delays [#1061]*
Changyin Sun, Derong Liu and Chun-Bo Feng, Hohai University and Southeast University, China; University of Illinois at Chicago, United States; Southeast University, China

In this paper, we proposed to study the robust exponential periodicity of interval-delayed neural networks. New condition ensuring existence, uniqueness and global robust exponential stability of the periodic solution of interval- delayed neural networks with periodic input are given.

18.40 *A Recurrent Neural Network for Solving Variational Inequality Problems with Nonlinear Constraints [#1118]*
Youshen Xia and Jun Wang, Nanjing University of Posts and Telecommunicatio, China; Vhinese University of Hong Kong, Hong Kong

This paper present a recurrent neural network for solving variational inequalities with nonlinear inequality constraints in real time. The proposed neural network has one-layer structure and is amenable to parallel implementation. The proposed neural network is a significant generalization of several existing neural networks for optimization. Moreover, the proposed neural network is stable in the sense of Lyapunov and globally convergent to an optimal solution under a strictly monotone condition of the mapping. The simulation shows that the proposed neural network is effective for solving this class of variational inequality problems.

Appl. of Blind source separation and Independent Comp Anal (ENNS special session)

Monday, 26 July, 17.00–19.00, Room: B, Chair: Yannick Deville and Roberto Tagliaferri

17.00 *Analysis of Auditory fMRI Recordings via ICA: A Study on Consistency [#1323]*
Jarkko Ylipaavalniemi and Ricardo Vigario, NNRC, Helsinki University of Technology, Finland; NNRC and AMI, Helsinki University of Technology, Finland

We apply independent component analysis (ICA) to functional magnetic resonance images (fMRI). The stimulus consisted of spoken text. Some components show similar temporal activation as the stimulus. In those, ICA further distinguishes between primary and secondary auditory areas. Further, we observe an activation of the thalamus, temporally unrelated to the stimulus, hence hard to detect in a classical manner. An evolving artifact is as well identified. The consistency of the estimates is tested with multiple runs of ICA for different initializations. Similar solutions are combined. Estimates differing greatly from run to run are less likely to correspond to true components, whereas those showing small variances are considered reliable.

17.20 *Time-frequency Blind Signal Separation: Extended Methods, Performance Evaluation for Speech Sources [#1257]*
Yannick Deville, Matthieu Puigt and Benoit Albouy, University of Toulouse, France

Most reported Blind Source Separation (BSS) methods are based on Independent Component Analysis (ICA), which esp. requires the sources to be stationary (and non-Gaussian). Time-Frequency (TF) BSS methods avoid these restrictions and are therefore e.g. attractive for speech signals. In this paper, we first introduce extensions of three types of TF-BSS methods that we recently proposed, and we analyze the relationships between these methods. We then provide a detailed benchmarking of these methods, based on a large number of tests performed with linear instantaneous mixtures of speech signals. This demonstrates the good performance of these methods (SNR typically above 60 dB) and their low sensitivity to the values of their TF parameters.

17.40 *ICA for Modelling and Generating Organ Pipes Self-sustained [#1184]*
Angelo Ciaramella, Enza De Lauro, Salvatore De Martino, Mariarosaria Falanga and Roberto Tagliaferri, DMI-University of Salerno, Italy; Dept. of Physics-University of Salerno, Italy; DMI, University of Salerno, Italy

Acoustic signals emitted by organ pipes in a variety of experimental frameworks have been recorded and analyzed by using ICA. Relevant features of the signals related to single tones of the chords have been extracted. Three Landau modes are extracted with three well defined frequencies. Following the dynamical systems approach, a simple and suitable analogical model, able to reproduce the registered waveform and sound in listening, have been constructed. The conclusion is that, in first approximation, the low dimensional dynamical system representing on average the fluid-dynamical equations modelling organ pipe is constituted by three linearly coupled nonlinear oscillators in limit cycle regime.

18.00 *Blotch Removal in Degraded Digital Video Using Independent Component Analysis [#1650]*
Michele Ceccarelli and Alfredo Petrosino, University of Sannio, Italy; ICAR-National Research Council, Italy

Blotchy noise is one of the most common and visually annoying noises noticed in digitized motion picture films. This work investigates a three-stage blotchy noise reduction scheme combining efforts of temporal median filtering, ICA unsupervised learning and deflation after motion/compensation estimation. Implementation of each module of the scheme is discussed; finally performance of the scheme is tested and compared with other methods over real short sequences and results are discussed.

18.20 *Comparative performance analysis of eight blind source separation methods on radiocommunications signals [#1712]*
Pascal Chevalier, Laurent Albera, Pierre Comon and Anne Ferreol, Thales-Communications - EDS/SPM/SBP, France; I3S, Sophia-Antipolis, France

For about two decades, many Second Order and Fourth Order blind methods have been developed to separate overdetermined mixtures of statistically independent Narrow-band sources. Besides, mainly to overcome some limitations of these methods, Sixth Order methods have been developed recently. Nevertheless, despite of this great number of methods, the performance of the latter for arbitrary electromagnetic sources are still almost unknown, which limits their use in operational contexts. The purpose of this paper is to fill the gap previously mentioned by presenting a comparative performance analysis of eight Blind Source Separation methods for arbitrary overdetermined mixtures of sources borrowed from the radiocommunications context.

18.40 *Linguistic Feature Extraction using Independent Component Analysis [#1289]*
Timo Honkela and Aapo Hyvarinen, Helsinki University of Technology, Finland; HIIT Basic Research Unit, Finland

Our aim is to find syntactic and semantic relationships of words based on the analysis of corpora. We propose the application of independent component analysis, which seems to have clear advantages over two classic methods: latent semantic analysis and self-organizing maps. Independent component analysis applied on word context data gives distinct features which reflect syntactic and semantic categories. The automatically generated distributed representation can be used as a well-motivated low-dimensional encoding for words in different applications. The limited number of dimensions brings computational efficiency whereas the meaningful interpretation of each component provides basis for intelligent processing.

Vision and Image processing

Monday, 26 July, 17.00–19.00, Room: C, Chair: Kunihiko Fukushima

17.00 *Extracting Symmetry Axes: A Neural Network Model [#1135]*
Kunihiko Fukushima and Masayuki Kikuchi, Tokyo University of Technology, Japan

We propose a neural network model that extracts axes of symmetry from visual patterns. The input patterns can be line drawings, plane figures or gray-scaled natural images taken by CCD cameras. The model is a multi-layered network. It has an input layer, a contrast-extracting layer, edge-extracting layers, and layers extracting symmetry axes. The model extracts oriented edges from the input image first, and then tries to extract axes of symmetry. To reduce the computational cost, the model checks conditions of symmetry, not directly from the oriented edges, but from a blurred version of them. The use of blurred signals endows the network with a large tolerance to deformation of input patterns, too.

17.20 *Neural Coding Model of Perceptual Reconstruction Using the Morphoelectrotonic Transform Theory [#1596]*
Norifumi Watanabe and Shun Ishizaki, Keio University, Japan

We construct the model of the perceptual reconstruction from input visual information. The relations between objects are simulated from the correlation of input pulse and associative memory model in this model. And, the relation and the bind between objects are characterized by the morphoelectrotonic transform based on the experimental data of neurophysiology. The associative memory model is composed of the synchronous associative memory network, and extracts the relations between objects by the phase obtained from input pulse sequence. The binding of the object is reconstructed the relation of the associative memory, and the correlation of the modality is learned.

17.40 *A Virtual Exploring Mobile Robot for Left Ventricle Contour Tracking [#1518]*
Faiza Admiraal-Behloul, Boudewijn .P.F. Lelieveldt, Luca Ferrarini, Hans Olofsen and Rob van der Geest, Leiden University Medical Center, Netherlands

In this paper we describe a totally new and original approach for combining global and local information in medical image processing. We implemented a virtual mobile robot and trained it using fuzzy neural networks to recognize segments of the myocardium while he navigates autonomously around the Left Ventricle (LV) of the heart. On its journey around the heart, the virtual exploring robot applies appropriate local edge detection to delineate fully automatically the borders of the myocardium. This may sound unconventional but it has proven effective enough to be integrated in a clinical analytical software tool.

18.00 *Influences of target discrimination capability on hand tracking [#1223]*
Yasuhiro Takachi, Fumihiko Ishida and Yasuji Sawada, Tohoku Institute of Technology, Japan; University of Electro-Communications, Japan

We performed visually guided hand tracking experiments, an ellipsoidal experiment, where subjects tracked an ellipsoidally moving target, and also a fixation experiment, where subjects fixated their eyes during tracking the target moving ellipsoidally. Performance on the natural ellipsoidal experiment showed that hand motion did not precede the target in almost all frequency. On the other hand, hand motion in the fixation experiment preceded the target at relatively high frequency range. We claimed that these results can be explained from the viewpoint of target discrimination capability, because eye measurements revealed that mean retinal eccentricity during the ellipsoidal tracking task was smaller than the natural ellipsoidal tracking.

18.20 *Active Learning System for Object Fingerprinting [#1708]*
Swarup Medasani, Narayan Srinivasa and Yuri Owechko, HRL Laboratories, LLC, United States

Object fingerprinting and identification is a critical part of effective visual surveillance systems. In this paper, we present an approach to actively learn the object models in order to fingerprint the objects. Our approach uses a view- based classifier cascade that actively learns to recognize the generic class of the object. Salient features unique to the specific instance of the selected class of objects are modeled using fuzzy attribute relational graphs. These graphs are also adapted to represent object information gathered from multiple views. Preliminary results are quite promising and extensive studies are underway to ascertain the use of the system in more complicated scenarios.

18.40 *Connectionist Based Dempster-Shafer Evidential Reasoning for Data Fusion [#1604]*
Hongwei Zhu and Otman Basir, University of Waterloo, Canada

A network realization of the Dempster-Shafer evidential reasoning is developed, and it is further extended to a neural network, referred to as DSETNN, for dealing with the dependence of evidence structures. DSETNN is tuned for optimal performance through a supervised learning process. To demonstrate the effectiveness of DSETNN, we apply it to two benchmark pattern classification problems. Experiments reveal that DSETNN outperforms the Dempster-Shafer evidential reasoning, the majority voting, single source based results, and provides encouraging results in terms of classification accuracy and the speed of learning convergence.

Datamining

Monday, 26 July, 17.00–19.00, Room: G, Chair: Anthony Kuh

17.00 *Value Estimation Based Computer-Assisted Data Mining for Surfing the Internet [#1035]*

Bálint Gábor, Zsolt Palotai and András Lőrincz, Eötvös Lórand University, Hungary

Gathering of novel information from the WWW constitutes a real challenge for artificial intelligence (AI) methods. Large search engines do not offer a satisfactory solution, their indexing cycle is long and they may offer a huge amount of documents. An AI-based link-highlighting procedure designed to assist surfing is studied here. It makes use of (i) `experts', i.e. pre-trained classifiers, forming the long-term memory of the system, (ii) relative values of experts and value estimation of documents based on recent choices of the users. Value estimation adapts fast and forms the short-term memory of the system. All experiments show that surfing based filtering can efficiently highlight 10-20% of the documents in about 5 steps, or less.

17.20 *Extracting the Knowledge Embedded in Support Vector Machines [#1722]*

Xiuju Fu, ChongJin Ong, S. Sathiya Keerith, Gih Guang Hung and Liping Goh, Institute of High Performance Computing, Singapore; National University of Singapore, Singapore

This paper exploits the fact that the decisions from a non-linear SVM can be decoded into linguistic rules based on the information provided by support vectors and decision function. Given a support vector of a certain class, cross points between each line, which is extended from the support vector along each axis, and SVM decision hyper-curve are searched first. A hyper-rectangular rule is derived from these cross points. The hyper-rectangle is tuned by a tuning phase in order to exclude those out-class data points. Finally, redundant rules are merged to produce a compact rule set. Comparisons with other rule extraction methods show that higher rule accuracy is obtained in our method with fewer number of premises in each rule.

17.40 *Initialization of Cluster Refinement Algorithms: A Review and Comparative Study [#1214]*

Ji He, Man Lan, Chew-Lim Tan, SAM–Yuan Sung and Hwee-Boon Low, School of Computing, National Univ. of Singapore, Singapore; Institute for Infocomm Research, Singapore

Various iterative refinement clustering methods are dependent on the initial state of the model and are capable of obtaining one of their local optima only. The study of the initialization method towards a sub-optimization is of great value. This paper reviews the various cluster initialization methods in the literature by categorizing them into three major families. In addition, using a set of quantitative measures, we assess their performance on a number of synthetic and real-life data sets. Our controlled benchmark identifies two distance optimization methods, namely SCS and KKZ, as complements of the K-Means learning characteristics towards a better cluster separation in the output solution.

18.00 *AMIFS: Adaptive Feature Selection by Using Mutual Information [#1439]*

Michel Tesmer and Pablo A. Estevez, University of Chile, Chile

An adaptive feature selection method based on mutual information, called AMIFS, is presented. AMIFS is an enhancement over Battiti's MIFS and MIFS-U methods. In AMIFS the tradeoff between eliminating irrelevance or redundancy is controlled adaptively, instead of using a fixed parameter. The mutual information is computed by discrete probabilities in the case of discrete features or by using an extended version of Fraser's algorithm in the case of continuous features. The performance of AMIFS is compared with that of MIFS and MIFS-U on artificial and benchmark datasets. The simulation results show that AMIFS outperforms both MIFS and MIFS-U, specially for high-dimensional data with many irrelevant and/or redundant features.

18.20 *An Adaptable Connectionist Text Retrieval System with Relevance Feedback [#1648]*

Mahmood Azimi-Sadjadi, Jaime Salazar, SaravanaKumar Srinivasan and Sassan Sheedvash, Colorado State University, United States; Hewlett Packard Corporation, United States

This paper introduces a new connenctionist network for large-scale text retrieval applications. A learning mechanism is proposed to optimally map the original query using relevance feedback from multiple expert users. The query mapping not only meets the requirements of the expert users but also preserves the positions and ranks of other relevant documents. An updating algorithm is also proposed to incorporate new documents (or delete the obsolete ones) into the system either one-by-one or in a batch mode without requiring to retrain the system. The algorithms are successfully tested on a large database and for a large number of most commonly used single-term or multi-terms queries.

18.40 *Fuzzy Hidden Markov Predictor in Electric Load Forecasting [#1345]*

Marcelo Andrade Teixeira and Gerson Zaverucha, Electric Power Research Center (CEPEL), Brazil; Federal University of Rio de Janeiro (UFRJ), Brazil

We present a new hybrid system that merges Fuzzy Logic with Dynamic Bayesian Networks (DBN's): the Fuzzy Hidden Markov Predictor. It is a modification of the Hidden Markov Model, a particular case of DBN's, in order to enable it to predict continuous values of a time series. A DBN is a Bayesian Network that represents a temporal probability model. This hybrid system is applied to the task of monthly electric load single-step forecasting and successfully compared with three regression-by-discretization systems, two fuzzy hybrid systems, two Kalman Filter Models, and Box-Jenkins and Winters exponential smoothing. The employed time series present a sudden significant changing behavior at their last years, as it occurs in an energy rationing.

Evolutionary Computing and Neural Networks

Monday, 26 July, 17.00–19.00, Room: I, Chair: Michael Georgiopoulos

17.00 *Studying the Capacity of Cellular Encoding to generate Feedforward Neural Network Topologies [#1567]*

Gutierrez German, Galvan Ines, Molina Jose M and Sanchis Araceli, Universidad Carlos III de Madrid, Spain

Many methods to codify Artificial Neural Networks have been developed to avoid the disadvantages of direct encoding schema, improving the search into the solution's space. A method to analyse how the search space is covered and how are the movements along search process applying genetic operators is needed in order to evaluate the different encoding strategies for Multilayer Perceptrons (MLP). In this paper, the generative capacity, this is how the search space is covered for a indirect scheme based on cellular systems is studied. The capacity of the methods to cover the search space (topologies of MLP space) is compared with the direct encoding scheme.

17.20 *A Relational Multi-Objective Genetic Algorithm [#1094]*
Sum Wai Lee and Hung-Tat Tsui, The Chinese University of Hong Kong, Hong Kong

In this paper, we propose a new Relational Multi-Objective Genetic Algorithm (RMOGA) with a novel generic operator, Inheritance. Inheritance is found to have very good performance when used with a multi-objective genetic algorithm. Its characteristic is similar to a crossover operator. However, it aims to exchange the mathematical relationships, but not values, between two selected sub-chromosomes. We also propose to use a Pareto-ranking to help form a fitness function. Then it is optimized by the Relational Multi-Objective Genetic Algorithm, which includes the new operator. The advantage of this approach is its ability to inherit the best relationships.

17.40 *Using Support Vector Machines in Multi-Objective Optimization [#1568]*
Yeboon Yun, Hirotaka Nakayama and Masao Arakawa, Kagawa University, Japan; Konan Univeristy, Japan

In this paper, we suggest to apply the support vector machines (SVM) in order to make the number of experiments for finding the solution of problem with multi-objective functions as few as possible. In addition, we show that the proposed method can approximate Pareto frontiers in multi-objective optimization problems effectively by employing support vectors in SVM. Finally, the effectiveness of our method will be illustrated through numerical examples.

18.00 *Bayesian Evolution of Rich Neural Networks [#1455]*
Matteo Matteucci and Dario Spadoni, Politecnico di Milano, Italy; Universita' della Svizzera Italiana, Switzerland

In this paper we present a genetic approach that uses a Bayesian fitness function to the design of rich neural network topologies in order to find an optimal domain-specific non-linear function approximator with good generalization performance. Rich neural networks have a feed-forward topology with shortcut connections and arbitrary activation functions at each layer. This kind of topologies is particularly well suited for non-linear regression tasks, but it may suffer for overfitting issues. In this paper we present a Bayesian fitness function to effectively apply genetic algorithms with these models obtaining, in a completely automated way, models well-matched to the problem, with good generalization capability, and low complexity.

18.20 *Generic Neural Markup Language: Facilitating the Design of Theoretical Neural Network Models [#1645]*
Talib Hussain, BBN Technologies, United States

There is a need for tools that facilitate the systematic exploration of novel theoretical neural network models. Existing neural network simulation environments, neural network specification languages, and genetic encoding of neural networks fall short of providing the tools needed for this task. We present the Attribute Grammar Encoding (AGE) which uses attribute grammars to create descriptions of neural network solutions in an XML-based format termed the Generic Neural Markup Language (GNML). Lessons learned from the development of this system are presented to identify and address the issues of a broader application of this approach to other specification formats and other grammar encoding approaches.

18.40 *Co-Evolutionary Particle Swarm Optimization Applied to the 7x7 Seega Game [#1672]*
Ashraf Abdelbar, Sherif Ragab and Sara Mitri, American University in Cairo, Egypt

Seega is an ancient Egyptian two-stage board game that, in certain aspects, is more difficult than chess. The two-player game is most commonly played on a 7x7 board, but is also sometimes played on a 5x5 or 9x9 board. In the first and more difficult stage of the game, players take turns placing one disk each on the board until the board contains only one empty cell. In the second stage players take turns moving disks of their color; a disk that becomes surrounded by disks of the opposite color is captured and removed from the board. Our approach employs co- evolutionary particle swarm optimization for the generation of feature evaluation scores. Two separate swarms are used to evolve White players and Black players, respectively.

Monday, 26 July, 20.00–22.00

Comput. Brain Science & Neuroinformatics in Asian Pacific Countries (special session)

Monday, 26 July, 20.00–22.00, Room: A, Chairs: Syozo Yasui and Shiro Usui

20.00 *Japanese Neuroinformatics Project in Vision and RIKEN Brain Science Institute [#1437]*
Shiro Usui and Shun-ichi Amari, Riken Brain Science Institute, Japan

We first summarize the research activities on computational neuroscience (CNS) in RIKEN Brain Science Institute (BSI) and then introduce the coordinated efforts on Neuroinformatics Research in Vision (NRV) project to build a neuroinformatics portal for vision science called the "Visiome" (Vision + Ome) Platform. We wish to discuss a possibility of international collaborations on related subjects among Asian countries.

20.20 *Neuroinformatics: the development of shared neuroscience databases and tools at the Australian National Neuroscience Facility [#1721]*
Gary Egan, Howard Florey Institute, University of Melbourne, Australia

The Australian National Neuroscience Facility (NNF) is providing Australian neuroscientists with access to networks of laboratories offering neuroscience consultancy, technical expertise and state-of-the-art equipment. Within the NNF a neuroscience informatics platform has being established as one Australian node of developing international collaborative neuroinformatics projects. This paper will review current Australian activities related to the development of multi- national neuroinformatics research activities. The organizational structure and objectives of the NNF and its role in contributing to the development of the Australian biotechnology industry are also outlined.

20.40 *Excerpts of Research in Brain Sciences and Neural Networks in Singapore [#1636]*
Jagath C. Rajapakse, Dipti Srinivasan, Meng Joo Er, Guang-Bin Huang and Lipo Wang, Nanyang Technological Univerisity, Singapore; National University of Singapore, Singapore; Nanyang Technological University, Singapore

We summarize some of the key research areas in brain sciences and neural networks that have recently been or are being worked on by researchers in Singapore. Researchers in Singapore are developing theory of neural networks, notably improved radial basis function networks, fuzzy neural networks, and fast learning neural networks. Applications of neural networks include bioinformatics, multimedia, data mining, and communications. Researchers are also working with neurophysiologists on functional brain imaging and brain disease analysis.

21.00 *Korean Brain Neuroinformatics Research Program: The 3rd Phase [#1504]*
Soo-Young Lee, Korea Advanced Institute of Science and technolo, Korea, Republic of

The Korean Brain Neuroinformatics Research Program will get into the 3rd phase from June 2004 for 4 years. It is a joint effort of researchers from many different disciplines including cognitive science, electrical engineering, and computer science. In the 3rd phase we would like to continue our efforts on functional artificial systems

for vision, auditory, inference, and behavior. Also, we would like to develop a "digital brain" to combine all the 4 functions, and an integrated demonstration system, i.e., "artificial secretary" alias "office mate" with exceptional human-like information processing capabilities. Researches on measurement and signal analysis for neuroscience are also included.

21.20 *Japan's Center-Of-Excellence Program: Two COE's for Brain Science/Technology [#1767]*

Minoru Tsukada, Takeshi Yamakawa and Syozo Yasui, Tamagawa University, Japan; Kyushu Institute of Technology, Japan

Recently, the Japanese government designated 246 university departments as 21th Century Centers of Excellence (COEs) covering almost all fields of science and technology. Two COEs have been selected for the area relevant to this special session. One is formed by the Brain Science Center and other departments of Tamagawa University, led by M. Tsukada with the project title being "Integrative Human Science Program". The other COE is the Department of Brain Science and Systems Engineering of Kyutech, led by T. Yamakawa. Its project title is "World of Brain Computing Interwoven out of Animals and Robots. Both COEs are engaged in biology experiments, besides engineering and computational studies.

Tuesday, 27 July, 8.30–9.50

Plenary IJCNN

Tuesday, 27 July, 8.30–9.50, Room: A, Chair: Anthony Kuh

8.30 *Challenges and Opportunities for Analog Neural Processing in the Deep SubMicron SoC Era*

Angel Rodriguez Vazquez, Inst. of Microelectronics of Seville, IMSE-CNM, Spain

Merging sensors, processors and actuators defines one prevalent target of modern electronic system design. Bionic prostheses, bio-inspired sensory systems, ambient intelligence, wireless personal area networks, monitoring of physiological parameters, ... define new scenarios for these systems. And pose new challenges for integrated circuit design. New architectures may be needed in connection to some of these scenarios. Also, issues like ultra low-power consumption, on-chip co-existence of analog and digital signals, incomplete characterization of design primitives, etc. force the exploration of new architectures as well as new circuit techniques. In many cases, inspiration can be gained from nature regarding processor organization, information coding, fault-tolerant operation, adaptive operation, etc. This talk overviews some relevant challenges and opportunities for analog design in these new microelectronic scenarios. Considerations will be illustrated through true VLSI mixed-signal chips for vision.

9.10 *Nanoelectronic Neuromorphic Networks (CrossNets): New Results [#1369]*

Ozgur Turel, Jung Hoon Lee, Xiaolong Ma and Konstantin Likharev, Stony Brook University, United States

Our group is developing neuromorphic network architectures for future hybrid semiconductor/nanowire/molecular ("CMOL") circuits. Estimates show that such networks ("CrossNets") may eventually overcome the cerebral cortex in areal density, operating at much higher speed, at acceptable power consumption. In this report, we demonstrate that CrossNets based on simple (two-terminal) molecular devices can be configured to reproduce the behavior of any known neural network, either feedforward or recurrent, using a synaptic weight import procedure. Two other training methods including the global reinforcement (that may enable CrossNets to perform more intelligent tasks) are also described in brief.

Tuesday, 27 July, 10.10–12.10

Support Vector Machines and Kernel Methods I

Tuesday, 27 July, 10.10–12.10, Room: A, Chair: Marc Embrechts

10.10 *Comparison of Loss Functions for Linear Regression [#1013]*

Vladimir Cherkassky and Yunqian Ma, University of Minnesota, United States

This paper addresses selection of the loss function for regression problems with finite data. In real-life applications the noise density is unknown and the number of training samples is finite. For such practical situations, we suggest using Vapnik's epsilon-insensitive loss function. We propose a practical method for setting the value of epsilon as a function of known number of samples and (known or estimated) noise variance. Empirical comparisons for several representative linear regression problems indicate that the proposed loss function yields more robust performance and improved prediction accuracy, in comparison with squared loss and least-modulus loss, especially for noisy high- dimensional data sets.

10.30 *Non-crossing Quantile Regressions by SVM [#1608]*

Ichiro Takeuchi and Takeshi Furuhashi, Mie University, Japan; Nagoya University, Japan

Most regression studies focus on the conditional mean estimation. A more informative description of the conditional distribution can be obtained through the conditional quantile estimation. In this paper, we study nonparametric quantile regression in support vector machine (SVM) regression framework. With the great flexibility of the functions estimated by SVM, we face an embarrassing phenomenon called Quantile Crossing, i.e. two or more estimated quantile regressions at different orders cross or overlap. In this paper, we propose an algorithm to estimate non-crossing quantile regressions. This can be realized in SVM regression framework and the problem can be formulated by a constrained maximization of a piecewise quadratic function.

10.50 *A New Method for Multiclass Support Vector Machines [#1339]*
Davide Anguita, Sandro Ridella and Dario Sterpi, DIBE - University of Genoa, Italy

In this paper, we present a new method for solving multiclass problems with a Support Vector Machine. Our method compares favorably with other proposals, appeared so far in the literature, both in terms of computational needs for the feedforward phase and of classification accuracy. The main result, however, is the mapping of the multiclass problem to a biclass one, which allows us to suggest a method for estimating the generalization error by using data--dependent error bounds.

11.10 *Spatially Chunking Support Vector Clustering Algorithm [#1673]*
Tao Ban and Shigeo Abe, Kobe University, Japan, China; Kobe University, Japan, Japan

In this paper, we propose a novel Spatially Chunking algorithm to speed up the Support Vector Clustering (SVC) method for large data sets. The input data set is first divided into subsets where samples are geometrically adjacent to each other, an SVC is trained for each subset, and finally the clustering results of the local SVCs are combined to yield a global clustering solution. This method can save the computation cost for SVC by breaking the quadratic programming problem into smaller ones, and since parameter selection is done for each subset, it is able to deal with unevenly distributed data sets. The proposed method has demonstrated satisfactory performance with image segmentation problems on both gray scale and color images.

11.30 *Exploiting Diversity of Margin-based Classifiers [#1263]*
Enrique Romero, Xavier Carreras and Lluis Marquez, Universitat Politecnica de Catalunya, Spain

An experimental comparison among Support Vector Machines, AdaBoost and a recently proposed model for maximizing the margin with Feed-forward Neural Networks has been made on a real-world classification problem, namely Text Categorization. The results obtained when comparing their agreement on the predictions show that similar performance does not imply similar predictions, suggesting that different models can be combined to improve performance. As a consequence, we derived a very simple confidence measure of the prediction of the tested margin-based classifiers. Combination of margin-based classifiers with this confidence measure lead to a marked improvement on the performance, when combined with several well-known combination schemes.

11.50 *Scaling up Support Vector Data Description by Using Core-Sets [#1442]*
Calvin Chu, Ivor Tsang and James Kwok, Hong Kong University of Science and Technology, Hong Kong

Support vector data description (SVDD) has been commonly used for novelty detection.While its quadratic programming formulation avoids the local minimum problem, this has a runtime complexity of O(N^3). Inspired from the use of core-sets in computational geometry, we propose in this paper an approximation method that allows SVDD to scale better to larger data sets. Most importantly, the proposed method has a running time that is only linear in N. Experimental results demonstrate that the proposed method can handle much larger data sets, while its approximate solution still attains equally good, or sometimes even better, novelty detection performance.

Special Track: Retinal Prothesis Symposium Part 1

Tuesday, 27 July, 10.10–12.10, Room: B, Chair: Frank S. Werblin

10.10 *Information Transmission from a Retina Implant to the Cat Visual Cortex [#1334]*
Reinhard Eckhorn, Marcus Eger, Marcus Wilms and Thomas Schanze, Philipps - University Marburg, Germany

Blind subjects with photoreceptor degeneration perceive phosphenes when their intact retinal ganglion cells are stimulated electrically. Is this approach suitable for transmitting enough information to the visual cortex for partially restoring vision? We stimulated the retina of anesthetized cats electrically and visually while recording the responses in the visual cortex. Transmission of retino-cortical information T was quantified by information theory. T was 20-160 bit/s (per stimulation and recording site) with random electrical or visual impulse stimulation at rates between 20-40/s. When we increased the spatial density of independent electrical stimulation channels T did not saturate with 7 electrodes/mm2 retina. With 7 electrodes up to 500 bit/s was transmitted to 15 cortical recording sites. Electrical stimulation basically employs temporal stimulus patterns. They are intimately linked with intensity/- contrast information coded by the spike density of retinal ganglion cells. From the cortical information spread we estimated the spatial resolution as 0.5 mm cortex corresponding to 0.5- 1.0° visual angle. If the human cortex of blind subjects can receive and decode the information transmitted by a retina implant, our quantitative results measured in cats suggest that visuo-motor coordination and object recognition in many in- and out-door situations will be possible.

10.50 *Concerning the Mapping of ambiguous Retinal Output Vectors onto unambiguous Visual Percepts*
Rolf Eckmiller, Dirk Neumann, and Oliver Baruth Department of Computer Science University of Bonn

1-From a systems theory and computational neuroscience perspective, the primate foveal visual system in the photopic range consists of a retina module as a large ensemble of spatio-temporal (ST) filters represented by the receptive field (RF) properties of mostly P- and M- ganglion cells feeding into a corresponding central visual system module (VM). VM in turn elicits visual percepts P2 corresponding to optical input patterns P1. 2-Human visual perception, which transcends neuroscience and biophysics, is considered here as the result of a sequence of two unidirectional mapping operations: Mapping 1 of an optical pattern P1 in the physical domain onto a retinal output vector R1(t) in a neural domain by means of the retina as encoder and Mapping 2 of R1(t) in a neural domain onto a visual percept P2 in the perceptual domain by means of VM (Fig. 1).

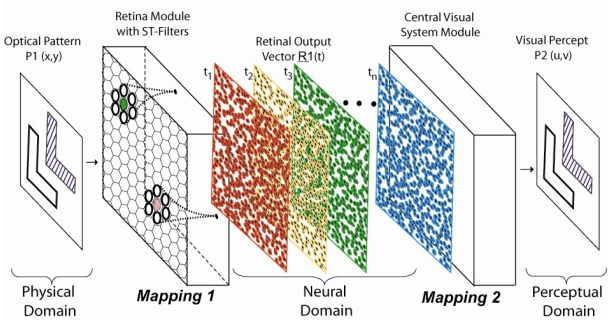

Figure. 1 Visual System as sequence of two unidirectional mappings from physical- via neural- onto perceptual domain.

3-Neurophysiological data of the primate retina suggest that both P- and M-cells represent non-invertible ST filters with concentric spatial DoG-or wavelet-type characteristics, which generate ambiguous output signals in that a given output signal can be caused by a number of different input signals . Accordingly, the retina module typically generates an ambiguous output vector R1(t), which could be caused by a number of input patterns. 4-For logical reasons, vision can only be achieved if the vast ambiguity of R1(t) can be resolved by VM. This task requires generation of an unambiguous pattern P2 as representation of P1 in the perceptual domain. 5-VM is simulated here as a functional inverter of the retina module since a given P1 and its corresponding percept P2 need to form an unambiguous pair including preservation of all spatial pattern details, as would be the case for the output (P2') of an ideal inverter of mapping 1, namely P2' = P1. For purposes of retina implant optimization, this approach emphasizes the principal similarities between the otherwise fundamentally different mapping 2 onto the perceptual domain and the inverse of mapping 1 back onto the physical domain.

6-The purpose of this paper is: a) to outline a novel Retina Encoder (RE*) for mapping of optical patterns P1 onto vectors R1(t) of ambiguous output signals; RE* serves both as retina module simulator and as neuroprosthetic retinal replacement; b) to identify essential requirements for the mapping of an ambiguous signal vector onto an unambiguous pattern, and; c) to discuss perceptual consequences of a low-dimensional (e.g. 100) vector of multiple ganglion cell activity generated by RE* in blind subjects with an epiretinal, learning retina implant, vs. the high-n respectively. dimensional vector of single ganglion cell activity generated by the human retina during normal vision. 7-The presented results suggest that: a) for the physiological visual process of a given pattern P1, VM requires miniature eye movements to retrieve / recognize an unambiguous pattern P2 corresponding to P1 and that b) for retina implant applications, RE* can be rapidly tuned to generate optimal single- vs. multiple ganglion cell codes for epiretinal single- vs. multineuron stimulatio

11.30 *Complex synaptic activation of bipolar, amacrine and ganglion cells is elicited with biphasic electrical stimulation.*

Shelley Fried, Tim Kubow, Frank Werblin, UC Berkeley, Berkeley, CA, USA

Purpose: To characterize the relative levels of responses of retinal neurons to .

biphasic electrical stimulation

Methods: On- and whole-cell patch clamp recordings were made from individual retinal ganglion cells in the rabbit retina in response to biphasic electrical stimulus pulses. A combination of dendritic morphology, light response and break-in currents were used to unambiguously assign each ganglion cell to a known morphological type. Timing and magnitudes of synaptic currents were measured in the different cell types. **Results:** Electrical pulses elicited robust spiking responses in retinal ganglion cells. Above threshold levels, these responses typically consisted of bursts of spiking activity alternating with periods of silence. Whole-cell patch clamp recordings revealed excitatory input currents that correlated temporally with the periods of spiking and inhibitory currents that correlated with the periods of silence. **Conclusions:** Correlation of excitatory and inhibitory input currents with ganglion cell spiking responses suggest that excitatory and inhibitory presynaptic neurons (likely bipolar and amacrine cells respectively) are activated by biphasic stimulus pulses. Inhibitory input, likely arising from direct or indirect (via bipolar) activation of amacrine cells, suppresses the ganglion cell spiking response and therefore increases the stimulus current threshold for ganglion cell activation. This suggests that electrical stimulation drives a complex interactive range of presynaptic activity. Stimulus parameters that minimize direct or indirect activation of amacrine cells may result in generating a higher response/stimulus efficiency.

Modeling attention & emotion in humans & agents (ENNS special session)

Tuesday, 27 July, 10.10–12.10, Room: F, Chair: John Taylor

10.10 *Modelling Human Attention and Emotions [#1326]*

John Taylor and Nickolaos Fragopanagos, King's College London, United Kingdom

We review a recently developed engineering control approach to attention, presenting detailed attention control function assignments to the wealth of brain modules experimentally observed. A proposed mechanism for attention amplification through acetylcholine is analysed by use of neural field theory. The control system is extended to include biasing by emotional valence, with qualitative analysis given of a range of emotion paradigms. A discussion of emotion recognition in the brain concludes the paper.

10.30 *The Effect of Emotional Bias in Attentional Processes [#1331]*

Nickolaos Fragopanagos and John Taylor, King's College London, United Kingdom

The Attentional Blink (AB) is an important paradigm to probe attention, observed when a subject tries to change the focus of their attention as fast as possible from one target input to another, when a rapid stream of targets is presented. The movement of attention to a second target (T2) is most difficult at about 200-500 msecs after detection or recognition of a first target (T1). This period is the blink, when there is little awareness of T2. We present a simulation that probes the control aspect of the movement of attention through the blink. We then show how the simulation can be extended by addition of an emotional bias, and how this can help ameliorate the blink for emotionally affective stimuli.

10.50 *Adaptation of Facial Feature Extraction and Rule Generation in Emotion-Analysis Systems [#1516]*

Spiros Ioannou, Amaryllis Raouzaiou, Kostas Karpouzis and Stefanos Kollias, National Technical University of Athens, Greece

The paper addresses the problem of emotion recognition in faces through an intelligent neuro-fuzzy system, where the extraction of facial features follows the MPEG-4 standard. These features are associated to symbolic fuzzy predicates providing the classification of facial images according to the underlying emotional states. For this classification we use rules extracted from psychological studies and expression databases. The experimental results, based both in extreme and naturalistic databases developed in the frameworks of IST ERMIS and NoE HUMAINE, illustrate the capability of the developed system to analyse and recognise facial expressions in human computer interaction applications.

11.10 *Knowing What and Where: A Computational Model for Visual Attention [#1367]*

Kaustubh Chokshi, Christo Panchev, Stefan Wermter and John Taylor, University of Sunderland, United Kingdom; King's College London, United Kingdom

We describe a model of invariant object recognition in the brain that incorporates feedback biasing effects of top-down attentional mechanism on a hierarchically organised set of visual cortical areas. The model displays a space based and a object based visual search by using a top-down attention feedback model from posterior parietal modules and interaction between the two processing streams dorsal and ventral.

11.30 *Attention-based Learning [#1624]*

Stathis Kasderidis and John Taylor, King's College London, United Kingdom

We apply an attention-based framework in the creation of an autonomous robot control system. We use a specific task, that of route planning for a robot in a dynamic environment, to present the general control architecture, and finally we show how it can be applied to the problem. Initial results of a simple simulation are presented with focus on the learning aspects.

11.50 *Graphical models for brain connectivity from functional imaging data [#1388]*

Xuebin Zheng and Jagath C. Rajapakse, Nanyang Technological University, Singapore; Nanyang Technological Univerisity, Singapore

This paper proposes a novel approach for analysis of brain connectivity shown in functional MRI (fMRI), using graphical models. Structural Equation Modeling (SEM) is currently used to model neural systems by using partial covariance values, which is only able to affirm or refute functional connectivity of a previously known anatomical model or select the best fit model from a set of a priori models. Our approach is exploratory in the sense that it does not require a priori model such as an anatomical model. It renders the interactions among brain regions with conditional densities and allows simulation of disconnectivity of neural systems.

Spiking Neuron Networks

Tuesday, 27 July, 10.10–12.10, Room: G, Chair: Joel Davis

10.10 *Extending SpikeProp [#1736]*
Benjamin Schrauwen and Jan Van Campenhout, ELIS, Ghent University, Belgium

This paper introduces enhancements to the SpikeProp algorithm, an error-backpropagation learning rule suited for spiking neurons using exact spike time coding. These enhancements provide additional learning rules for the synaptic delays, time constants and for the neurons' thresholds. This results in less constrained network topologies (the XOR problem for example needs up to 10 times less weights and learning convergence is up to two times faster).

10.30 *Spike Train Decoding Scheme for a Spiking Neural Network [#1473]*
Hesham Amin and Robert Fujii, PhD Student, Japan; Associate Prof., Japan

A spiking neural network models a type of biological neural system in which spike trains are used to convey information. A spike train consists of a series of asynchronous input spikes which are input into a neuron through a synapse. A new decoding scheme which can uniquely distinguish spike trains by using the relative spike arrival times in a spike train is proposed. Only a limited number of neurons are needed to implement the decoding scheme.

10.50 *Dual Threshold Based Neural Modeling to Study Systems of Spiking Neurons [#1395]*
Krzysztof Cios and Jeffrey Lovelace, University of Colorado at Denver, United States; Univeristy of Toledo, United States

The paper describes development and application of a spiking neuron model. The neuron model mimics the observed behavior of neurons in that the firing frequency is proportional to the input signal. This model of artificial spiking neurons is applied to the processing of received echolocation data to map out an area in 2D space in real-time.

11.10 *Emerging evolutionary features in noise driven STDP networks? [#1119]*
Zsolt Palotai, Gábor Szirtes and András Lárincz, Eötvös Loránd University, Hungary

In this paper we study the emergent structure of networks in which spike- timing dependent synaptic plasticity is induced only by external random noise. We show that such noise driven Hebbian networks are able to develop a broad range of network structures, including scale-free small-world networks. The development of such network structures may provide an explanation of the role of noise and its interplay with Hebbian plasticity. We also argue that this model can be seen as a unification of the famous Watts-Strogatz and preferential attachment models of small-world and scale-free nets. Our results may support Edelman's idea on that the development of central nervous system may have evolutionary components.

11.30 *Organization of Cell Assemblies that Code Temporal Sequences in a Hippocampal CA3-CA1 Model [#1495]*
Motoharu Yoshida and Hatsuo Hayashi, Kyushu Institute of Technology, Japan

Experimental evidences suggest involvement of the hippocampus in temporal sequence learning. Taking physiological differences between the hippocampal CA3 and CA1 regions into account, we propose a mechanism of temporal sequence encoding. Input signals that mimicked the activity of the rat entorhinal cortex during animal's spatial behavior were applied to a model hippocampal CA3-CA1 network. Following an organization of spatiotemporal patterns of spontaneous activity in the CA3 region, Schaffer collateral synaptic conductances were modified eventually forming a distinct spatial pattern. As a result, a CA1 pyramidal cell assembly was tuned to a specific sequence of input signals.

Face detection and recognition

Tuesday, 27 July, 10.10–12.10, Room: I, Chair: D. S. Huang

10.10 *SVM Classification Tree Algorithm With Application to Face Membership Authentication [#1169]*
Shaoning Pang, Auckland University of Technology, New Zealand

To recognize an individual's membership in a face group, but without revealing the individual's identity and without restricting the members of group, this paper introduces an SVM classification tree algorithm conducting face membership authentication in terms of the ``divide and conquer" strategy, and recognizing the membership in a face group whenever the member or the size of group changes dynamically. Compared with the previous SVM ensemble method and the traditional face identification method, the proposed SVM classification tree gets a very promising improvement in stability performance as the group size increases larger.

10.30 *Face Recognition Methods Based on Principal Component Analysis and Feedforward Neural Networks [#1190]*
Milos Oravec and Jarmila Pavlovicova, Slovak University of Technology, FEI, Slovakia

In this paper, human face as biometric is considered. Original method of feature extraction from image data is introduced using MLP (multilayer perceptron) and PCA (principal component analysis). This method is used in human face recognition system and results are compared to face recognition system using PCA directly, to a system with direct classification of input images by MLP and RBF (radial basis function) networks, and to a system using MLP as a feature extractor and MLP and RBF networks in the role of classifier. In order to obtain deeper insight into eight presented methods, also visualizations of internal representation of input data obtained by neural networks are presented.

10.50 *Empirical Comparison and Evaluation of classifier Performance for data mining in Customer Relationship Management [#1749]*
Sven F. Crone, Stefan Lessmann and Robert Stahlbock, Lancaster University, United Kingdom; University of Hamburg, Germany

In competitive consumer markets, data mining for customer relationship management faces the challenge of systematic knowledge discovery in large data streams to achieve opera-tional, tactical and strategic competitive advantages. Methods from computational intelligence, most prominently artificial neural networks and support vector machines, compete with established statistical methods in the domain of classification tasks. As both methods allow extensive degrees of freedom in the model building process, we analyse their comparative perform-ance and sensitivity towards data pre- processing in a real-world scenario.

11.10 *Real-time Face Shape and Position Recognition by a Two-D Spreading Associative Neural Network [#1461]*
Kiyomi Nakamura, Hironobu Takano and Tsukasa Sakamoto, Toyama Prefectural University, Japan

The Two-D spreading associative neural network (two-D SAN-net), which is constructed based on the spatial recognition system in the brain, not only recognizes the shape of an object irrespective of its position, but also recognizes its position irrespective of its shape in the input pattern. We developed a real-time face recognition system which performed the recognition by on-line processing using serial images from a video camera. In the recognition experiment, the system recognized both shape and position with sufficient accuracy. Regarding the generalization ability, the real-time two-D SAN-net system recognized scale changes

of 80 percent - 120 percent, and view plane rotation of the faces of up to plus or minus 4 - 5 degrees.

11.30 *Face Identification System using Single Hidden Markov Model and Single Sample Image per Person [#1630]*
Hung-Son Le and Haibo Li, First author, Sweden; Co-author, Sweden

This paper presents a novel approach for recognizing faces in images taken from different illumination, expression, near frontal pose, partially occlusion and time delay. The method is based on one dimensional discrete Hidden Markov Model (1D-DHMM) with new way of extracting observations and using observation sequences. All subjects in the system share only one HMM that is used as a means to weigh a pair of observations. The Haar wavelet transform is applied to face images to reduce the dimension of the observation vectors. The selection of the recognized person is based on the highest score, which is the summation of the likelihoods of all observation sequences extracted from image on both vertical and horizontal dimensions.

Tuesday, 27 July, 14.00–16.00

Least squares support vector machines (special session)

Tuesday, 27 July, 14.00–16.00, Room: A, Chair: Johan Suykens

14.00 *Adaptive Selective Kernel Learning Algorithms [#1472]*
Anthony Kuh, University of Hawaii, United States

This paper studies kernel regression problems using the least squares error criteria. The Least Squares - Support Vector Machine (LS-SVM) and variants have attracted researchers as the solution to nonlinear problems can be formulated as an optimization problem that involves finding a solution to a set of linear equations in primal or dual spaces. A drawback of using the LS-SVM is that the solution is not sparse, but involves solving a set of linear equations that depends on the number of observations. This paper discusses on-line algorithms that selectively chooses to add and delete training observations. Through examples we show that this algorithm can outperform LS-SVM solutions that use a larger window of randomly trained examples.

14.20 *A Sparse Least Squares Support Vector Machine Classifier [#1256]*
József Valyon and Gábor Horváth, Budapest University of Technology and Economics, Hungary

Support Vector Machines are attracting more and more attention due to their applicability to a large number of problems. To overcome the high computational complexity of Support Vector Machines, the Least-Squares SVM has been introduced. Unfortunately a very attractive feature of SVM, namely its sparseness, was lost. LS-SVM simplifies the required computation to solving linear equation set. This equation set embodies all available information about the learning process. By applying modifications to this equation set, we present a Least Squares version of the Least Squares Support Vector Machine. The proposed modification speeds up the calculations and provides better results, but most importantly it concludes a sparse solution.

14.40 *Comparison of four Support-Vector based Function [#1502]*
Bas J. de Kruif and Theo J. A. de Vries, University of Twente, Department of Control, Netherlands

One of the uses of the support vector machine (SVM), is as a function approximator. The SVM, and approximators based on it, approximate a relation in data by applying interpolation between so-called support vectors, being a limited number of samples that have been selected from this data. Several support-vector based function approximators are compared in this research. The comparison focusses on the following subjects: i) how many support vectors are involved in achieving a certain approximation accuracy; ii) how well are noisy training samples handled; and iii) how is ambiguous training data dealt with. The comparison shows that the so-called Key Sample Machine (KSM) outperforms the other schemes, specifically on aspects i) and ii).

15.00 *Speeding up the IRWLS convergence to the SVM solution [#1588]*
Fernando Perez-Cruz and Antonio Artes-Rodriguez, Gatsby Computational Neuroscience Unit. UCL, United Kingdom; Dpt. Signal Theory and Communications., Spain

We present the convergence demonstration of the Iterative Re-Weighted Least Squares (IRWLS) procedure to the SVM solution, to propose two modifications, which significantly reduces the runtime complexity of the IRWLS. We show by means of computer experiments that the convergence can be speed up between two and eight times compare to the standard IRWLS procedure.

15.20 *Primal Space Sparse Kernel Partial Least Squares Regression for Large Scale Problems [#1488]*
Luc Hoegaerts, Johan A. K. Suykens, Joos Vandewalle and Bart De Moor, Katholieke Universiteit Leuven, Belgium

Kernel based methods suffer from exceeding time and memory requirements when applied on large datasets since the involved optimization problems typically scale polynomially in the number of data samples. As a remedy we propose both working on a reduced set (for fast evaluation) and at the same time keeping the number of model parameters small (for fast training). Departing from the Nystroem based feature approximation we describe fixed-size LS-SVM in the context of primal space least squares regression, to extend it with a supervised counterpart, sparse kernel Partial Least Squares. The model is illustrated on a large scale example.

15.40 *Mapping LSSVM on Digital Hardware [#1586]*
Davide Anguita, Andrea Boni and Alessandro Zorat, DIBE - University of Genoa, Italy; DIT - University of Trento, Italy

In this paper we show how to map a LSSVM on digital hardware. In particular, we provide a thoretical analysis of quantization effects, due to finite register lenghts, that leads to some useful bounds for computing the necessary number of bits for a correct hardware implementation. Then, we describe a new FPGA-based architecture, the KTRON, which implements the feedforward phase of a LSSVM.

Pattern Recognition Applications

Tuesday, 27 July, 14.00–16.00, Room: H, Chair: Donald C. Wunsch II

14.00 *Color and Texture Features for Person Recognition [#1280]*
Michael Haehnel, Daniel Kluender and Karl-Friedrich Kraiss, Aachen University, Germany

In this paper, we present our experiments with color and texture features in the application of full body person recognition. On a database of 53 individuals we tested approved features for object recognition as well as MPEG7 color and texture descriptors on a person recognition task. For comparison, we used a RBF network classifier as well as a Nearest-Neighbor classifier. Our experiments showed that color as well as texture information is important for a person recognition system. Additionally, a combination of these two kind of features results in a performance improvement.

14.20 *Comparative Study of Connectionist Techniques for Implementing the Pattern Recognition System of an Artificial Nose [#1275]*

Marcelo B. de Almeida, Marcilio C. P. de Souto and Teresa Ludermir, Center of Informatics/UFPE, Brazil; Dept. of Informatics/UFRN, Brazil

The main goal of this work is to develop a systematic study on the several types of artificial neural networks (and their respective learning algorithms) that have been used to implement the pattern recognition system of the artificial nose proposed in [9], pointing out their advantages and limitations. The models analyzed are the Multi-layer Perceptrons (MLPs) with, respectively, backpropagation (BP), resilient backpropagation (Rprop) and tabu search (TS), and networks with radial basis function (RBF networks).

14.40 *Segmenting Handwritten Text Using Supervised Classification Techniques [#1012]*

Yi Sun, Tim Butler, Alex Shafarenko, Rod Adams and Martin Loomes, University of Hertfordshire, United Kingdom

Recent work on extracting features of gaps in handwritten text allows a classification into inter-word and intra-word classes using suitable classification techniques. In this paper, we apply 5 different supervised classification algorithms from the machine learning field on both the original dataset and a dataset with the best features selected using mutual information. The classifiers are compared by employing McNemar's test. We find that SVMs and MLPs outperform the other classifiers and that preprocessing to select features works well.

15.00 *Neural Network and Tree Automaton for Seismic Pattern Recognition [#1160]*

Kou-Yuan Huang and Yi-Hsiang Chao, National Chiao Tung University, Taiwan

We combine neural network and syntactic pattern recognition, and propose a tree automaton system for the recognition of structural seismic patterns in a seismogram. Multilayer perceptron is used for the identification of subpatterns, then a tree representation of the structural seismic pattern is constructed. We use three kinds of modified bottom-up structure preserved error correcting tree automata to recognize the tree representation of syntactic pattern, and propose a new top-down error correcting tree automaton to recognize non-structural preserved seismic pattern. In the experiments, the system is applied to the simulated and the real seismic bright spot patterns. The recognition result can improve seismic interpretation.

15.20 *Hidden Markov Model Finds Behavioral Patterns of Users Working with a Headmouse Driven Writing Tool [#1268]*

György Hévízi, Mihály Biczó, Barnabás Poczos, Zoltán Szabó and Bálint Takács, Eötvös Loránd University, Hungary

We studied user behaviors when the cursor is directed by a head in a simple control task. We used an intelligent writing tool called Dasher. Hidden Markov models (HMMs) were applied to separate behavioral patterns. We found that a similar interpretations can be given to the hidden states upon learning. It is argued that the recognition of such general application specific behavioral patterns should be of help for adaptive human-computer interfaces.

15.40 *Evolving Fuzzy Neural Networks Applied to Odor Recognition in an Artificial Nose [#1273]*

Cleber Zanchettin and Teresa B. Ludermir, Federal University of Pernambuco, Brazil

A pattern recognition system using Evolving Fuzzy Neural Networks for an artificial nose is presented. The artificial nose is composed of an adaptive and on-line learning method. For the classification of gases derived from the petroliferous industry, the method presented achieves better results (mean classification error of 0.88%) than those obtained by Time Delay Neural Networks (10.54%).

Special Track: Retinal Prothesis Symposium Part 2

Tuesday, 27 July, 14.00–16.00, Room: B, Chair: Frank S. Werblin

14.00 *In vivo evaluations of retinal prostheses*

DJ. Salzmann[1,3], P. Linderholm[2], M. Paques[3], M Simonutti[3], J. A Chiappore[3], A. B. Safran[1], P. Renaud[2], J. Sahel[3], S. Picaud[3] – [1]Geneva University Eye Clinic, Geneve [2]Microsystems Unit, Ecole Polytechnique Fédérale, Lausanne, [3]Laboratoire de physiopathologie cellulaire et moléculaire de la rétine, Paris

Purpose: In vivo evaluations of retinal prostheses were achieved either in animals with normal vision or in blind persons. To assess stimulating electrodes in vivo on an animal with photoreceptor degeneration, we have implanted P23H rhodopsin rats. The present study describes the implant design and our surgical strategy. **Methods:** Retinal prosthesis were fabricated in polyimide with platinum electrodes at the Microsystems Laboratory at the Swiss Federal Polytechnic in Lausanne (EPFL). Retinal implants were inserted into the subretinal space following a radial sclerotomy approximately 1.5mm behind the limbus. In several animals, the distal electrical connector was positioned on the skull with dentist cement. Electrode impedances were measured in vivo with a computer-controlled LCR-meter (HP4284A). Retinal implants were observed in vivo with a Kowa camera and a scanning laser ophthalmoscope. Histology was performed on paraffin and cryostat sections. **Results:** Proper surgical procedure was obtained with symmetrical implants, designed with a 1mm large head, and 50-20µm thin. Electrode impedances could be repeatedly measured on animals after the implantation. The implant was recovered in most animals up to 2 months in the proper position. No specific reaction or retinal detachment could be detected in fluorescein angiography or eye fundus. On retinal sections, the implants was observed in close contact to the retinal tissue. **Conclusions:** These experiments indicate clearly that implant electrodes can be tested on a leaving rat with photoreceptor degeneration. Future studies will assess the electrode characteristics and the stimulating protocol to trigger cellular and/or animal behavior responses.

14.40 *Design of a new subretinal implant for prosthetic vision*

John Wyatt, Massachusetts Institute of Technology, MA

This talk describes the efforts at MIT and the Massachusetts Eye and Ear Infirmary over the past 15 years to develop a chronically implantable retinal prosthesis. The goal is to restore some useful level of vision to patients suffering from outer retinal diseases, primarily retinitis pigmentosa and macular degeneration. We initially planned to build an intraocular implant, wirelessly supplied with signal and power, to stimulate the surviving cells of the retina. In this design electrical stimulation is applied through an epiretinal microelectrode array attached to the inner (front) surface of the retina. We have carried out a series of six acute surgical trials on human volunteers (five of whom were blind with retinitis pigmentosa and one with normal vision and cancer of the orbit) to assess electrical thresholds and the perceptions resulting from epiretinal retinal stimulation. The reported perceptions often corresponded poorly to the spatial pattern of the stimulated electrodes. In particular, no patient correctly recognized a letter. We hope that chronically implanted patients will adapt over time to better interpret the abnormal stimuli supplied by such a prosthesis.

Experiences with both animals and humans exposed surgical, biocompatibility, thermal and packaging difficulties with this epiretinal approach. Two years ago we altered our approach to a subretinal design which will, we believe, reduce these difficulties. Our current design places essentially the entire bulk of the implant on the temporal outer wall of the eye, with only a tiny sliver of the 10 micron thick microelectrode array inserted through a scleral flap beneath the retina. In this design the entire implant lies in a sterile area behind the conjunctiva. We hope to have the first prototype version of this design ready for chronic animal implantation late this calendar year.

15.20 *From passive to active subretinal implants, serving as adapting electronic substitution of degenerated photoreceptors*

E. Zrenner[1], V.P. Gabel[3], F. Gekeler[1], H.G. Graf[4], H. Gruber[4], H. Hämmerle[2], K. Kohler[1], W. Nisch[2], H. Sachs[3], H. Sailer[2], K. Shinoda,[1] A. Stett[2], B. Wilhelm[1*] – [1]University Eye Hospital Tuebingen, Dept. II [1*] Steinbeis Transfer Centre for Biomedical Optics and Function Testing [2] Natural and Medical Institute Reutlingen [3] University Eye Hospital Regensburg [4] Institute for Microelectronics, University of Stuttgart

Background: *In vitro* measurements in chicken and RCS retinae have shown that electrical signals elicited by subretinal electrodes, separated by a distance of 70 µm, produce neuronal responses in separate axons of the ascending visual system. The energy that can be provided by a purely passive single light sensor of 70 µm x 70 µm area, however, is not large enough to generate sufficient charge (1 nC – 10 nC) to stimulate retinal neurons by itself; external energy is required.

Methods: An active implant, driven by external energy, was developed consisting of 40 x 40 CMOS cells on an area of 3 x 3 mm. Within a layer of 100 µm in every cell there are circuits that measure the difference between local and global brightness and perform a charge transfer. Independent from ambient light this is adapted to the transfer functions of retinal neurons, only depending on local contrast. Thereby, amplification as well as adaptation to the ambient light levels is achieved. Electrical energy is provided by subretinal foil-bound (1 mm x 0.1 mm), gold lanes. Transchoroidal surgical techniques have been successfully applied.

Results: The function of the active chip was tested in an experimental set-up, in which input/output functions were determined and adaptive properties defined. This allowed to calculate the visual capability to transfer spatial information and contrast in a model. The bonding of the chip with its "wire-bound" external energy transfer was successfully performed and a passivation layer was developed and allowing biostability for at least 12 months. A study in 8 blind patients suffering from retinitis pigmentosa (RP) is in preparation. For the quantifying assessment of function, a standardized, scrrenbased test battery was developed, light sensitivity, spatial and temporal discrimination, localization and motion, are important features of that test. Numerous animal tests on biocompatibility (up to 28 months) have been successfully performed together with the development of specific surgical procedures.

Conclusion: Utilising differential amplifiers for adaptation of subretinal implants allows sufficient spatial resolution at varying ambient light surroundings in a grid of 70 µm, as defined by physiological *in vitro* experiments. It has been shown that an implant can be created that can be positioned in the subretinal space. Electronic circuits have been imprinted underneath each pixel that receive their external energy by subretinal foil-bound wires. Biocompatibility and biostability tests as well as successful surgical procedures have prepared the ground for clinical study in blind RP patients.

Cognitive Information Processing

Tuesday, 27 July, 14.00–16.00, Room: C, Chair: John Taylor

14.00 *``Object Permanence'': Results From Developmental Robotics [#1640]*

Yi Chen, Weng Juyang and Huang Xiao, DepT.of Comp. Sci. and Egr, Michigan State Univ, United States

Object permanence is an important theoretical construct that has been widely researched with infants. For the last twenty years, many researchers have been involved in a debate as whether object permanence is an innate conceptual knowledge or a gradually constructed perceptual capability. However, the lack of autonomous computational models has always made this debate vague. In this paper, a neurologically inspired computational model based on priming is proposed and applied on our developmental SAIL robot to test this issue....

14.20 *Estimating Driving Performance Based on EEG Spectrum and Fuzzy Neural Network [#1509]*

Ruei Cheng Wu, Chin Teng Lin, Sheng Fu Liang, Te Ying Huang, Yu Chieh Chen and Tzyy Ping Jung, National Chiao Tung University, Taiwan; National Chiao-Tung University, Taiwan; University of California San Diego, United States

The growing number of traffic fatalities has become a serious concern to society. Accidents caused by drivers' drowsiness have a high fatality rate because of the marked decline in the drivers' abilities of perception and vehicle control abilities. Preventing accidents caused by drowsiness requires a technique for estimating and predicting the level of alertness of a driver. This paper describes a system that combines EEG power spectrum estimation, principal component analysis, and fuzzy neural network model to estimate/predict drivers' drowsiness level. Our results demonstrated that it is feasible to accurately estimate task performance and quantitatively measured driving performance in a realistic driving simulation.

14.40 *An Associator Network Approach to Robot Learning by Imitation through Vision, Motor Control and Language [#1330]*

Mark Elshaw, Cornelius Weber, Alex Zochios and Stefan Wermter, University of Sunderland, United Kingdom

Imitation learning offers a valuable approach for developing intelligent robot behaviour. We present an imitation approach based on an associator neural network inspired by brain modularity and mirror neurons. The model combines multimodal input based on higher-level vision, motor control and language so that a simulated student robot is able to learn from observing three behaviours which are performed by a teacher robot. The student robot associates these inputs to recognise the behaviour being performed or to perform behaviours by language instruction. With behaviour representations segregating into regions it models aspects of the mirror neuron system as similar patterns of neural activation are involved in recognition and performance.

15.00 *Assessing similarity of emergent representations based on unsupervised learning [#1585]*

Juha Raitio, Ricardo Vigario, Jaakko Sarela and Timo Honkela, Helsinki University of Technology, Finland

We consider a method for comparing the similarity of representations in connectionist networks, and examine the possibilities of exploiting it for comparing emergent representations in unsupervised learning networks. We report the results based on applying this method for representations of color spectrum emerging in the Self-Organizing Maps.

15.20 *Combining Visual and Proprioceptive Information in a Model of Spatial Learning and Navigation [#1474]*

Ricardo Chavarriaga and Wulfram Gerstner, IC, Brain Mind Institute, EPFL, Switzerland

Animals can adopt different navigation strategies according to the environment and the task they have to solve. The process of selecting the appropriate navigation strategy in mammals involves parallel pathways. The hippocampus has been thought to be the potential basis for a type of navigation strategy in which a representation of the space is required. A second navigation strategy that involves the dorsal striatum is used by rats if the target can be identified by a visible cue. This paper presents a computational model of the rat hippocampus and its interactions with the basal ganglia, able to reproduce neurobehavioral experiments regarding self-localisation and navigation strategies.

15.40 *Deep sleep: Understanding the process of hippocampal playback and plasticity [#1320]*

Matthew Hartley, Neill Taylor and John Taylor, King's College London, United Kingdom

The hippocampus is a critical brain region for human memory function, particularly the encoding of new episodic memories. Recent experiments based on rats running for a food reward show that temporal sequences of place cell firings are encoded in the hippocampus during waking exploration, and replayed at a twentyfold increased rate during slow wave sleep. We show that a suitable hippocampal model using spiking neurons, and recent results from synaptic plasticity research, can replicate

these results, and provide answers to important questions about the function of sleep and the mechanisms of neural plasticity. We also suggest avenues of further research, and make predictions for experimental verification.

Comput. theories of Hippocampus behavior and intellig. (special session)

Tuesday, 27 July, 14.00–16.00, Room: F, Chair: Edmund Rolls and Péter Érdi

14.00 *Dendritic Processing in Hippocampal Pyramidal Cells and its Modulation by Inhibitory Interneurons [#1452]*

Szabolcs Kali and Tamás Freund, Institute of Experimental Medicine, Hungary

Area CA1 of the hippocampus contains a population of pyramidal cells, accompanied by a diverse array of inhibitory interneurons, which are believed to modulate the activity and plasticity of pyramidal neurons. We created appropriately detailed models of hippocampal principal cells and interneurons, which were then used to explore how these different cell types interact within the hippocampal network. In particular, we show that different input pathways drive pyramidal cells with a different efficacy, and that the relative efficacy of different inputs can be modulated by various neurotransmitters and, in a more specific manner, by dendritic inhibition. Feedback inhibition could also selectively gate backpropagating action potentials.

14.20 *Functional Role of Entorhinal Cortex in Working Memory and Information Processing of the Medial Temporal Lobe [#1082]*

Erik Fransen, Royal Institute of Technology, Sweden

Our learning and memory system has the challenge to work in a world where items to learn are dispersed in space and time. From the information extracted by the perceptual systems, the learning system must select and combine information. Both these operations may require a temporary storage where significance and correlations may be assessed. This work builds on the common hypothesis that hippocampus and subicular, entorhinal and parahippocampal/postrhinal areas are essential for these functions. We bring up two examples of models, one modeling data from delay match-to-sample working memory experiments, and one modeling cellular ``integrator-like" intrinsically generated stable graded levels of spiking activity.

14.40 *Computing with oscillations by phase encoding and decoding [#1569]*

Ole Jensen, F.C. Donders Centre fog Cognitive Neuroimaging, Netherlands

Even though brain oscillations are found in many brain regions, the role of oscillations in neural computation remains an open question. Experimental work in the hippocampus has provided examples where the phase of firing of neurons with respect to ongoing network oscillations codes for information. This scheme has been termed phase coding. A network receiving the phase encoded firing patterns must receive the oscillatory signal as well in order to utilize the phase code. Thus, the oscillatory coupling between brain networks often observed experimentally might reflect exchange of phase coded information. In this work I will demonstrate that phase encoding and decoding allow for a set of simple computations.

15.00 *Neurophysiology of the primate hippocampus leading to a model of its functions in episodic and spatial memory [#1702]*

Edmund Rolls and Simon Stringer, University of Oxford, United Kingdom

Single hippocampal neurons in primates respond to spatial view, to objects, or to a combination of an object and its spatial position, forming the basis for an attractor model of episodic memory combining continuous and discrete representations which is described. Given that idiothetic (self-motion) cues such as eye movements update the spatial view representation in the dark, path integration as well as memory is implemented. In a model of this, a model is proposed for how the hippocampal system incorporates a continuous attractor network for the spatial representation that can be moved in the state space by idiothetic inputs.

15.20 *Memory Encoding of Object Relocation in a Hierarchical Associative Network with Theta Phase Coding [#1255]*

Naoyuki Sato and Yoko Yamaguchi, Japan Science and Technology Agency, Japan; RIKEN Brain Science Institute, Japan

Memory of the natural environment corresponds to the complex alignments of objects and changes in their locations. We hypothesized that the neural dynamics of theta phase precession observed in the rat hippocampus should contribute to the memory of object-place associations because of its high selectivity in synaptic plasticity of an on-line process. Our computer experiments have demonstrated that object-place associations can be instantaneously stored in the hippocampus as a hierarchical associative network, where object-relocation is stored by rewiring its part in the network. It indicates an advantage of theta phase coding in the memory of the natural environment.

15.40 *An Hypothesis on the Origin of Variable Spatial Scaling Along the Septo-Temporal Axis of the Rodent Hippocampus [#1763]*

Bruce McNaughton, Carol Barnes, Alejandro Terrazas and Francesco Battaglia, University of Arizona, United States

The spatial scaling of place specific activity in the rodent hippocampus varies systematically from the septal pole (high spatial resolution) to the temporal pole (low spatial resolution). This variable scaling permits the read-out of spatial proximity relationships. Decoupling movement in space from ambulatory motion, by having the animal activate and ride on a mobile platform, results in marked attenuation of the amplitude of the local theta rhythm and a corresponding enlargement of the spatial scale factor in the dorsal hippocampus. These results lead to the hypothesis that the self-motion signal is embodied in the theta rhythm, whose gain may vary systematically along the septo-temporal axis of the hippocampus.

Tuesday, 27 July, 16.00–19.00

Plenary Poster Session: Support Vector Machines and Kernel Methods (incl. special session S7)

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T001 *Kernel CMAC with Improved Capability (special session S7) [#1146]*

Gábor Horváth, Budapest University of Technology and Economics, Hungary

Cerebellar model articulation controller (CMAC) neural network is a real alternative to MLP and has some advantageous features: its training is fast and its architecture is especially suitable for digital hardware implementation. The price of these attractive features is its rather poor capability. CMAC may have significant approximation and generalization errors. The paper shows that the proposed new version of the CMAC where kernel interpretation and a new regularization term are applied can significantly improve the capability of the network: both the approximation and the generalization capabilities are improved without increasing the complexity of the network

T002 *Direct Kernel Least-squares Support Vector Machines with Heuristic Regularization (special session S7) [#1126]*
Mark Embrechts, Rensselaer polytechnic Institute, United States

This paper introduces least-squares support vector machines as a direct kernel method, where the kernel is considered as a data pre-processing step. A heuristic formula for the regularization parameter is proposed based on preliminary scaling experiments.

T003 *Why Pairwise Is Better than One-against-All or All-at-Once(special session S7) [#1458]*
Daisuke Tsujinishi, Yoshiaki Koshiba and Shigeo Abe, Kobe University, Japan

In this paper, first we discuss acceleration of classification by reducing support vectors. Then, we discuss multiclass least squares SVMs (LS-SVMs) that resolve unclassifiable regions for multiclass problems. Next, we compare three types of LS-SVMs from the standpoint of training difficulty and show that the fuzzy one-against-all LS-SVM and the all-at-once LS-SVM have similar decision boundaries when classification problems are linearly separable in the feature space. Finally, we evaluate three types of multiclass LS-SVMs for some benchmark data sets and show that classification performance of fuzzy one- against-all and one-against-all LS-SVMs are almost the same but inferior to that of fuzzy pairwise LS-SVMs.

T004 *Regularization Constants in LS-SVMs: a Fast Estimate via Convex Optimization (special session S7) [#1595]*
Kristiaan Pelckmans, Johan A. K. Suykens and De Moor Bart, K.U.Leuven - ESAT - SCD - SISTA, Belgium; Katholieke Universiteit Leuven, Belgium

In this paper, the tuning of the regularization constant in applications of Least Squares Support Vector Machines (LS-SVMs) for regression and classification is considered. The formulation of the LS-SVM training and regularization constant tuning problem (w.r.t.the validation performance) is considered as a single constrained optimization problem. In the formulation with Tikhonov regularization the problem of estimation the weights, validation errors and the regularization constants is a non-convex problem. The main result of this paper is a conversion of the nonlinear constraints into a set of linear constraints which turns the problem into a convex one.

T005 *Fast Bootstrap applied to LS-SVM for Long Term Prediction of Time Series (special session S7) [#1706]*
Amaury Lendasse, Vincent Wertz, Geoffroy Simon and Michel Verleysen, Cis-Hut, Finland; Auto-Ucl, Belgium; Machine Learning Group, UCL, Belgium

Time series forecasting is usually limited to one-step ahead prediction. This goal is extended here to longer-term prediction, obtained using the least- square support vector machines model. The influence of the model parameters is observed when the time horizon of the prediction is increased and for various prediction methods. The model selection to optimize the design parameters is performed using the Fast Bootstrap methodology introduced in previous works.

T006 *Support Conformal Vector Machine with Optimal Bayes Point [#1705]*
Eduardo (Edu) Bayro-Corrochano, Refugio Vallejo-Gutierrez and Nancy Arana-Daniel, CINVESTAV Unidad Guadalajara, Computer Science, Mexico

This paper design support vector machines using the conformal Clifford geometric algebra framework. In this study we map the feature space into hyperspheres in order to get a uniformly distribution data. In this domain we apply as classifier a Support Conformal Vector Machines. In this context the optimal hyperplane found by the Support Conformal Vector Machine will approach to the optimal Bayes point. An experimental analysis clarifies our approach.

T007 *Kernel-Based Subpixel Target Detection in Hyperspectral Images [#1353]*
Heesung Kwon and Nasser M. Nasrabadi, US Army Research Laboratory, United States

We present a nonlinear realization of a signal detection approach that uses the generalized likelihood ratio tests (GLRTs). It is based on converting the linear subspace models, so called matched subspace detectors (MSD). The linear model for the GLRT of MSD is first extended to a high dimensional feature space and then the corresponding nonlinear GLRT expression is obtained. In order to address the intractability of the nonlinear GLRT we kernelize the nonlinear GLRT using the kernel trick. The proposed detectors, so called kernel matched subspace detectors (KMSD), are applied to a given hyperspectral imagery – HYDICE images – to detect targets. KMSD showed superior detection performance over MSD for the HYDICE images tested.

T008 *Non-stationary Data Domain Description using Weighted Support Vector Novelty Detector [#1376]*
Fatih Camci and Ratna Babu Chinnam, Wayne State University, United States

Whilst most classification methods deal with multiple classes, there is an objective need for methods that deal with a single class. This is particularly true when it is difficult or expensive to find examples for other classes. One- class classification is often used for outlier or novelty detection. Methods with parametric density assumptions have the weakness of applicability to real world settings. Very few one-class classification methods can handle non- stationary data. These methods tend to make stringent assumptions. This paper proposes an effective data domain description method based on support vector machine principles for stationary as well as non-stationary data.

T009 *Cluster-based Support Vector Machines in Text-Independent Speaker Identification [#1412]*
Sheng-Yu Sun, C. L. Tseng, Y. H. Chen, H. C. Chuang and H. C. Fu, National Chiao-Tung University, Taiwan

Based on Statistical learning theory, Support Vector Machines(SVM) is a powerful tool for various classification problems, such as pattern recognition and speaker identification etc. However, SVM needs large memory and long computing time to learn from training data. This paper propose a cluster-based learning methodology to speed up training time and to reduce the memory size for SVM. By using k-means based clustering technique, training data at boundary of each cluster were selected for SVM learning. We also applied this technique to textindependent speaker identification problems.Without deteriorating recognition performance, the training data and time can be reduced up to 75 percentage and 87.5 percentage respectively.

T010 *A part-versus-part method for massively parallel training of support vector machines [#1493]*
Bao-Liang Lu, Kai-An Wang, Masao Utiyama and Hitoshi Isahara, Shanghai Jiao Tong University, China; Communications Research Laboratory, Japan

This paper presents a part-versus-part decomposition method for massively parallel training of multi-class support vector machines (SVMs). By using this method, a multi-class classification problem is decomposed into a number of two-class subproblems as small as needed. An important advantage of this method over existing pairwise-classification approach is that a large-scale two-class subproblem can be further divided into a number of samller two-class subproblems, and fast training of SVMs on multi-class classification problems can be easily implemented in a massively parallel way. The experimental results show that the proposed method is faster than the existing appraoch and better generalization performance can be achieved.

T011 *Kernel-Based Associative Memory [#1563]*
Dimitri Nowicki and Oleksiy Dekhtyarenko, Institute of Mathematical Machines and Systems, Ukraine

We propose a new approach to pseudo-inverse associative memories using kernel machine methodology. Basing on Hopfield-type pseudoinverse associative memories we developed a series of kernel-based hetero- and auto-associative algorithms. There are convergence processes possible during examination procedures even for continuous data. Kernel approach enables to overcome capacity limitations inherent to Hopfield-type networks. Memory capacity virtually does not depend on data dimension. We provide theoretical investigation for proposed methods and prove its attraction properties. Also we have experimentally tested them for tasks of classification and associative retrieval.

Plenary Poster Session: Self Organizing Maps

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T012 *Learning and Forgetting - How They Should be Balanced in SOM Algorithm [#1066]*
Youichi Kobuchi and Masataka Tanoue, Ryukoku University, Japan

A two layered neural network is considered as Kohonen's dot-product type SOM model. This note examines the role of learning rate and forgetting rate in such SOM algorithms. The properties we consider are the relation between stability of winner functions and topographic mapping formation. We propose three classes of networks which depend on the two parameters or their ratio, and the former class includes the latter and the most restrictive class is here called topographic. The main result is once a network belongs to this topographic class we can maintain the property in the evolution process if we choose the parameters appropriately.

T013 *Cross-Language Information Retrieval using Latent Semantic Indexing and Self-Organizing Maps [#1366]*
Nikolaos Ampazis and Helen Iakovaki, University of the Aegean, Greece

The present paper describes a method of fully automated cross-language information retrieval which does not require any query translation. Namely, monolingual queries retrieve documents from a multilingual collection which includes items from the query's source language. This is achieved by a method which combines the construction of a multilingual semantic space using Latent Semantic Indexing (LSI) and the clustering ability of Self-Organizing Maps (SOM) for the generation of multilingual semantic categories. Tests on an English-Greek corpus reveal the effectiveness and robusteness of the proposed method.

T014 *A New Visualization Scheme for Self-Organizing Neural Networks [#1447]*
Cristian Figueroa and Pablo A. Estevez, University of Chile, Chile

A new on-line visualization scheme for self-organizing neural networks is presented. The proposed updating rule for position vectors is applied to the Kohonen's SOM, the Neural Gas (NG) and the Growing Neural Gas (GNG) neural networks, to create the enhanced versions TOPSOM, TOPNG and TOPGNG, respectively. The proposed models are tested on the visualization of benchmark and real-world datasets, and compared with DIPOL-SOM, as well as the off-line combination of SOM, NG and GNG with the Sammon's nonlinear mapping. The results obtained with TOPSOM and TOPNG are better than that of DIPOL-SOM, and similar to those obtained with off-lines strategies, in terms of distance and topology preservation measures.

T015 *M-SOM: Matricial Self Organizing Map for sequence clustering and classification [#1530]*
Farida Zehraoui and Younes Bennani, LIPN, UMR 7030, France

This paper presents approaches for sequence clustering and classification. These approaches use the self organizing map ``SOM''. The inputs of the map are modelled in order to take into account the information and the and correlation of the patterns (the dynamics) contained in the sequences. The first approaches represent the input of the map by a representative vector or by a covariance matrix in order to take into account the correlations between the sequence components. These approaches do not take into account the temporal order in the sequences. The other approaches introduce the dynamics in the covariance matrix. The SOM is modified in order to take into account the fact that the inputs are matrices.

T016 *Generational Trends in Obesity in the United States: Analysis with a Wavelet Coefficient Self-Organizing Map [#1670]*
Susan Garavaglia, Sanofi-Synthelabo, United States

Increasing prevalence of obesity is considered to be a major public health problem, particularly in the USA. Many factors have been considered in causing this unhealthy condition, but an aging population could be a dominant cause, as it is well known that most people gain weight as they age. However, when the US population is analyzed as generational cohorts (based on year of birth), not simply as age cohorts growing older each year, some different patterns emerge. Trends based on age versus generational cohorts are compared controlling for geography. As trends in population weight can serve as a health status "signal," a wavelet- based approach was selected, using Haar wavelet coefficients as the Self-Organizing Map weight vectors.

T017 *Adaptive Second Order Self-Organizing Mapping for 2D Pattern Representation [#1028]*
Banchar Arnonkijpanich and Chidchanok Lursinsap, Dept. of Mathematics, Khon Kaen University, Thailand; Dept. of Mathematics, Chulalongkorn University, Thailand

The problem of unsupervisedly classifying a set data and identifying the principal direction of each class at the same time is studied. A new adaptive unsupervised learning model called Adaptive Second Order Self- Organizing Map is proposed for this problem. ASOSOM combines the advantages of the SOM with KL transformation. Instead of having one neuron representing each class, an additional neuron is introduced to cooperate with the class neuron for identifying the principal direction. Furthermore, a new performance measurement based on the co-variance between the principal direction and its perpendicular direction is introduced. The obtained results are better than KL and MKL transformations.

T018 *SOM-based Optimization [#1052]*
Mu-Chun Su, Yu-Xiang Zhao and Jonathan Lee, National Central University, Taiwan; Dep. of CSIE, National Central University, Taiwan

In this paper, a new approach to optimization problems based on the self- organizing feature maps is proposed. We name the new optimization algorithm the SOM-based optimization (SOMO) algorithm. Through the self-organizing process, good solutions to an optimization problem can be simultaneously explored and exploited. An additional advantage of the algorithm is that the outputs of the neural network allow us to transform a multi-dimensional fitness landscape into a three-dimensional projected fitness landscape. Several simulations are used to illustrate the effectiveness of the proposed optimization algorithm.

T019 *Superposition-Based Order Analysis in Self-Organizing Maps [#1341]*
Laurentiu Hetel, Jean-Luc Buessler and Jean-Philippe Urban, Universite de Haute Alsace, France

Topology preservation, the central feature of SOM, proves to be difficult to define and quantify. We propose new criteria and measurements for order preservation, based on the superposition of neuron cells in the input space. As an application, we establish a taxonomy of topological errors and disorder states and we use it for error detection in 2-dimensional SOM during the first learning epochs.

T020 *Regional and Online Learnable Fields [#1269]*
Rolf Schatten, Nils Rolf Goerke and Rolf Eckmiller, University of Bonn, Germany; Neuroinformatics, University of Bonn, Germany

Within this paper a new data clustering algorithm is proposed based on classical clustering algorithms. Here k-means neurons are used as substitude for the original data points. These neurons are online adaptable extending the standard k-means clustering algorithm. They are equipped with perceptive fields to identify if a presented data pattern fits within its area it is responsible for. In order to find clusters within the input data an extension of the e-nearest neighbouring algorithm is used to find connected groups within the set of k-means neurons. The clustering abilities of the presented algorithm are shown using data sets from two different kind of applications.

T021 *Non-Euclidean Self-Organizing Classification Using Natural Manifold Distance [#1406]*
Saichon Jaiyen and Chidchanok Lursinsap, Advanced Virtual and Intelligent Computing (AVIC), Thailand; Advanced Virtual and Intelligent Computing (AVIC, Thailand

Current unsupervised classification using self organizing mapping (SOM) competitive learning is based on the minimum Eucledian distance between a prototype neuron and the selected data. This is not suitable for several classification problems where the geometrical structure and curvature of the data space are the main concern. The problem studied in this paper concerns the algorithm for measuring the non-Eucledian distance in a data point space, i.e. the surface function is unknown, and moving the prototype neurons along the actual geometrical structure of the data points. Our algorithm successfully classifies the experimental data spaces with various aspects while the SOM classification gives incorrect results.

T022 *Surface reconstruction using neural networks and adaptive geometry meshes [#1508]*
Agostinho de Medeiros Brito Junior, Adriao Duarte Doria Neto and Jorge Dantas de Melo, Universidade Federal do Rio Grande do Norte, Brazil

We present a multiresolution surface reconstruction method from point clouds in 3D space based on Kononen's self-organizing neural networks. It uses a set of mesh operators and simple rules for selective mesh refinement. Experimental results show the method is very successfull on reconstructing forms with different geometry.

T023 *Generalization of Topology Preserving Maps: A Graph Approach [#1250]*
Arpad Barsi, Budapest University of Technology and Economics, Hungary

The paper presents a novel algorithm, which is based on the self-organizing map (SOM) method. The combination of an undirected acyclic graph with the Kohonen learning rule results the efficient Self-Organizing Neuron Graph (SONG) algorithm. It has two modi: one is based on the adjacency information of the neuron graph, the other integrates an all-pair shortest path function, which permanently updates a generalized distance matrix. The newly developed SONG techniques were involved in pattern recognition tasks, where they proved their efficiency and flexibility.

Plenary Poster Session: Recurrent Neural Networks

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T024 *On Stable Learning of Block-Diagonal Recurrent Neural Networks - Part I: The RENNCOM Algorithm [#1054]*
Paris Mastorocostas and John Theocharis, Technological and Educational Institute of Serre, Greece; Aristotle University of Thessaloniki, Greece

A novel learning algorithm, the RENNCOM (Recurrent Neural Network Constrained Optimization Method) is suggested in this paper, for training block-diagonal recurrent neural networks. The training task is formulated as a constrained optimization problem, whose objective is twofold: (i) minimization of an error measure, leading to successful approximation of the input/output mapping and (ii) optimization of an additional functional, which aims at ensuring network stability throughout the learning process. The characteristics of the proposed algorithm are highlighted by a simulation example, where a nonlinear dynamic identification problem is presented.

T025 *On Stable Learning of Block-Diagonal Recurrent Neural Networks - Part II: Application to the Analysis of Lung Sounds [#1055]*
Paris Mastorocostas and John Theocharis, Technological and Educational Institute of Serre, Greece; Aristotle University of Thessaloniki, Greece

A recurrent neural filter for the separation of discontinuous adventitious sounds from vesicular sounds is presented. The filter uses two Block-Diagonal Recurrent Neural Networks to perform the task of separation and is trained by the RENNCOM training algorithm. Extensive experimental results are given and performance comparisons with a series of other models are conducted, underlining the effectiveness of the proposed filter.

T026 *On Global Exponential Periodicity of Dynamical Neural Systems [#1062]*
Changyin Sun, Dequan Li, Liangzheng Xia and Chun-Bo Feng, Hohai University and Southeast University, China; Anhui University of Science and Technology, China; Southeast University, China

Without assuming the boundedness and differentiability of the activation functions, some new sufficient conditions ensuring existence and uniqueness of periodic solution for a general class of neural systems are obtained. Discrete- time analogue of the continuous-time system with periodic input is formulated and we study their dynamical characteristics. The exponential periodicity of the continuous-time system is preserved by the discrete-time analogue without any restriction imposed on the uniform discretization step-size.

T027 *Flow Estimation Using Elman Networks [#1301]*
Pedro Coelho, Luiz Biondi Neto, Joao Mello, Lidia Meza and Maria Velloso, State University of Rio de Janeiro, Brazil; Federal Fluminense University, Brazil; Veiga de Almeida University, Brazil

This paper investigates the application of partially recurrent artificial neural networks (ANN) in the flow estimation for Sao Francisco River that feeds the hydroelectric power plant of Sobradinho. An Elman neural network was used, suitably arranged to receive samples of the flow time series data available for Sao Francisco River shifted by one month. The data used in the application concern to the measured Sao Francisco river flow time series from 1931 to 1996, in a total of 65 years from what 60 were used for training and 5 for testing. The obtained results indicate that the Elman neural network is suitable to estimate the river flow for 5 year periods monthly. The average estimation error was less than 0.2 per cent.

T028 *A Comparison of First- and Second-Order Training Algorithms for Dynamic Neural Networks [#1303]*
Ferid Bajramovic, Christian Gruber and Bernhard Sick, University of Passau, Germany

Neural networks are often used for time series processing. Temporal information can, for example, be modeled using the Dynamic Neural Network (DYNN) paradigm which combines delay-elements in feedforward direction with recurrent connections. If networks were applied to process time series, learning typically becomes a very complex and time consuming task. Therefore, training algorithms are needed which are both accurate and fast. In this article six learning algorithms are presented and applied to DYNN. The various learning algorithms are compared w.r.t. four criteria. Each algorithm is evaluated by means of three real-world application examples.

T029 *Backpropagation-Decorrelation: online recurrent learning with O(N) complexity [#1556]*
Jochen J. Steil, Neuroinformatics Group, Bielefeld University, Germany

We introduce a new learning rule for fully recurrent neural networks which we call Backpropagation-Decorrelation rule (BPDC). It combines important principles: one-step backpropagation of errors and the usage of temporal memory in the network dynamics by means of decorrelation of activations. The BPDC rule is derived and theoretically justified from regarding learning as a constraint optimization problem and applies uniformly in discrete and continuous time. It is very easy to implement,

and has a minimal complexity of 2N multiplications per time-step in the single output case. Nevertheless we obtain fast tracking and excellent performance in some benchmark problems including the Mackey-Glass time-series.

T030 *A Novel Recurrent Neural Network with Minimal Representation for Dynamic System Identification [#1660]*
Yen-Ping Chen and Jeen-Shing Wang, National Cheng Kung University, Taiwan

This paper presents a self-adaptive learning algorithm for dynamic system identification using a novel recurrent neural network with minimal representation. The proposed algorithm consists of two mechanisms, a minimal realization technique based on Markov parameters and a recursive parameter learning method on the ordered derivatives, for the minimal order identification and parameter optimization, respectively. Computer simulations on unknown dynamic system identification using the proposed approach have successfully validated: 1) the order of the recurrent network representation is minimal, and 2) the proposed network is able to closely capture the dynamical behavior of the unknown system with a satisfactory performance.

Plenary Poster Session: Cerebellar Model Articulation Controller CMAC

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T031 *Active Training on the CMAC Neural Network [#1081]*
Luis Weruaga, Austrian Academy of Sciences, Austria

The CMAC presents a rigid architecture for learning and generalizing simultaneously, limitation stressed with non-dense training datasets, and hardly solved by the current algorithmic. This paper proposes a novel training that overcomes that tradeoff. The mechanism is based on the minimization of the stiffness energy, base of the active deformable model theory. This leads to a cell-interaction-based internal mechanism that preserves the CMAC learning capabilities and delivers a higher generalization degree than the one a-priori in its architecture. The active training is derived from a rigorous analysis, being supported with results on the inverse kinematics of a robotic arm, which prove the performance of the method.

T032 *A Pruning Structure of Self-Organizing HCMAC Neural Network Classifier [#1T09]*
Chen Chih-Ming, Hong Chin-Ming and Lu Yung-Feng, National Hualien Teachers College, Taiwan; National Taiwan Normal University, Taiwan; Institute for Information Industry, Taiwan

A self-organizing HCMAC neural network was proposed to solve high dimensional pattern classification problems well in our previous work. However, a large amount of redundant GCMAC nodes might be constructed due to the expansion approach of complete binary tree topology. Therefore, this study presents a pruning structure of self-organizing HCMAC to solve this problem. Experimental results show the proposed pruning structure not only can largely reduce memory requirement, but also keep fast training speed and has higher pattern classification accuracy rate than the original self-organizing HCMAC does in the most testing benchmark data sets.

T033 *The Treatment of Image Boundary Effects in CMAC Networks [#1219]*
Hung-Ching Lu and Ted Tao, EE Department, Tatung University, Taiwan; EE Department, Kuang Wu Institute of Technology, Taiwan

A novel coding procedure is proposed in this paper, which makes two dimension CMAC networks learn the feature of transmitted image without boundary effects. As a result, the reconstructed image from the proposed CMAC networks will get higher PSNR. Finally, we apply CMAC networks to JPEG compression. Experimental results demonstrate the presented method can get higher PSNR at lower bit rate after reconstruction.

T034 *Integrated Structure Design for CMAC-Based Fuzzy Logic Controller [#1221]*
Hung-Ching Lu and Jui-Chi Chang, EE Department, Tatung University, Taiwan

Fuzzy logic controller (FLC) is a very effective technique for complicated control processes and easily approximates well under some ill-defined environments. However, the knowledge base that human experts build is the most important factor to the performance of the FLC. To enhance the performance of FLC, we adopt the cerebellar model arithmetic controller to reduce the error of the FLC in control application. Simulation results show that the proposed structure is better than the ill-defined FLC.

T035 *Fault Accommodation for Nonlinear Systems Using Cerebellar Model Articulation Controller [#1496]*
Chih-Min Lin, Yu-Ju Liu, Chiu-Hsiung Chen and Li-Yang Chen, Yuan-Ze University, Taiwan

This paper presents a learning approach using cerebellar-model-articulation-controller (CMAC) to accommodate faults for nonlinear dynamic systems. A robust fault accommodation scheme is derived based on Lyapunov stability theorem. Finally, the proposed fault accommodation system is applied to a jet engine compression system. Simulation results show that this method can effectively achieve the fault accommodation.

T036 *Adaptive Recurrent Cerebellar Model Articulation Controller for Unknown Dynamic Systems with Optimal Learning-Rates [#1271]*
Ya-Fu Peng, Chih-Min Lin and Wei-Laing Chin, Ching-Yun University, Taiwan; Yuan-Ze University, Taiwan

In this study, an adaptive recurrent cerebellar model articulation controller (ARCMAC) is designed for feedback control system with unknown dynamics. The proposed ARCMAC has superior capability to the conventional cerebellar model articulation controller (CMAC) in efficient learning mechanism, guaranteed system stability and dynamic response. The dynamic gradient descent method is adopted to adjust ARCMAC parameters on-line. Moreover, the variable optimal learning-rates are derived to achieve most rapid convergence of tracking error. Finally, the effectiveness of the proposed control system is verified by experimental results of linear piezoelectric ceramic motor position control system.

Plenary Poster Session: Associative memories

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T037 *Higher Order Differential Correlation Associative Memory of Sequential Patterns [#1144]*
Hiromi Miyajima, Noritaka Shigei and Yasuo Hamakawa, Kagoshima University, Japan

This paper describes some properties of storage capacity and robustness of differential correlation associative memory of sequential patterns using higher order neural networks. First, it is shown that storage capacities for k=1, 2 and 3 dimensional cases are 0.059N, 0.023C(N,2) and 0.014C(N,3) from the prediction using the transition properties, respectively, where N is the number of neurons and C(N,k) means the combination of k from N. And it is shown that higher order models are superior in the pattern selection ability to the conventional one. Further, it is shown that higher order differential correlation models have high robustness compared to the conventional correlation models.

T038 *Chaos Associative Memory Model [#1179]*
Masahiro Nakagawa, Nagaoka University of Technology, Japan

In this paper we shall propose a chaos dynamic memory model applied to the chaotic autoassociation memory. The present artificial neuron model is properly characterized in terms of a time-dependent sinusoidal activation function to involve a transient chaotic dynamics as well as the energy steepest descent strategy. It is elucidated that the present neural network has a remarkable retrieval ability beyond the conventional models with such a monotonous activation function as sigmoidal one. This advantage is found to result from the property of the analogue periodic mapping accompanied with a chaotic behaviour of the neurons as well as the symmetry of the dynamic equation.

T039 *Chaotic Associative Memory using Distributed Patterns for Image Retrieval by Shape Information [#1236]*
Satoshi Kosuge and Yuko Osana, Tokyo University of Technology, Japan

We propose a Chaotic Associative Memory using Distributed Patterns for image retrieval by Shape Information. This model is based on the Chaotic Associative Memory using Distributed Patterns that is based on the Chaotic Associative Memory which can separate superimposed patterns and the Multi Winners Self-Organizing Neural Network which has the ability to generate distributed representation patterns corresponding to input in a self-organizing manner.

T040 *Vector-Neuron Models of Associative Memory [#1329]*
Boris Kryzhanovsky, Leonid Litinskii and Andrey Mikaelian, Institute of Optical Neural Technologies RAS, Russia

We consider two models of Hopfield-like associative memory with q-valued neurons: Potts-glass neural network (PGNN) and parametrical neural network (PNN). In these models neurons can be in more than two different states. The models have the record characteristics of its storage capacity and noise immunity, and significantly exceed the Hopfield model. We present a uniform formalism allowing us to describe both PNN and PGNN. This networks inherent mechanisms, responsible for outstanding recognizing properties, are clarified.

T041 *A Morphological Auto-Associative Memory based on Dendritic Computing [#1519]*
Gerhard Ritter and Laurenţiu Iancu, University of Florida, United States

This paper presents a model of an artificial neural network whose neurons are endowed with dendritic structures and have a computational framework based on lattice algebra. Such neurons bear closer resemblance to their biological counterpart than other current artificial models. Employing a two-layer dendritic network model, we construct an auto-associative memory which is robust in the presence of random noise. Furthermore, unlike the kernel method, this memory does not require that the original patterns satisfy any conditions of morphological independence.

T042 *Influence of Parameter Deviations in An Associative Chaotic Neural Network [#1555]*
Masaharu Adachi, Tokyo Denki University, Japan

Influence of parameter deviations in an associative chaotic neural network is analyzed in this paper. The network is composed of chaotic model neurons whose parameter values have small deviations among the neurons in the network. Comparisons of the network with the parameter deviation and the network with common parameters are made in the retrieval characteristics and in the dynamical property. The network with parameter deviation among the neurons shows aperiodic associative dynamics even if the nominal values of the parameters are set to show periodic behavior. The aperiodic associative dynamics of the network with the parameter deviation can be characterized by the index for the orbital instability.

T043 *Introduction to Implicative Fuzzy Associative Memories [#1605]*
Marcos Eduardo Valle, Peter Sussner and Fernando Gomide, State University of Campinas, Brazil

Associative neural memories are models of biological phenomena that allow for the storage of pattern associations and the retrieval of the desired output pattern upon presentation of a possibly noisy or incomplete version of an input pattern. In this paper, we introduce implicative fuzzy associative memories (IFAM's), a class of associative memories models based on fuzzy set theory. An IFAM consists of a network of completely interconnected Pedrycz logic neurons whose connection weights are determined by the minimum of implications of presynaptic and postsynaptic activations. We present a series of results for autoassociative models including one pass convergence, unlimited storage capacity and tolerance with respect to eroded patterns.

T044 *Properties of a Chaotic Network Separating Memory Patterns [#1466]*
Pawel Matykiewicz, Nicholaus Copernicus University, Poland

A simple method aimed at improving the separation abilities of a chaotic neural network is presented and its memory properties investigated. Estimation of the invulnerability to the external input disturbance and the damage of weight connections are performed. Significant improvements of retrieval characteristics are reported. When weight connection are damaged, high instability of separation of the memory patterns is observed.

T045 *Forms of Adapting Patterns to Hopfield Neural Networks with Larger Number of Nodes and Higher Storage Capacity [#1693]*
Emilio Del Moral Hernandez and Clayton SIlva Oliveira, University of Sao Paulo - Polytechnic School, Brazil

This paper addresses forms of adapting patterns that have to be stored in a Hopfield neural network that contains a higher number of nodes than the dimension of such patterns we desire to store. With a brief introduction about the Hopfield network storage capacity subject, the paper presents the problem that appears when we have to adapt the length of the patterns to be stored, after a Hopfield network has its number of nodes increased. This increase in architecture size is frequently necessary in order to achieve a higher storage capacity and consequently a better recovery performance. Basically, three forms of adapting these stored patterns (and the probe vectors) are proposed.

T046 *Pattern Memory and Acquisition Based on Stability of Cellular Neural Networks [#1040]*
Zeng Zhigang and Huang De-Shuang, Institute of Intelligent Machines, China

In this paper, some sufficient conditions are obtained to guarantee that the n-dimensional cellular neural networks can have even memory patterns. And we have obtained the estimates of attracting domain of such stable memory patterns. Those conditions directly derived from the parameters of the neural networks, are very easy to verified. A new design algorithm for cellular neural networks is developed based on stability theory (not base on the well-known perceptron training algorithm), and the convergence of the design algorithm is guaranteed by some stability Theorems. The results presented in this paper are new. Finally, the validity and performance of the results are illustrated by simulation results.

Plenary Poster Session: Learning and generalization

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T047 *Second-Order Generalization [#1004]*
Richard Neville, Department of Computation, UMIST, United Kingdom

Second-order generalization is usually of a more abstract nature than standard generalization, as unseen stimuli may be classified by some higher order rule. The research presents a new theory which utilises information inheritance in order to perform second-order generalization.

T048 *Searching for Linearly Separable Subsets using the Class of Linear Separability Method [#1008]*
David Elizondo, De Montfort University, United Kingdom

In a non linearly separable two-class classification problem, a subset of one or more points, belonging to one of the two classes, which is linearly separable from the rest of the points (the two classes combined), can always be found. This is the basis for constructing RDP neural networks. In this case, the subsets of maximum cardinality are of special interest as they minimise the size of the topology. An exhaustive strategy is normally used for finding these subsets. This paper shows how the class of linear separability method, for testing linear separability, can be used for finding these subsets more directly and efficiently.

T049 *The Application of OBE to Neural Networks [#1153]*
Yan Jiang, Qing He, Tiaosheng Tong and Werner Dilger, Hunan University, China; Zhejiang University, China; Chemnitz University, Germany

In 1989, Singhal and Wu showed that training a feed forward neural network can be viewed as an identification problem for a nonlinear dynamic system using Extended Kalman filter algorithm, which can converge in few iterations. In this paper, a new type of Optimal Bounding Ellipsoid (OBE) algorithm is presented, which is a set-membership identification algorithm based on set theory, and it is shown how it can be used for training feed-forward Neural Networks. The algorithm is compared with Back-Propagation (BP) and Extended Kalman Filter (EKF) algorithms and simulation results are presented.

T050 *On Learning a Function of Perceptrons [#1165]*
Martin Anthony, London School of Economics, United Kingdom

This paper concerns the generalization accuracy when training a classifier that is a fixed Boolean function of the outputs of a number of perceptrons. The analysis involves the `margins' achieved by the constituent perceptrons on the training data. A special case is that in which the fixed Boolean function is the majority function (where we have a `committee of perceptrons'). Recent work of Auer et al. studied the computational properties of such networks (where they were called `parallel perceptrons'), proposed an incremental learning algorithm for them. The The results given here provide further motivation for the use of this learning rule.

T051 *On a Generalization Complexity Measure for Boolean Functions [#1195]*
Leonardo Franco and Martin Anthony, University of Oxford, United Kingdom; London School of Economics, United Kingdom

We analyze Boolean functions using a recently proposed measure of their complexity. This complexity measure, motivated by the aim of relating the complexity of the functions with the generalization ability that can be obtained when the functions are implemented in feed-forward neural networks, is the sum of two components. The first of these is related to the `average sensitivity' of the function and the second is, in a sense, a measure of the `randomness' or lack of structure of the function. In this paper, we investigate the importance of using the second term in the complexity measure. We also explore the existence of very complex Boolean functions, considering, in particular, the symmetric Boolean functions.

T052 *Softprop: Softmax Neural Network Backpropagation Learning [#1218]*
Michael Rimer and Tony Martinez, Brigham Young University Computer Science Dept., United States; Brigham Young University, United States

Multi-layer backpropagation, like many learning algorithms that can create complex decision surfaces, is prone to overfitting. Softprop is a novel learning approach presented here that is reminiscent of the softmax explore- exploit Q-learning search heuristic. It fits the problem while delaying settling into error minima to achieve better generalization and more robust learning. This is accomplished by blending standard SSE optimization with lazy training, a new objective function well suited to learning classification tasks, to form a more stable learning model. Over several machine learning data sets, softprop reduces classification error by 17.1 percent and the variance in results by 38.6 percent over standard SSE minimization.

T053 *Extreme Learning Machine: A New Learning Scheme of Feedforward Neural Networks [#12T0]*
Guang-Bin Huang, Qin-Yu Zhu and Chee-Kheong Siew, Nanyang Technological University, Singapore

It is clear that the learning speed of feedforward neural networks is generally very slow and it has been a major bottleneck in applications for past decades. Unlike traditional implementations, this paper proposes a new learning algorithm called extreme learning machine (ELM) for single-hidden layer feedforward networks (SLFNs). In theory, this algorithm tends to provide the best generalization performance at extremely fast learning speed. The experimental results show that the new algorithm can produce best generalization performance in most cases and can learn thousands of times faster than traditional popular learning algorithms for feedforward neural networks.

T054 *Multiple-Start Directed Search for Improved NN Solution [#1336]*
Lee Feldkamp, Danil Prokhorov and Charles Eagen, Ford Research and Advanced Engineering, United States

We propose a new technique to improve the confidence in results of repeated neural network training runs under the practical constraint of a fixed computational budget. Our technique is applicable to problems for which there is a correlation between results early in the training process and results near the end of training. Targeting well-studied training problems, the technique may be most valuable when the computational time required for thorough training makes impractical performing a large number of differently initialized training sessions.

T055 *Over-fitting behavior of Gaussian unit under Gaussian noise [#1450]*
Katsuyuki Hagiwara and Kenji Fukumizu, Faculty of Education, Mie University, Japan; Institute of Statistical Mathematics, Japan

In the training of neural networks and radial basis function networks under noisy environment, it is important to know how the network over-fits to the noise in the given data since it directly related to the model selection and regularization problem. In this article, we firstly derived a probabilistic upper bound for the degree of over-fitting. By applying this result, we considered the over-fitting behavior of a Gaussian unit when trained under Gaussian noise and we showed that the probability that the extremely small value is obtained for the width parameter of the Gaussian unit in training under Gaussian noise goes to one as the number of samples goes to infinity.

T056 *Multi-Layer Perceptron Learning in the Domain of Attributed Graphs [#1408]*
Brijnesh Jain and Fritz Wysotzki, Technical University of Berlin, Germany

We propose a multi-layer perceptron for learning on data represented in terms of attributed graphs. The approach is based on the idea to associate each simple

perceptron with an attributed weight graph and to provide a concept similar to the inner product of vectors in the domain of graphs. This is achieved by the Schur-Hadamard inner product of graphs. To provide a supervised learning mechanism we customize the feed-forward pass, the error-backpropagation algorithm, and the error correcting rule. In first experiments the proposed algorithm is successfully applied to function regression and classification tasks. The results show better performance than support vector and nearest neighbor classifiers.

T057 *Model Selection Methods in Multilayer Perceptrons [#1088]*

Elisa Guerrero, Pedro Galindo, Joaquin Pizarro and Andres Yanez, Cadiz University, Spain

Despite the huge amount of model selection theory for linear systems and the importance of neural networks in applied work, there is still little published work about the assessment on which model selection method works best for nonlinear systems such as Multilayer Perceptrons. Crossvalidation can be applied to linear as well as nonlinear systems, while algebraic model selection criteria are more attractive from the computational perspective, but they should take into account linear or nonlinear learning systems as well as whether regularization is used. In this paper we determine relative performance by comparing the novel NNDIC against well-known criteria such as GPE and NIC and the nonlinear crossvalidation method

T058 *A Study of Removing Hidden Neurons in Cascade-Correlation Neural Networks [#1072]*

Xun Liang and Long Ma, Peking University, China

In this paper, the techniques of removing hidden neurons in cascade- correlation neural networks are studied. The removing processes are based on the orthogonal projection and the crosswise propagation (CP) method. They avoid randomly deleting hidden neurons. Examples are given.

T059 *An Alternative Approach to Solve Convergence Problems in the Backpropagation Algorithm [#1756]*

Alessandro Goedtel, Ivan Nunes da Silva and Paulo Serni, State University of Sao Paulo, Brazil

The multilayer perceptron network has become one of the most used in the solution of a wide variety of problems. The training process is based on the supervised method where the inputs are presented to the neural network and the output is compared with a desired value. However, the algorithm presents convergence problems when the desired output of the network has small slope in the discrete time samples or the output is a quasi-constant value. The proposal of this paper is presenting an alternative approach to solve this convergence problem with a pre-conditioning method of the desired output data set before the training process and a post-conditioning when the generalization results are obtained.

T060 *Approximation of Interval Models by Neural Networks [#1085]*

Xifan Yao, Shengda Wang and Shaoqiang Dong, South China University of Technology, China; University of Massachusetts, United States

An approach to approximate interval models by neural networks is proposed. The networks are structured according to the corresponding interval models, which makes them different from the existing interval backpropagation networks. The approach can incorporate analytical knowledge as well as expert's knowledge in the network and can provide transparency to the network. Furthermore, since the networks are linear, they are guaranteed to converge to the minimum. The proposed approach is applied to static interval systems as well as dynamic interval systems. Simulation results indicate that these relative simple interval networks achieve good approximation.

T061 *Deterministic Weight Modification Algorithm for Efficient Learning [#1116]*

S. C. Ng, C. C. Cheung and S. H. Leung, The Open University of Hong Kong, Hong Kong; The Chinese University of Hong Kong, Hong Kong; City University of Hong Kong, Hong Kong

This paper presents a new approach using deterministic weight modification (DWM) to speed up the convergence rate effectively and improve the global convergence capability of the standard and modified back-propagation (BP) algorithms. The main idea of DWM is to reduce the system error by changing the weights of a multi-layered feed-forward neural network in a deterministic way. Simulation results show that the performance of DWM is better than BP and other modified BP algorithms for a number of learning problems.

T062 *Multi-Branch Structure and its Localized Property in Layered Neural Networks [#1175]*

Takashi Yamashita, Kotaro Hirasawa and Jinglu Hu, Waseda University, Japan

Neural networks (NNs) can solve only a simple problem if the network size is too compact, on the other hand, if the network size increases, it costs a lot in terms of calculation time. So, we have studied how to construct the network structure with high performances and low costs in space and time. A solution is a multi-branch structure. Conventional NNs uses the single-branch for the connections, while the multi-branch structure has multi-branches between the nodes. In this paper, a new method which enable the multi-branch NNs to have localized property is proposed. By using the multi-branch structure having localized property, NNs could obtain high performances keeping the lower costs in space and time.

T063 *A Study on the Simple Penalty Term to the Error Function from the Viewpoint of Fault Tolerant Training [#1285]*

Haruhiko Takase, Hidehiko Kita and Terumine Hayashi, Mie university, Japan

We discussed training algorithms for multi-layer neural networks to enhance fault tolerance of the trained networks. In our previous paper, we proposed adding a simple penalty term to the error function for BP algorithm. The penalty term is a simple polynomial (sum of n-th power of weights). It is also introduced for another purpose (structural training). In this paper, we discuss about the effect of the term, especially the effect of its exponent. Through some experiments and discussions, we conclude that the change of the parameter n brings drastic change of its effect. For small n, the training works as the structural training. For great n, the training enhances the fault tolerance of trained networks.

T064 *Threshold-based Multi-thread EM Algorithm [#1469]*

Tetsuro Kawai and Ryohei Nakano, Nagoya Institute of Technology, Japan

The EM is an efficient algorithm for ML estimate but has the local optimality problem. The deterministic annealing EM (DAEM) was once proposed to solve the problem but the global optimality is not guaranteed due to a single-token search. Then a multi-token search was incorporated with better solution quality and quite heavy computing cost. This paper proposes a new variant of EM (epsilon-EM) by incorporating a multi-token search together with threshold- based bifurcation. Our experiments using Gaussian mixture showed that the epsilon-EM finds excellent solutions with small computing cost and the threshold epsilon plays a key role in reducing computing cost.

T065 *Incremental Learning from Unbalanced Data [#1592]*

Michael Muhlbaier, Apostolos Topalis and Robi Polikar, Rowan University, United States

An ensemble based algorithm, Learn++.MT2, is introduced as an alternative to our previously reported incremental learning algorithm, Learn++. Both algorithms are capable of learning novel information from new datasets that consecutively become available, without requiring access to the previously seen data. In this contribution, we describe Learn++.MT2 which specifically targets learning from unbalanced data, where the amount of data that become available varies from one database to the next. The problem of unbalanced data within the context of incremental learning is discussed first, followed by a description of the proposed solution. Initial results indicate considerable improvement on the performance and the stability of the algorithm.

T066 *Parallel Tangent Methods with Variable Stepsize [#1617]*

Yannis Petalas and Michael Vrahatis, University of Patras, Greece

The most widely used algorithm for training Multilayer Feedforward Neural networks is Backpropagation. Since its appearance various modifications have been created

to improve its efficiency. One such algorithm which uses an adaptive learning rate is backpropagation with variable stepsize. Parallel Tangent methods are used in global optimization to modify and improve the simple gradient descent algorithm by using from time to time the difference between the current point and the point before two steps as a search direction, instead of using the gradient. In his study, we investigate the combination of the BPVS method with the Parallel Tangent approach for neural network training. We perform experimental results on well--known test problems.

T067 *Nonextensive Entropy and Regularization for Adaptive Learning [#1615]*

Aristoklis Anastasiadis and George Magoulas, Birkbeck College,University of London, United Kingdom

This paper builds on the theory of nonextensive statistical mechanics to develop a new adaptive gradient--based learning scheme that applies a sign-- based weight adjustment, inspired from the Rprop algorithm, on a perturbed version of the original error function. The perturbations are characterized by the q entropic index of the nonextensive entropy, and their impact is controlled by means of regularization. This approach modifies the error landscape at each iteration allowing the algorithm to explore previously unavailable regions of the error surface, and possibly escape undesired local minima. The performance of the adaptive scheme is empirically evaluated using problems from the UCI Repository and other classic benchmarks.

T068 *An On-line Learning Neuro-Fuzzy System based on Artificial Immune Systems [#11T0]*

Mu-Chun Su, Yuan-Shao Yang, Chien-Hsing Chou, Eugene Lai and Min-Nan Hsiao, National Central University, Taiwan; Academic Sinica, Taiwan; Tamkang University, Taiwan

This paper presents a new approach to an on-line learning neuro-fuzzy system based on artificial immune systems. Via the proposed on-line learning algorithm, a neuro-fuzzy system can be incrementally constructed. Several data sets were tested to illustrate the effectiveness of the proposed on-line learning neuro-fuzzy system.

Plenary Poster Session: Reinforcement learning

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T069 *Two Stochastic Dynamic Programming Problems by Model-Free Actor-Critic Recurrent Network Learning in Non-Markovian Settings [#1049]*

Eiji Mizutani and Stuart Dreyfus, Computer Science Dept., Tsing Hua University, Taiwan; IEOR Dept., UC. Berkeley, United States

We describe two stochastic non-Markovian dynamic programming (DP) problems, showing how the posed problems can be attacked by using model-free actor-critic reinforcement learning with recurrent neural networks (RNN). In particular, we assume that the current state of a dynamical system is completely observable, but that the rules, unknown to our agent, for the current reward and state transition depend not only on current state and action, but on possibly the entire history of past states and actions. This should not be confused with problems of partially observable Markov decision processes (POMDPs), where the current state is only deduced from either partial (observable) state alone or error-corrupted observations.

T070 *Reinforcement Learning in Multiresolution Object Recognition (special session Sb) [#1083]*

Khan Iftekharuddin and Taufiq Widjanarko, The University of Memphis, United States

We propose an adaptive Automatic Target Recognition (ATR) technique that exploits reinforcement learning (RL) for mulitiresolution object recognition. The RL structure is the implementation of neuro-dynamic programming for the critic and action networks. The critic network calculates the cost-to-go function J* based on a simplistic ATR plant that involves multiresoluton images as the input state variable. The calculation of J* includes the role of the reinforcement signal in the critic network. Output of this critic stage is fed back to update the weights of both action and critic networks respectively. Our simulation results suggest that RL may be successfully integrated into an adaptive multiresolution ATR framework.

T071 *Model-free off-policy reinforcement learning in continuous environment [#1189]*

Pawel Wawrzynski and Andrzej Pacut, Warsaw University of Technology, Poland

We introduce an algorithm of reinforcement learning in continuous state and action spaces. In order to construct a control policy, the algorithm utilizes the entire history of agent-environment interaction. The policy is a result of an estimation process based on all available information rather than result of stochastic convergence as in classical reinforcement learning approaches. The policy is derived from the history directly, not through a model of the environment. We test our algorithm in the Cart-Pole Swing-Up simulated environment. The algorithm learns to control this plant in about 100 trials, which corresponds to 15 minutes of plant's real time. This time is several times shorter than the one required by other algorithms.

T072 *Asymmetric Multiagent Reinforcement Learning in Pricing Applications [#1274]*

Ville Kononen and Erkki Oja, Helsinki University of Technology, Finland

Two pricing problems are solved by using asymmetric multiagent reinforcement learning methods in this paper. In the first problem, the flat pricing scenario, there are two competing brokers that sell identical products to customers and compete on the basis of price. The second problem is a hierarchical pricing scenario where a supplier sells products to two competing brokers. In both cases, the methods converged and led to very promising results. We present a brief literature survey of pricing models based on reinforcement learning, introduce the basic concepts of Markov games and solve two pricing problems based on multiagent reinforcement learning.

T073 *Forecasting Series-based Stock Price Data using Direct Reinforcement Learning [#1335]*

Hailin Li, Cihan Dagli and David Enke, University of Missouri-Rolla, United States

A significant amount of work has been done in the area of price series forecasting, most of which are base upon supervised learning. Unfortunately, there has been evidence that such models suffer from fundamental drawbacks. Given that the short-term performance of the financial forecasting architecture can be immediately measured, it is possible to integrate reinforcement learning into such application. We present the novel hybrid view for a financial series and critic adaptation stock price forecasting architecture using direct reinforcement. A new utility function called policies-matching ratio is also proposed. The empirical results using real financial data illustrate the effectiveness of such a learning framework.

T074 *A reinforcement learning scheme for acquisition of via-point representation of human motion [#1396]*

Yasuhiro Wada and Kei-ichi Sumita, Nagaoka University of Technology, Japan

Humans can generate a complex trajectory by imitative learning of others' movement. A method for learning complex sequential movements, but utilizing a via-point representation is proposed. However, the proposed algorithm for estimating a set of via-points from the complex movement does not involve a learning process such as a learning by trial and error. In this paper, we report an acquisition algorithm for via-point representation through trial and error in a human-like manner. The proposed via-point acquisition algorithm based on reinforcement learning finds a set of via-points that can mimic the reference trajectory by iterative learning using evaluation values of generated movement pattern.

T075 *State Space Construction of Reinforcement Learning Agents Based upon Anticipated Sensory Changes [#1419]*
Hisashi Handa, Okayama University, Japan

In this paper, we propose a new incremental state construction method which consists of Fritzke's Growing Neural Gas algorithm and a Class Management Mechanism of GNG units. The GNG condenses sensory inputs and learns which area is frequently sensed. On the other hand, the CMM yields a new state based upon agent's anticipated behaviors, namely, a couple of agent's action and the resultant change of sensory inputs. Computational simulations on mountain-car task confirm us the effectiveness of the proposed method.

T076 *Incremental Policy Learning: An Equilibrium Selection Algorithm for Reinforcement Learning Agents with Common Interests [#1652]*
Nancy Fulda and Dan Ventura, Brigham Young University, United States

We present an equilibrium selection algorithm for reinforcement learning agents that incrementally adjusts the probability of executing each action based on the desirability of the outcome obtained in the last time step. The algorithm assumes that at least one coordination equilibrium exists and requires that the agents have a heuristic for determining whether or not the equilibrium was obtained. In deterministic environments with one or more strict coordination equilibria, the algorithm will learn to play an optimal equilibrium as long as the heuristic is accurate.

T077 *Overcoming Communication Restrictions in Collectives [#1379]*
Kagan Tumer and Adrian Agogino, NASA Ames Research Center, United States; University of California, Santa Cruz, United States

The performance of distributed systems generally depend on the actions and interactions of a large number of independent components (e.g., agents, neurons). Such ``collectives'' are often subject to communication restrictions, making it difficult for the components to coordinate their actions to provide good system level performance. In this article we address that coordination problem and derive four agent utility functions that make different tradeoffs between alignedness between agent and system utilities and the signal-to-noise each agent encounters. The results show that these utility functions outperform both traditional methods and previous collective-based methods by up to 75 percent in systems with communication restrictions.

T078 *Response Knowledge Learning of Autonomous Agent [#1432]*
Chi-kin Chow and Hung-Tat Tsui, The Chinese University of Hong Kong, Hong Kong

In robot applications, the performance of a robot agent is measured by the quantity of award received from its response. Many literatures [1-5] define the response as either a state diagram or a neural network. Due to the absence of a desired response, neither of them is applicable to an unstructural environment. In this paper, a novel Response Knowledge Learning algorithm is proposed to handle this domain. By using a set of experiences, the algorithm can extract the contributed experiences to construct the response function. Two sets of environments are provided to illustrate the performance of the proposed algorithm. The results show that it can effectively construct the response function that receives an nearly maximum award.

Plenary Poster Session: Ensemble methods

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T079 *Online Learning Theory of Ensemble Learning Using Linear Perceptrons [#1111]*
Kazuyuki Hara and Masato Okada, Tokyo Metropolitan College of Technology, Japan; Riken, Japan

Within the framework of on-line learning, we study the generalization error of an ensemble learning machine learning from a linear teacher perceptron. The generalization error achieved by an ensemble of linear perceptrons having homogeneous initial weight vectors is precisely calculated at the thermodynamic limit of a large number of input elements and shows rich behavior. Our main findings are as follows. The generalization error using an infinite number of linear student perceptrons is equal to only half that of a single linear perceptron, and converges with that of the infinite case with O(1/K) for a finite number of K linear perceptrons.

T080 *Hyperspectral Image Classification by Ensembles of Multilayer Feedforward Networks [#1130]*
Mercedes Fernandez-Redondo, Carlos Hernandez-Espinosa and Joaquin Torres-Sospedra, Universidad Jaume I, Spain

A hyperspectral image is used in remote sensing to identify different type of coverts on the Earth surface. Neural networks and ensemble techniques have been applied to remote sensing images with a low number of spectral bands per pixel. In this paper we apply different ensemble methods of Multilayer Feedforward networks to images of 224 spectral bands per pixel, where the classification problem is clearly different. We conclude that in general there is an improvement by the use of an ensemble. For databases with a high number of classes and pixels the improvement depends strongly on the ensemble method. We also present results of classification of support vector machines.

T081 *Analysis of Ensemble Learning using Simple Perceptrons based on Online Learning Theory [#1237]*
Seiji Miyoshi, Kazuyuki Hara and Masato Okada, Kobe City College of Technology, Japan; Tokyo Metropolitan College of Technology, Japan; Riken, Japan

Ensemble learning of K nonlinear perceptrons, which determine their outputs by sign functions, is discussed within the framework of online learning and statistical mechanics. This paper shows that ensemble generalization error can be calculated by using two order parameters, that is, the similarity between a teacher and a student, and the similarity among students. The differential equations that describe the dynamical behaviors of these parameters are derived analytically in the cases of Hebbian, perceptron and AdaTron learning. These three rules show different characteristics in their affinity for ensemble learning, that is ``maintaining variety among students.'' Results show that AdaTron learning is superior to the other two rules.

T082 *Sharing Training Patterns in Neural Network Ensembles [#1750]*
Rozita Dara and Mohamed Kamel, University of Waterloo, Canada

The need for the design of complex training algorithms in neural network ensembles has motivated us to study combining methods from cooperation perspective. One way of achieving effective cooperation is through sharing. The degree by which multiple classifier systems share training resources can be a measure of cooperation. Despite the growing number of interests in data modification techniques, there is no guidance whether sharing or not sharing training patterns results in higher accuracy. We implemented examined the effect of sharing training patterns by varying the size of overlap between 0- 100% of the size of training sets. Under most conditions studied, multinet systems showed improvement over presence of larger overlapped sets.

T083 *AdaBoost.RT: a Boosting Algorithm for Regression Problems [#1198]*

Dimitri Solomatine and Durga Lal Shrestha, UNESCO-IHE Institute for Water Education, Netherlands

A boosting algorithm, AdaBoost.RT for regression problems is proposed. Its idea is in filtering out the examples with the relative estimation error that is higher than the pre-set threshold value, and then following the AdaBoost procedure. Thus it requires to select the sub-optimal value of relative error threshold to demarcate predictions from the predictor as correct or incorrect. Some experimental results using M5 model tree as a weak learning machine for benchmark data sets and for hydrological modeling are reported, and compared to other boosting methods, bagging and Artificial Neural Networks, and to a single M5 model tree. AdaBoost.RT is proved to perform better on most of the considered data sets.

T084 *Design of Experiments by Committee of Neural Networks [#1357]*

Nicolas Gilardi and Abdelaziz Faraj, French Institute of Petroleum, France

In this paper, we present a way of constructing Design of Experiments for neural networks models such as Multi-Layer Perceptron (MLP). We are trying to solve the problem of modeling a phenomenon with a minimum of measurements and almost no a priori knowledge. Our method is based on Query By Committee (QBC) which compares the predictions of various models on unsampled locations in order to select the most informative. We compare it to a random selection of samples. Results shows that the QBC approach is moderately improving prediction compared to a random sampling. However, for the same performances, the QBC design is significantly smaller than the random one.

T085 *Semi-optimal Hierarchical Regression Models and ANNs [#1197]*

Dimitri Solomatine and Michael Siek, UNESCO-IHE Institute for Water Education, Netherlands

A hierarchical modular model is comprised of a set of specialized models (committee machine) that are constructed in hierarchical (tree) fashion and each of which is responsible for a particular region of input space. Many algorithms in this class, for example M5 model tree, are greedy and hence far from being optimal. An algorithmic framework leading to building more accurate optimal and semi-optimal trees is proposed. Its particular implementation for regression problems, M5opt algorithm, constructs model trees that are more accurate than those obtained by the greedy approach of M5 and in a number of cases more accurate than ANNs.

Plenary Poster Session: Bioinformatics

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T086 *Aligning Multiple Protein Sequence by An Improved Genetic Algorithm [#1044]*

Guangzheng Zhang and De-Shuang Huang, University of Science and Technology of China, China; Hefei Institute of Intelligent Machines, CAS, China

Genetic Algorithm (GA) is one of important and successful approaches in Multiple Sequences Alignment (MSA) problem. In this paper, we propose an improved GA methods, Multiple Small-Popsize Initialization Strategy (MSPIS) and Hybrid One-Point Crossover Scheme (HOPCS) based GA, which can search the solution space in a very efficient manner. The experimental results show that our improved approach can obtain a better result compared with traditional GA approach in aligning multiple protein sequences problem.

T087 *Representation of DNA Sequences with Multiple Resolutions and BP Neural Network Based Classification [#1045]*

Xin Huang, De-Shuang Huang, HongQiang Wang and Xing-Ming Zhao, Hefei Institute of Intelligent Machines, CAS, China; University of Science and Technology of China, China

In this paper we propose a new representation of DNA sequences,which constructs the word frequency vector with multiple resolutions based on the chaos game representation.Compared with traditional vector,it combines a range of resolutions and reserves higher resolutions but the dimension is reduced greatly relatively.The algorithm is detailed,which calculates coding format and codes each sequence.To evaluate the significance of our method,we represent Alu sequences by our proposed coding format.After that the acquired vectors are used to train BP neural networks to recognize the Alu sequences.The experimental results show that this representation of DNA sequences is significant and efficient in biological data processing.

T088 *Modelling Gene Expression Time-Series with Radial Basis Function Neural Networks [#1307]*

Carla S. Moller-Levet, Hujun Yin, Kwang-Hyun Cho and Olaf Wolkenhauer, Univ. of Manchester Inst. of Sci. and Tech., United Kingdom; University of Ulsan, Korea (South); University of Rostock, Germany

Gene expression time-series are discrete, noisy, short and usually unevenly sampled. Most existing methods used to compare expression profiles operate directly on the time points. While modelling the profiles can lead to more generalised, smooth characterisation of gene expressions. In this paper a Radial Basis Function neural network is employed to model gene expression time-series. The Orthogonal Least Square method, used for selection of centres, is further combined with a width optimisation scheme. The experiments on a number of expression datasets have shown the advantages of the approach in terms of generalisation and approximation. The results on known datasets have indeed coincided with biological interpretations.

T089 *Inductive vs Transductive Inference, Global vs Local Models: SVM, TSVM, and SVMT for Gene Expression Classification Problems [#1382]*

Pang Shaoning and Kasabov Nikola, Auckland University of Technology, New Zealand

This paper compares inductive-, versus transductive modeling, and also global-, versus local models with the use of SVM for gene expression classification problems. SVM are used in their three variants - inductive SVM, transductive SVM (TSVM), and SVM tree (SVMT) - the last two techniques being recently introduced by the authors. The problem of gene expression classification is used for illustration and four benchmark data sets are used to compare the different SVM methods. The TSVM outperforms the inductive SVM models applied on a small to medium variable (gene) set and a small to medium sample set, while SVMT is superior when the problem is defined with a large data set, or - a large set of variables.

T090 *Computational Neurogenetic Modelling: Gene Networks within Neural Networks [#1384]*

Nikola Kasabov, Lubica Benuskova and Simei Wysoski, KEDRI, Auckland University of Technology, New Zealand

The paper introduces a novel connectionist approach to neural network modelling that integrates dynamic gene networks within neurons with a neural network model. A generic computational neurogenetic model is introduced that implements this approach. It is illustrated by means of a simple neurogenetic model of a spiking neural network (SNN). Functioning of the SNN can be evaluated for instance by the field potentials, thus making it possible to attempt modelling the role of genes in different brain states such as epilepsy, schizophrenia, and other states, where EEG data is available to test the model predictions.

T091 *On Generalization of Multilayer Neural Network Applied to Predicting Protein Secondary Structure [#1656]*
Kenji Nakayama, Akihiro Hirano and Ken-ichi Fukumura, Kanazawa Univ, Japan

A learning process of a single neural network (SNN) to improve prediction accuracy of protein secondary structure is optimized. A multi-modal neural network (MNN) has been proposed to improve the precision of prediction. This method uses five independent neural networks. In the proposed method, the same prediction accuracy can be achieved by using only a single NN and optimizing a learning process. The learning process is optimized so as to avoid the over learning. For this purpose, small learning rates, adding small random noise to the input data, and updating the connection weights by the average in some group are useful. The prediction accuracy 58 percent obtained by using the conventional SNN is improved to 66 percent.

T092 *Inference of Genetic Regulatory Networks from Time Series Gene Expression Data [#1765]*
Rui Xu, Xiao Hu and Donald Wunsch, University of Missouri - Rolla, United States; University of Missouri-Rolla, United States

Large-scale gene expression data coming from microarray experiments provide us a new means to reveal fundamental cellular processes, investigate functions of genes, and understand relations and interactions among them. To infer genetic regulatory networks from these data with effective computational tools has become increasingly important. Several mathematical models, including Boolean networks, Bayesian networks, linear additive model, and recurrent neural networks, have been used to explore the behaviors of regulatory networks. In this paper, we survey these methods in the inference of genetic regulatory networks from time series gene expression data.

T093 *Comparison of Self-Organizing Map with K-means Hierarchical Clustering for Bioinformatics Applications [#1634]*
Somnath Shahapurkar and Malur Sundareshan, Intel Corporation, United States; University of Arizona, United States

The Self-Organizing Map (SOM) has emerged as one of the popular choices for clustering data; however, when it comes to point density accuracy of codebooks or reliability and interpretability of the map, the SOM leaves much to be desired. In this paper, we compare the newly developed K-Means Hierarchical (KMH) clustering algorithm to the SOM. We also introduce a new initialization scheme for the K-means that improves codebook placement and, propose a novel visualization scheme that combines the Principal Component Analysis (PCA) and Minimal Spanning Tree (MST) in an arrangement that ensures reliability of the visualization unlike the SOM. A practical application of the algorithm is demonstrated on a challenging Bioinformatics problem.

T094 *Generic Bi-layered Net of the 'Functional Nodes' in Process Modeling [#1717]*
Béla Csukás and Gyöngyi Bánkuti, Inst. of Math. and Inf. Tech., Univ. of Kaposvar, Hungary

There is a tendency to integrate the 'a priori' knowledge in neural networks in form of "functional nodes". This paper presents a novel method for the description of the whole process model in form of a net, consisting of two basic kinds of "functional nodes". The Generic Bi-layered Net (GBN) model provides a common framework for the simulation of the hybrid processes. The models are represented by a bi-layered net that also determines the network (ring) structures of the influence routes and of the flux routes. Artificial neural networks seem to be useful collaborating tool of the GBN in the model based problem solving. The structure of the GBN models can be homomorphic or isomorphic with the recurrent neural networks.

Plenary Poster Session: Neural control

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T095 *Modeling and Controlling Interstate Conflict [#1022]*
Tshilidzi Marwala and Monica Lagazio, University of the Witwatersrand, South Africa

Bayesian neural networks were used to model the relationship between input parameters, Democracy, Allies, Contingency, Distance, Capability, Dependency and Major Power, and the output parameter which is either peace or conflict. The automatic relevance determination was used to rank the importance of input variables. Control theory approach was used to identify input variables that would give a peaceful outcome. It was found that using all four controllable variables Democracy, Allies, Capability and Dependency; or using only Dependency or only Capabilities avoids all the predicted conflicts.

T096 *Supervisory Enhanced Genetic Algorithm Control for Indirect Field-Oriented Induction Motor Drive [#1168]*
Rong-Jong Wai Wai, Jeng-Dao Lee and Kuo-Ho Su, Dept. Electrical Engineering, Yuan Ze University, Taiwan; Dept. Electrical Engineering, Tatung University, Taiwan

A supervisory enhanced genetic algorithm control (SEGAC) system is proposed for an indirect field-oriented induction motor (IM) drive to track periodic commands. The proposed control scheme comprises an enhanced genetic algorithm control (EGAC) and a supervisory control. In the EGAC design, the spirit of gradient descent training is embedded in genetic algorithm (GA) to construct the major controller for searching optimum control effort under the possible occurrence of uncertainties. To stabilize the system states around a defined bound region, a supervisory controller, which is derived in the sense of Lyapunov stability theorem, is designed within the EGAC. The effectiveness is verified by simulation and experimentation.

T097 *Neural Network Control for Leg Rhythmic Movements via Functional Electrical Stimulation [#1170]*
Dingguo Zhang and Kuanyi Zhu, Nanyang Technological University, Singapore

A neural network control system is developed to control the leg rhythmic movements with Functional Electrical Stimulation (FES). The neural network contains two parts. One part is the neural oscillator. It derives from the center pattern generator of biological nervous system and generates the rhythmic pattern for the leg movements. Another part of the neural network is a radial basis function (RBF) artificial neural network, which maps the signals from the neural oscillator to regulate the FES stimulator, then the stimulator generates electrical pulse to stimulate the muscles. A computer model of leg is developed in this paper. Satisfactory simulation results indicate feasible clinical application for the paralyzed patients in future.

T098 *Comparative Analysis of Neural Predictive Controllers and Its Application to a Laboratory Tank System [#1T04]*
Martin Alayon, Doris Saez and Ricardo Veiga, Universidad de Buenos Aires, Argentina; Universidad de Chile, Chile

In this paper, a novel control strategy based on neural networks is proposed in order to reduce the computation effort of a nonlinear predictive controller. The proposed method is favorably compared with the nonlinear predictive controller and approximated predictive controller based on neural networks. Also, the control strategies are designed and evaluated by simulation tests and in real-time for a laboratory tank system.

T099 *Observer-Based Adaptive Neural Control for Nonlinear Systems [#1231]*
Shaocheng Tong and Yan Shi, Liaoning Institute of Technology, China; Kyushu Tokai University, Japan

Based on the Lyapunov synthesis approach, many adaptive neural control schemes have been developed during the last few years. So far, most of these schemes have been applied to the classes of uncertain systems whose state variables are assumed to be measurable. This paper develops an adaptive neural control approach that relaxes the restrictive assumption that is usually made by designing a state observer. The overall adaptive neural control scheme is shown to guarantee the stability of the closed-loop system and obtain good tracking performance as well.

T100 *A Direct Adaptive Neural Control for MIMO Nonlinear Systems with Output Delays [#1385]*
Wen-Shyong Yu, Tatung Univserity, Taiwan

In this paper, an algorithm using an artificial neural network (ANN)-based direct adaptive control algorithm is presented for multi-input multi-output (MIMO) nonlinear systems with unknown output delays. This algorithm contains two parameter estimations, one for estimating unknown plant delays and the other for unknown control parameters. If the number of center frequency is enough, the predicted output signal can approximate the true delayed output, especially for large output delays. It is shown that the proposed algorithm not only can guarantee control parameter estimation convergence but can achieve the tracking purposes. Simulation studies are presented to validate the theoretical findings.

T101 *Neural-Network-based Approximate Predictive Control for the Start-up of a Steam Generator [#1607]*
Dionisio Suarez-Cerda, Instituto de Investigaciones Electricas, Mexico

This paper presents a neural-network-based approximate predictive control scheme, which has demonstrated via simulations the feasibility of its application as a supervisory scheme for the steam generator startup process at a fossil electric power plant. Appropriate methodology is offered to carry out the implementation of this scheme. It includes the modelling of the process to be controlled using experimental data, the predictive control algorithm, the design of a state observer, as well as the linearization process of a dynamic nonlinear model based on a MLP network.

T102 *Dynamics of Oscillator Network and Its Application to Offset Control of Traffic Signals [#1655]*
Ikuko Nishikawa, Ritsumeikan University, Japan

Dynamics of a coupled system of oscillator neurons is used for an area-wide signal control of an urban traffic network. Each signal is modeled by a simple phase oscillator, and a pair-wise interaction between the adjacent neurons leads to an entrainment with a phase difference which corresponds to a signal offset. Therefore, each interaction is designed to attain a desired offset. In the paper, the method is applied to a various traffic condition including a one-way road, left or right turn traffic at an intersection etc. The results of computer simulations on several traffic flow patterns and conditions show the effective control by the statistics such as an average travel time.

T103 *Addressing to Online Adaptive Controller Malfunction in Fault Tolerant Control [#1764]*
Pedro deLima and Gary Yen, Oklahoma State University, United States

A complete Fault Tolerant Control solution calls for a nonlinear adaptive controller with universal approximation capability and guaranteed stability. To fulfill this requirement we propose the use of Neural Networks trained online under a Globalized Dual Heuristic Programming architecture supervised by a decision logic capable of identifying controller malfunctions in early stages and providing new avenues with greater probability of convergence using information from a Dynamic Model Bank. The classification and distinction of controller malfunctions and of the faults in the system is achieved through three independent quality indexes. Proof-of-the-concept simulations of nonlinear plants demonstrate the approach legitimacy.

T104 *Stability Analysis of a DC Motor System Using Universal Learning Networks [#1025]*
Ahmed Hussein, Kotaro Hirasawa and Jinglu Hu, Kyushu University, Japan; Waseda University, Japan

Stability is one of the most important subjects in control systems. As for the stability of nonlinear dynamical systems, Lyapunov's direct method and linearized stability analysis method have been widely used. But, finding an appropriate Lyapunov function is fairly difficult especially for complex nonlinear dynamical systems. Also it is hard to obtain the locally asymptotically stable region (R_LAS) by these methods. Therefore, it is highly motivated to develop a new stability analysis method that can obtain R_LAS easily. Accordingly, in this paper a new stability analysis method based on the higher ordered derivatives (HODs) of universal learning networks (ULNs) and its application to a DC motor system are described.

T105 *Modelling of Gasoline Blending via Discrete-Time Neural Networks [#1559]*
Wen Yu, Marco Moreno and Eduardo Gomez, Cinvestav-IPN, Mexico; La Salle University, Mexico

Gasoline blending is an important operation in chemical industry. A good model for the blending process is beneficial for supervision operation, prediction of gasoline qualities and realizing model-based optimal control. Gasoline blending process includes static and dynamic properties which are corresponded to thermodynamic and the storage tank respectively. Since the blending does not follow the ideal mixing rule in practice, we propose static and dynamic neural networks to approximate the blending process. Input-to-state stability approach is applied to access new robust learning algorithms of the neural networks. Numerical simulations are provided to illustrate the neuro modeling approaches.

T106 *Projection-Based Gradient Descent Training of Radial Basis Function Networks [#1716]*
Mehmet Muezzinoglu and Jacek Zurada, University of Louisville, United States

A new Radial Basis Function (RBF) network training procedure that employs a linear projection technique along parameter search is proposed. To be applied simultaneously with the conventional center and/or weight adjustment methods, a gradient descent iteration on the width parameters of RBF units is introduced. The projection mechanism used by the procedure avoids negative width parameters and enables detection of redundant units, which can then be pruned from the network. Proposed training approach is applied to design a feedback neuro-controller for a nonlinear plant to track a desired trajectory.

Plenary Poster Session: Pattern recognition I

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T107 *A Novel Clustering-Neural Tree for Pattern Classification [#1032]*
Zhong-Qiu Zhao, De-Shuang Huang and Lin Guo, Institute of Intelligent Machines, Chinese Acade, China; Hefei Institute of Intelligent Machines, CAS, China

When performing classification of large set of samples, Neural Tree Classifiers (NTs) are preferredly used. However, the classical NTs have poor generalization properties. So, in this paper we propose a new classification method referred to as clustering-neural tree classifier, combining clustering technique with neural networks. It can be well applied to classifications of large set of samples, while having good generalization properties. The experimental results on the two spirals problem and the iris problem show that our proposed NN-tree classifier is effective and efficient.

T108 *Neural Network Based Threat Assessment for Automated Visual Surveillance [#1106]*

Tony Jan, University of Technology, Sydney, Australia, Australia

In automated visual surveillance systems (AVSS), reliable detection of suspicious human behavior is of great practical importance. Many conventional classifiers have shown to perform inadequately because of unpredictable nature of human behavior. Flexible models such as artificial neural network (ANN) models can perform better; however, computational requirement of ANN models can be prohibitively large. In this paper, modified probabilistic neural network (MPNN) is introduced that shows to achieve reliable classification, with significantly reduced computation in visual surveillance application. In this paper, trajectory profile and motion history image information from the observed human subject are used for threat assessment.

T109 *Improvement of the Reliability of Bank Note Classifier Machines [#11T1]*

Ali Ahmadi, Sigeru Omatu and Toshihisa Kosaka, Osaka Prefecture University, Japan; Glory Ltd., Japan

This paper addresses the reliability of neuro-classifiers for bank note recognition. A local principal component analysis (PCA) method is applied to remove non-linear dependencies among variables and extract the main principal features of data. By defining a new algorithm for rating the reliability and using a set of test data, we estimate the reliability of the system.

T110 *Fire Detection Systems by Compact Electronic Nose Systems Using Metal Oxide Gas Sensors [#1122]*

Bancha Charumporn, Sigeru Omatu, Michifumi Yoshioka, Toru Fujinaka and Toshihisa Kosaka, Osaka Prefecture Ubniversity, Japan; Osaka Prefecture University, Japan; Glory Ltd., Japan

Conventional fire detectors use the smoke density or the high air temperature to trigger the fire alarm. These devices lack of ability to detect the source of fire in the early stage and they always create false alarms. In this paper, a reliable electronic nose (EN) system designed from the combination of various metal oxide gas sensors (MOGS) is applied to detect the early stage of fire from various sources. The time series signals of the same source of fire in every repetition data are highly correlated and each source of fire has a unique pattern of time series data

T111 *Real-time Intelligent Pattern Recognition, Resource Management and Control under Constrained Resources for Distributed Sensor Networks [#1140]*

Ashit Talukder, Tanwir Sheikh and Lavanya Chandramouli, CHLA/Univ. of Southern California and JPL/NASA, United States; CHLA/Univ. of Southern California, United States

We propose a new machine learning architecture with integrated system control and resource management capability for use in autonomous sensing applications with limited resources. Novel neural network dimensionality reduction with a mixture-of-experts classifier ensures that only relevant information is processed while handling missing sensor data. Genetic optimisation algorithms are used to control the system in the presence of dynamic events, while ensuring that system constraints are met. This tight integration of control optimisation and machine learning algorithms results in a highly efficient intelligent sensor network. The applicability of our technology in remote health monitoring and environmental monitoring is shown.

T112 *Feature Weighting Using Neural Networks [#1166]*

Xinchuan Zeng and Tony Martinez, Brigham Young University, United States

In this work we propose a feature weighting method for classification tasks by extracting relevant information from a trained neural network. This method weights an attribute based on strengths (weights) of related links in the neural network, in which an important feature is typically connected to strong links and has more impact on the outputs. This method is applied to feature weighting for the nearest neighbor classifier and is tested on 15 real-world classification tasks. The results show that it can improve the nearest neighbor classifier on 14 of the 15 tested tasks, and also outperforms the neural network on 9 tasks.

T113 *Using Permutations Instead of Student's t Distribution for p-values in Paired-Difference Algorithm Comparisons [#1167]*

Joshua Menke and Tony Martinez, Brigham Young University CS Deptartment, United States

The paired-difference t-test is commonly used in the machine learning community to determine whether one learning algorithm is better than another on a given learning task. This paper suggests the use of the permutation test instead because it calculates the exact p-value instead of an estimate. The permutation test is also distribution free and the time complexity is trivial for the commonly used 10-fold cross-validation paired-difference test. Results of experiments on real-world problems suggest it is not uncommon to see the t-test estimate deviate up to 30-50 percent from the exact p-value.

T114 *A Feature Extraction Technique for Online Handwriting Recognition [#1489]*

Brijesh Verma, Jenny Lu, Moumita Ghosh and Rana Ghosh, Central Queensland University, Australia; University of Ballarat, Australia

The paper presents a feature extraction technique for on-line handwriting recognition. The technique incorporates many characteristics of handwritten characters based on structural, directional and zoning information and combines them to create a single global feature vector. The technique is independent to character size and it can extract features from the raw data without resizing. Using the proposed technique and a Neural Network based classifier, many experiments were conducted on UNIPEN benchmark database. The recognition rates are 98.2% for digits, 91.2% for uppercase and 91.4% for lowercase.

T115 *Fast Insect Damage Detection in Wheat Kernels Using Transmittance Images [#1644]*

Zehra Cataltepe, Tom Pearson and Enis Cetin, Siemens Corporate Research, United States; U.S. Department of Agriculture, United States; Bilkent University, Turkey

We used transmittance images and different learning algorithms to classify insect damaged and un-damaged wheat kernels. Using the histogram of the pixels of the wheat images as the feature, and the linear model as the learning algorithm, we achieved a False Positive Rate (1-specificity) of 0.12 at the True Positive Rate (sensitivity) of 0.8 and an Area Under the ROC Curve (AUC) of 0.90 +- 0.02. Combining the linear model and a Radial Basis Function Network in a committee resulted in a FP Rate of 0.09 at the TP Rate of 0.8 and an AUC of 0.93 +- 0.03.

T116 *Self-enhanced Relevant Component Analysis with Side-information and Unlabeled Data [#1248]*

Fei Wu, Yonglei Zhou and Changshui Zhang, Tsinghua University, China

Relevant component analysis (RCA) is a powerful tool for relevant linear feature extraction with side-information, a new focus in machine learning fields. But its only utilizing positive constraints weakens this algorithm's performance and robustness, especially when there are few positive constraints -- a common case in practice. To overcome this drawback, in this paper we propose an extended algorithm named self-enhanced relevant component analysis (SERCA). Through a boosting procedure in the product space, it efficiently uses both the given side-information and unlabeled data. The experimental results on several data sets show that SERCA achieves an obvious improvement compared with RCA.

T117 *Simultaneous estimation of odor classes and concentrations using an electronic nose [#1434]*

Daqi Gao, Qing Miao and Guiping Nie, East China University of Science and Technology, China

This paper sets up an electronic nose and presents a kind of combinative and modular multilayer perceptrons (MLPs). Every module is made up of multiple one- to-one MLPs as well as one many-to-one MLP, and one MLP is regarded as an expert. In electronic noses, one module is behalf of a kind of odor, and determines its strengths. The most similar module gives the class and strength of the odor. By means of enlarging the input components to the range of [0, 6.0] and transforming the standard sigmoid activation function to be f(x)=3 (1+exp(-x/3))-1, the learning speeds of MLPs are sped up. The experiment for simultaneously estimating the classes and concentrations of 4 kinds of fragrant materials shows that the proposed method is effective.

Plenary Poster Session: Datamining

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T118 *Relevance Feedback Document Retrieval using Support Vector Machines [#1104]*

Takashi Onoda, Hiroshi Murata and Seiji Yamada, Central Research Inst. of Elec. Power Industry, Japan; Central Research Inst. of Electric Power Industry, Japan; National Institute of Informatics, Japan

We investigate the following data mining problems from the document retrieval: From a large data set of documents, we need to find documents that relate to human interest as few iterations of human testing or checking as possible. Our proposed SVM based relevance feedback approach has been very useful for document retrieval experimentally. In this paper, we adopt several representations of the Vector Space Model and several selecting rules of displayed documents at each iteration, and then show the comparison results of the effectiveness for the document retrieval in these several situations.

T119 *Knowledge acquisition and revision via neural networks [#1262]*

Arnulfo Azcarraga, Ming Hsieh, Shan-Ling Pan and Rudy Setiono, De La Salle University, Philippines; Yuan Ze University, Taiwan; National University of Singapore, Singapore

We investigate how knowledge acquired by a neural network from one input environment can be revised for similar application in a new environment. Knowledge revision is achieved by re-training the network. Knowledge common to both environments are retained, while localized knowledge are introduced during network re-training. Network performance measures are computed to see how much knowledge is transferred and revised. As the knowledge can be expressed as rules, we are able to compare knowledge extracted from one network with that from another. In a cross-national study of car perceptions, a comparison of the original and revised knowledge gives us insights into the commonalities and differences in brand perceptions across countries.

T120 *Optimal Brain Surgeon Variants For Feature Selection [#1759]*

Attik Mohammed, Bougrain Laurent and Alexandre Frederic, Loria, France

This paper presents three pruning algorithms based on Optimal Brain Surgeon (OBS) and Unit-Optimal Brain Surgeon (Unit-OBS). The first variant performs a backward selection by successively removing single weights from the input variables to the hidden units in a fully connected multilayer perceptron (MLP) for variable selection. The second one removes a subset of non-significant weights in one step. The last one combines the two properties presented above. Simulation results obtained on the Monk's problem illustrate the specificities of each method described in this paper according to the preserved variables and the preserved weights.

T121 *An Input Variable Importance Definition based on Empirical Data Probability and Its Use in Variable Selection [#1752]*

Vincent Lemaire and Fabrice Clérot, France Telecom Research and Development, France

Variable and feature selection have become the focus of much research in areas of application for which datasets with tens or hundreds of thousands of variables are available. We propose a new method to score subsets of variables according to their usefulness for the performance of a given model. This method is applicable on every kind of model and on classification or regression task. We assess the efficiency of the method with our results on the NIPS 2003 feature selection challenge and with an example of a real application.

T122 *A Constructive Unsupervised Learning Algorithm for Clustering Binary Patterns [#1188]*

Di Wang, Narendra S. Chaudhari and Chandra Jagdish, Nanyang Technological University, Singapore

We propose a Constructive Unsupervised Learning Algorithm (CULA) for Boolean Neural Networks based on geometrical expansion. CULA constructs two- layered (input and output layer) neural networks. We visualize output neurons in terms of hyperspheres. CULA results in fast learning because it determines if to add a new coming vertex to a neuron by its geometrical location, not by iterant computation. We illustrate CULA by using 101 instances in zoo database of Richard Forsyth, and compare our unsupervised clustering with clustering by biological experts given in the zoo database.

T123 *MLP Networks for Classification and Prediction with Rule Extraction Mechanism [#1356]*

Paulemir Campos, Eleonora Oliveira, Teresa Ludermir and Aluizio Araujo, Federal University of Pernambuco, Brazil

This work describes the use of direct supervised MLP network with a hidden layer. Its weights are adjusted by the backpropagation algorithm. In an ANN the knowledge is represented by your topology and weight values used. Thus, it is considerably difficult to explain how an ANN achieved its outputs. However, we utilize a IF/THEN rules extraction mechanism from the trained network to explain your results obtained. It is worth noting that such rules are more acceptable by specialists, due to their resemblance to the human reasoning. In order to accomplish this task, a Breast Cancer database and another with minimum indexes from BOVESPA was adopted to assess the capacity for classification and prediction of the implemented model.

T124 *Prediction of Rainfall Rate Based on Weather Radar Measurements [#1359]*

C.I. Christodoulou, S.C. Michaelides, M. Gabella and C.S. Pattichis, University of Cyprus, Cyprus; Meteorological Service, Cyprus; Politecnico Di Torino, Italy

Weather radars are used to measure the electromagnetic radiation backscattered by cloud raindrops. Clouds that backscatter more electromagnetic radiation consist of larger droplets of rain and therefore they produce more rain. In an experiment during two days in June and August 1997 over the Italian-Swiss Alps, data from a weather radar and surrounding rain-gauges were collected at the same time. The neural SOM and the statistical KNN classifier were implemented for the classification task using the radar data as input and the rain-gauge measurements as output. The rainfall rate on the ground was predicted based on the radar reflections with an average error rate of 23 per cent.

T125 *Extracting Characteristic Words of Text Using Neural Networks [#1413]*

Kazumi Saito and Ryohei Nakano, NTT Communication Science Laboratories, Japan; Nagoya Institute of Technology, Japan

In this paper, we consider models for estimating categories of documents and extracting characteristic words of such categories. To this end, we focus on three models, i.e., naive Bayes and two types of neural networks formalized as statistical models. Here suitable categories of documents are estimated based on posterior probabilities, and characteristic words are extracted based on the magnitude of resulting parameter values. In our experiments using a set of real Web pages, we compare these models in the aspect of categorization performances and extraction capabilities of characteristic words.

T126 *Transferring Domain Rules in a Constructive Network: Introducing RBCC [#1507]*

Jean-Philippe Thivierge, Frederic Dandurand and Thomas R. Shultz, McGill University, Canada

A new type of neural network is introduced where symbolic rules are combined using a constructive algorithm. Initially, symbolic rules are converted into networks. Rule-

based Cascade-correlation (RBCC) then grows its architecture by a competitive process where these rule-based networks strive at capturing as much of the error as possible. A pruning technique for RBCC is also introduced, and the performance of the algorithm is assessed both on a simple artificial problem and on a real-world task of DNA splice-junction determination. Results of the real-world problem demonstrate the advantages of RBCC over other related algorithms in terms of processing time and accuracy.

T127 *N2Grid: Neural Networks in the Grid [#1528]*
Erich Schikuta and Thomas Weishaeupl, University of Vienna, Austria

We present a framework for the usage of neural network resources on a world-wide basis. Our approach employs the novel infrastructure of the Grid as a transparent environment to allow users the exchange of information (neural network objects, neural network paradigms) and the exploit of available computing resources for neural network specific tasks leading to a Grid based, world-wide distributed, neural network simulation system, which we call N2Grid. Our system uses only standard protocols and services aiming for a wide dissemination of this Grid application.

T128 *Comparison of feature ranking methods based on information entropy [#1542]*
Wlodzislaw Duch, Tadeusz Wieczorek, Jacek Biesiada and Marcin Blachnik, Department of Informatics, NCU, Poland, Poland; Department of Electrotechnology, SUT, Poland, Poland

A comparison between five feature ranking methods based on entropy is presented on artificial and real datasets. Feature ranking method using chi^2 statistics gives results that are very similar to the entropy-based methods. The quality of feature rankings obtained by these methods is evaluated using the decision tree and the nearest neighbor classifier with growing number of most important features. Significant differences are found in some cases, but there is no single best index that works best for all data and all classifiers. Therefore to be sure that a subset of features giving highest accuracy has been selected requires the use of many different indices.

T129 *Energy Generalized LVQ with Relevance Factors [#1544]*
Angel Cataron and Razvan Andonie, Transylvania University of Brasov, Romania; Central Washington University, United States

Input feature ranking and selection represent a necessary preprocessing stage in classification, especially when one is required to manage large quantities of data.We introduce a weighted generalized LVQ algorithm, called Energy Generalized Relevance LVQ (EGRLVQ), based on the Onicescu's informational energy. EGRLVQ is an incremental learning algorithm for supervised classification and feature ranking.

T130 *A Self-Regulating Clustering Algorithm for Identification of Minimal Cluster Configuration [#1671]*
Jiun-Kai Wang and Jeen-Shing Wang, National Cheng Kung University, Taiwan

This paper presents a self-regulating clustering algorithm (SRCA) that is capable of identifying the cluster configuration without a priori knowledge regarding the given data set. The proposed SRCA integrates growing, merging, and splitting mechanisms into a systematic framework to identify the minimal cluster configuration. A novel idea of cluster boundary estimation has been proposed to effectively perform the three mechanisms. A virtual cluster spread coupled with a regulating vector enables the proposed SRCA to reveal the compact cluster configuration which may close to the true one. Computer simulations have been conducted to demonstrate the effectiveness of the proposed SRCA in terms of a minimal error of cluster estimation.

T131 *Design Interpretable Neural Network Trees Through Self-organized Learning of Features [#1137]*
Qinzhen Xu, Qiangfu Zhao, Wenjiang Pei, Luxi Yang and Zhenya He, Southeast University, China; The University of Aizu, Japan

Neural network tree (NNTree) is a hybrid learning model. Recently we have proposed evolutionary algorithms for designing interpretable NNTrees, but the algorithms are good only for problems with binary inputs. For problems with continuous inputs, the NNTrees are still too difficult to interpret. This paper proposes to quantize the inputs using self-organized learning. The basic idea is to replace each input with a few critical points. By so doing the number of binary inputs for the ENNs can be greatly reduced. Experimental results with public databases show that the NNTrees built from the quantized data are as good as those obtained from the original data, and the NNTrees are much more interpretable.

T132 *Pruning The Vocabulary For Better Context Recognition (special session S6) [#1192]*
Rasmus Madsen, Sigurdur Sigurdsson, Lars Hansen and Jan Larsen, Technical University of Denmark, Denmark

In this communication we study the effect of pruning the vocabulary in text categorization. We consider a new approach, using neural network based sensitivity maps and information gain for determination of term relevancy, when pruning the vocabularies. With reduced vocabularies documents are classified using a latent semantic indexing representation and a probabilistic neural network classifier. Reducing the vocabularies with 90-98 percent, we find consistent classification improvement using two mid size data-sets.

T133 *An Approach for Generalizing Knowledge Based on Rules with Priority Orders [#1416]*
An Zeng, Qi-Lun Zheng, Dan Pan and Hong Peng, South China University of Technology, China; Guangdong Mobile Communication Co. Ltd.c, China

Based on some similarities between the knowledge system composed of the rules with priority orders and the sequential learning ahead masking (SLAM) model, an approach to enhance the generalization capabilities of the former with the help of the later is advocated. Firstly, the mapping from a rule to weights is realized. Secondly, the SLAM model is initialized to contain the knowledge from the rules and the generalization capabilities of the model are improved through the adjustment of the weights. Thirdly, based on the model, the approach can realize the incremental learning to grasp the knowledge containing in the newly added instances. Finally, the experimentations testify the obtained model has stronger generalization capabilities.

T134 *Distributed mining of the Internet for novel news: Evolutionary community of news foragers [#1095]*
Zsolt Palotai, Sándor Mandusitz and András Lőrincz, Eötvös Loránd University, Hungary

We populated a huge scale-free portion of Internet environment with news foragers. They evolved by a simple internal selective algorithm: selection concerned the memory components, being finite in size and containing the list of most promising supplies. Foragers received reward for locating not yet found news and crawled by using value estimation. Foragers were allowed to multiply if they passed a given productivity threshold. A particular property of this community is that there is no direct interaction (here, communication) amongst foragers. It is found that, still, fast compartmentalization, i.e., fast division of work can be achieved.

Plenary Poster Session: Computational neuroscience

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T135 *Thematic Role Assignment through a Biologically Plausible Symbolic-connectionist Hybrid System [#1096]*

Joao Luis Garcia Rosa and Alberione Braz da Silva, Ceatec - PUC-Campinas, Brazil

The proposed system consists of a bi-directional connectionist architecture, which employs a biologically plausible learning algorithm, concerning the thematic role assignment in natural language sentences context. Thematic roles assigned to nouns (agent, theme, instrument, etc.) are operands of a semantic predicate, usually the main verb of a sentence. Through the symbolic data extracted from the connectionist architecture, it is possible to show that, regarding the expected thematic grids, the biologically plausible system reflects successfully the thematic relationships learned.

T136 *Self-Organized Function Localization Neural Network [#1232]*

Takafumi Sasakawa, Jinglu Hu and Kotaro Hirasawa, Waseda University, Japan

This paper presents a self-organized function localization neural network (FLNN) inspired by Hebb's cell assembly theory about how the brain worked. It consists of two parts: main part and control part. The main part is an ordinary 3-layered feedforward neural network, but each hidden neuron contains a signal from the control part, controlling its firing strength. The control part consists of a SOM network whose outputs are associated with the hidden neurons of the main part. Trained with an unsupervised learning, SOM control part extracts structural features of input-output spaces and controls the firing strength of hidden neurons in the main part. Such self-organized FLNN realizes capabilities of function localization and learning.

T137 *Using Latent Attractors to Discern Temporal Order [#1403]*

Simona Doboli and Ali A. Minai, Hofstra University, United States; University of Cincinnati, United States

The paper presents a neural model for learning sequences of relevant patterns embedded in distractors. A contextual episode is a sequence of relevant patterns -- always in the same order -- intermixed with distractors. By repeated presentations of all contextual episodes, the model discovers for each episode the set of relevant patterns and their order. The problem is solved in two stages: (a) by eliminating distractors, and (b) by learning the order between relevant patterns. The model uses the concept of latent attractors - essential in creating different neural representations for same patterns in distinct episodes. No external teacher and only Hebbian type learning rules are used.

T138 *Information Transformation from a Spatiotemporal Pattern to Synchrony through STDP Network [#1512]*

Ryosuke Hosaka, Hikoichiro Nakamura, Tohru Ikeguchi and Osamu Araki, Saitama University, Japan; Tokyo University of Science, Japan

Although a number of studies have been made on STDP, little is known about the effect of STDP on the relation between external input patterns to the recurrent neural network and its output spikes. In this study, we examine this relation by computer simulations of a spiking neural network with STDP. We have found that STDP organizes the neural network to transform an external spatiotemporal input pattern into a synchronous firing, and the synchrony is much dependent on the spatiotemporal structure of the external input. This result suggests that a neural network can be self-organized through STDP so that it transforms the input information is represented by spatiotemporal spike patterns into temporal representation.

T139 *Desynchronization in networks of globaly coupled neurons: effects of inertia [#1576]*

Milan Majtanik, Kevin Dolan and Peter A. Tass, Research Center Juelich, Germany

Recently extensive work has been done towards understanding the synchronization of globally coupled phase oscillators, and in particular, possible methods for desynchronizing such systems with sequences of pulses. This is of great importance for the treatment of neurological disorders and can also be used to design new sensory and cognitive experimental techniques. As a progressive step towards a microscopic model of phase resetting in the brain, and being able to apply the desynchronization medically and experimentaly, we demostrate how these ideas can be generalized and applied to a network of neurons with inertia. In this article we analyze the mechanism of desynchronization in networks of such neurons.

T140 *Electrode-cell Distance Estimation Method, Based on Spatial Potential Patterns of Spiking Cells [#1583]*

Zoltán Somogyvári, Gábor Borbáth, László Zalányi, István Ulbert and Péter Érdi, Dept. Biophysics, KFKI RIPN of HAS, Hungary; Institute of Psychology of HAS, Hungary

In this paper, first a new principle for cell-electrode distance estimation was presented, which renewed the possibility of the cell localization. This new method required a reliable model of spiking cells' current source density distribution. Thus, properties of the extracellular potential patterns were discussed - referring to problems with monopole, and other point source models. Instead of point source models, a new model was set up and circumstances of its validity were determined. Finally the precision of the new distance estimation method was examined on simulated data and was applied on in vivo measurements

T141 *Hippocampal and prefrontal mechanisms for goal-directed and memory guided behavior (special session S9) [#1761]*

Michael E. Hasselmo, Boston University Center for Memory and Brain, United States

Mechanisms of memory-guided behavior were analyzed in a simulation of the hippocampus and prefrontal cortex which guided movements of a virtual rat in virtual tasks including goal directed movement in a spatial alternation task. In these tasks, hippocampal circuits mediate retrieval from episodic memory. Possible episodes are retrieved in entorhinal cortex and temporal context from dentate gyrus and region CA3 allows selection of specific episodes in CA1. Episodic retrieval allows selection of correct goal-directed movement by prefrontal cortex circuits. Network activity replicates physiological data on field potentials and unit firing in hippocampus.

T142 *Spatial Representation versus Navigation through Hippocampal, Prefrontal and Ganglio-basal Loops [#1317]*

Jean-Paul Banquet, Yves Burnod, Philippe Gaussier, Mathias Quoy and Arnaud Revel, Inserm 483, France; Etis - Universite de Cergy-Pontoise - Ensea, France

A neural network model of intrahippocampal and hippocampo-cortico-gangliobasal loops allows the robotic implementation of the spatial maps in neural space, into temporo-spatial sequences during navigation in outer space. The hippocampal (HS) representation level combines visual information and path integration. The hippocampo-cortical loop includes prefrontal cortex (PF) and accumbens (ACC). PF stores a global graph-map of an environment and goal locations. The diffusion of activation from the goals through the graph allows planning and path selection. The top-down output from PF and the bottom-up output from HS combine onto ACC for the stepwise selection and implementation of the optimal actions in the direction of the goal.

Plenary Poster Session: Neurodynamics

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T143 *Stability Analysis of a Self-Organizing Neural Network with Feedforward and Feedback Dynamics [#1354]*
Anke Meyer-Baese, Sergei Pilyugin and Axel Wismueller, Florida State University, United States; University of Florida, United States

We present a new method of analyzing the dynamics of self-organizing neural networks with different time scales based on the theory of flow invariance. We are able to show the conditions under which the solutions of such a system are bounded being less restrictive than with the K-monotone theory, singular perturbation theory, or those based on supervised synaptic learning. We prove the existence and the uniqueness of the equilibrium. A strict Lyapunov function for the flow of a competitive neural system with different time scales is given, and based on it we are able to prove the global exponential stability of the equilibrium point.

T144 *Studies on the Conditions of Limit Cycle Oscillations in the KII Models of Neural Populations [#1690]*
Roman Ilin, Robert Kozma and Walter J. Freeman, University of Memphis, United States; University of California at Berkeley, United States

KII sets are basic building blocks of dynamical neural network memories called KIII. The KIII's are strongly biologically motivated models of neural organization and functioning at the mesoscopic level in the cortex of vertebrate brains. The present study focuses on the fixed point and the limit cycle attractors in KII's. It considers the eigenvalues of the linearized KII system and outlines the conditions under which it exhibits limit cycle oscillations. The derived conditions will be instrumental in tuning the parameters of the KIII models having sustained chaotic oscillations.

T145 *Applying KIV Dynamic Neural Network Model for Real Time Navigation by Mobile Robot Aibo [#1627]*
Sangeeta Muthu, Robert Kozma and Walter J. Freeman, University of Memphis, United States; University of California at Berkeley, United States

We use a biologically inspired dynamic neural network model to accomplish goal-oriented navigation by a mobile robot in a real environment with obstacles. This model is the KIV model of the brain. Real time navigation is a challenging task, especially when there is no a priori information about the environment. Our robot EMMA is designed to be autonomous using various sensory inputs, which are integrated to achieve an efficient navigation task. This paper focuses on the design, implementation, and evaluation of the performance of EMMA and give a proof-of-principle in a real environment.

T146 *Neural communication systems [#1758]*
Péter András, University of Newcastle upon Tyne, United Kingdom

Understanding how biological neural systems work needs appropriate models that focus on relevant features of neural activities and ignore irrelevant ones. Here we propose a new way of describing biological neural systems in terms of abstract communication systems. Such systems use pattern languages formulated as probabilistic continuation rules that determine which communications follow other communications. We apply this framework to define neural communication systems. The formal analysis is followed by a brief interpretation of how the crab stomatogastric ganglion works in the context of the proposed framework. We also discuss further implications of the description of neural systems as abstract communication systems.

T147 *Theta Rhythm Selection of a Dentate Gyrus Network Model [#1316]*
Katsumi Tateno, Takahiro Hashimoto, Satoru Ishizuka, Koushi Nakashima and Hatsuo Hayashi, Kyushu Institute of Technology, Japan

The dentate gyrus selectively transmits the theta rhythm to the hippocampal CA3 region. We show preliminary experimental results of this filtering property in vitro, and propose a neural network model which may account the theta rhythm selection.

T148 *A new hybrid neural architecture (MLP+RPE) for hetero association: Multi Layer Perceptron and coupled Recursive Processing Elements Neural Networks [#1744]*
Emilio Del Moral Hernandez and Leandro Silva, University of Sao Paulo - Polytechnic School, Brazil; Polytechnic School of University of Sao Paulo, Brazil

This paper addresses a new hybrid neural network, which joins the classical Multi Layer Perceptron with a Neural Network composed of coupled Recursive Processing Elements. The individual characteristics of each one of these architectures, once combined, permitted the implementation of input-output mappings. Experiments for the performance evaluation of this hybrid neural architecture employing nodes that exhibit bifurcation and chaotic dynamics are described and the results addressing the operation under analog noise added to the input patterns are presented and analyzed. The MLP+RPE architecture was contrasted with other hybrid arrangements, and the results have shown that the MLP+RPE presents significant superiority.

T149 *Segregation of Motion Aftereffect Following Adaptation to Transparent Motion [#1546]*
Makoto Hirahara, Naoki Fukushima and Takashi Nagano, Hosei University, Japan

Characteristics of motion aftereffect (MAE) following adaptation to two dot-populations moving in orthogonal directions at different speeds are reported. A test stimulus also consisted of two populations of randomly moving dots whose speeds were equal to the two adaptation speeds. In every pair of adaptation speeds we employed, the results of experiments showed that (1) when the contrast of the test stimulus was high, a transparent (bidirectional) MAE was perceived; (2) when the test contrast was low, a unidirectional MAE was perceived. Test contrast, thus, determined whether two MAE-components generated by the two adaptation speeds were segregated or not. These results suggest that speed channels in our visual system are multiple.

Plenary Poster Session: Communications and security

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T150 *Reinforced Snap-Drift Learning for Proxylet Selection in Active Computer Networks [#1593]*
Dominic Palmer-Brown, Sin Wee Lee and Chris Roadknight, Leeds Metropolitan University, United Kingdom; Brtitish Telecom, United Kingdom

A new continuous learning method is applied to the problem of optimising the selection of services in a computer network environment. The learning is an enhanced version of the snap-drift algorithm for non-stationary environments. Snap is based on ART, and drift on LVQ Quantization. The algorithm swaps its learning style between the two modes when performance levels decline, but maintains the same learning style during episodes of improved performance. Reinforcement also occurs since learning is enabled with a probability that increases with declining performance. The method rapidly re-learns and simulations demonstrate stability, combined with the ability to discover solutions in response to new performance requirements.

T151 *Convolutional Decoders Based on Artificial Neural Network [#1187]*

Stevan Berber and Vojislav Kecman, School of Engineering, University of Auckland, New Zealand

The paper investigates new methods of decoding convolutional codes based on neural networks. The methods are compared using BER curves obtained by simulation. New algorithms, based on iterative decoding, simulated annealing and total search, are investigated and results obtained are presented. Both the Neural Network decoder and the Viterbi decoder are simulated and the bit error rates are compared. It is seen that the BER curves of the neural network decoders compare well with and even outperforms that of the decoder based on Viterbi algorithm. It was shown that the novel decoding algorithm based on total search gives the results that are comparable with or better than the results obtained by using turbo decoding techniques.

T152 *Neural Network Approach for User Activity Monitoring in Computer Networks [#1484]*

Natalia Kussul and Serhiy Skakun, Space Research Institute NASU-NSAU, Ukraine

It is proposed a system for user activity monitoring in computer networks. The system is based on the use of neural networks and is implemented using agent approach. The monitoring system allows to detect anomalies in user activity, and consists of two components - on-line and off-line. On-line monitoring is carried out in real time and is used to predict the processes started by user on the basis of previous ones. Off-line monitoring is carried out at the end of the day and is based on analysis of statistical parameters of user behavior (user signature). Both on-line and off-line monitoring use neural network approach to detect anomalies in user behavior.

T153 *Feature Selection for Intrusion Detection: An Evolutionary Wrapper Approach [#1557]*

Alexander Hofmann, Timo Horeis and Bernhard Sick, University of Passau, Germany

Soft-computing techniques found their way more and more into the research area of intrusion detection and are now an inherent part of it. Although, feature selection is an important task for almost all neural network applications,only very few investigations dealing with any type of automated feature selection are known in the area of intrusion detection. This article sets out an evolutionary algorithm (EA) that performs the tasks of feature selection and architecture optimization for radial basis function (RBF) networks automatically. With the feature selection process proposed, it is possible to reduce the number of input features significantly (about 2 up to 5 features are needed for attack detection).

T154 *A Neural Network Application for Attack Detection in Computer Networks [#1572]*

Adriana Cristina Santos, Lilia de Sa Silva, Jose Demisio S. Silva and Antonio Montes, National Institute for Spearch Research - INPE, Brazil; National Institute for Space Research, Brazil

We have observed a growing concern with the information handling and protection in the enterprise world. In ther constant technological evolution, it is verified the use of computer networks in essential and commercial activities and the interconnection between these nets. Information security systems are a key subject in several areas of application due to the increase in the intrusion attempts to network computers. This paper presents an application of post-mortem attack detection that uses a neural network concept. The neural network architecture, the system global view and the obtained results are presented. Also, some possible improvements of the tool in future works are commented.

T155 *Feature Extraction for Neural Network Equalizers Trained with Multi-gradient [#1700]*

Chulhee Lee, Jinwook Go and Byungjoon Baek, Yonsei University, Korea, Republic of

In this paper, we view equalization as a multi-class classification problem and use neural networks for classification. In particular, we use a recently published training algorithm, multi-gradient, to train neural networks. Then, we apply a feature extraction method to obtain more efficient neural networks. Experiments show that the neural network equalizers which view equalization as multi-class problems provide significantly improved performances compared to neural network equalizers trained by the conventional LMS algorithm while the feature extraction method significantly reduces the complexity of the neural network equalizers.

Plenary Poster Session: Time series prediction competition

Tuesday, 27 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

T156 *Time Series Prediction with Evolvable Block-based Neural Networks (special session Sf) [#1191]*

Seong G. Kong, The University of Tennessee, United States

This paper presents a time series prediction technique using the block-based neural networks (BbNNs). Building a model dynamical system can be a general approach to the time series prediction problem. However, the functional form and the order of the dynamics of the process generating the time series data are usually unknown. BbNNs, an evolvable neural network model with simultaneous optimization of network structure and connection weights by use of evolutionary algorithms, provide a model-free estimation of underlying nonlinear dynamical systems. Empirical results with a benchmark Mackey-Glass time series show that the evolved BbNNs can predict a future behavior of a complex dynamical system with sufficient accuracy.

T157 *A hierarchical Bayesian learning scheme for autoregressive neural networks: application to the CATS benchmark (special session Sf) [#1788]*

Antonio Eleuteri, Fausto Acernese, Leopoldo Milano and Roberto Tagliaferri, DSF University of Napoli and INFN Sez. Napoli, Italy; DMI Univerisity of Salerno and INFM, Italy

In this paper a hierarchical Bayesian learning scheme for autoregressive neural network models is shown, which overcomes the problem of identifying the separate linear and nonlinear parts modeled by the network. We show how the identification can be carried out by defining suitable priors on the parameter space, which help the learning algorithms to avoid undesired parameter configurations. An application to synthetic data is shown and we apply the method to the CATS times series prediction benchmark.

T158 *Batch Learning Competitive Associative Net and Its Application to Time Series Prediction (special session Sf) [#1790]*

Shuichi Kurogi, Takamasa Ueno and Miho Sawa, Kyushu Institute of Technology, Japan

A batch learning method for competitive associative net called CAN2 is presented and applied to time series prediction of the CATS benchmark (for Competition on Artificial Time Series). Although we have presented online learning methods for the CAN2 so far, which are basically for infinite number of training data. Provided that only a finite number of training data are given, however, the batch learning scheme seems more suitable. We here present a batch learning method to efficiently learn a finite number of data. We finally apply the present method to the time series prediction of the CATS benchmark.

T159 *A Hybrid Predictor for Time Series Prediction (special session Sf) [#1797]*

Chen Yen-Ping, Wu Sheng-Nan and Wang Jeen-Shing, National Cheng Kung University, Taiwan

This paper presents a hybrid predictor for the CATS benchmark. We tackled the prediction problem by a hybrid predictor consisting of two models--a kernel regression model (KRM) and a recurrent neuro-fuzzy model (RNFM). The KRM based on Gaussian function expansions was first applied to predict the major trend of the time series. The time series was sectioned into several data sets to obtain the best-fitting regression model. Subsequently, the RNFM associated with a learning

algorithm was used to predict the dynamics of the residual series. The learning algorithm has been developed to construct a minimum size of the recurrent model in state-space representation. The best prediction results were presented and discussed.

T160 *MultiGrid-Based Fuzzy Systems for Time Series Forecasting: CATS Benchmark IJCNN Competition (special session Sf) [#1798]*

Luis Javier Herrera Maldonado, Hector Pomares, Ignacio Rojas, Jesus Gonzalez, Mohammed Awad and Ana Maria Herrera Maldonado, University of Granada, Spain

In this paper, the MultiGrid-Based Fuzzy System (MGFS) approach is applied for the CATS Time Series Prediction Benchmark. The MGFS architecture overcomes the problem inherent to all grid-based fuzzy systems when dealing with high dimensional input data, thus keeping low computational cost and high performance. A greedy algorithm for MGFS structure identification allows to perform the input variable selection for the time series prediction problem, while identifying the pseudo-optimal architecture according to the provided dataset.

T161 *Time Series Prediction Using Chaotic Neural Networks: Case Study of IJCNN CATS Benchmark Test (special session Sf) [#1809]*

Robert Kozma and Igor Beliaev, University of Memphis, United States; U of Memphis, United States

KIII is a strongly biologically inspired neural network model. It has a multi-layer architecture with excitatory and inhibitory neurons, which have massive lateral, feedforward, and delayed feedback connections between layers. KIII has been shown previously to be an efficient tool of classification and pattern recognition. In this work we develop a methodology to use KIII for multi-step time series prediction. The method is applied for the IJCNN CATS benchmark data.

Tuesday, 27 July, 16.30–18.30

Special Track: Retinal Prothesis Symposium Part 3

Tuesday, 27 July, 16.30–.18.30, Room: B, Chair: Frank S. Werblin

Panel Discussion

Tuesday, 27 July, 20.00–22.40

Time Series Prediction Competition (special session)

Tuesday, 27 July, 20.00–22.40, Room: A, Chair: Amaury Lendasse

20.00 *Time Series Prediction Competition: The CATS Benchmark [#1821]*

Amaury Lendasse, Erkki Oja, Olli Simula and Michel Verleysen, Cis-Hut, Finland; Dice-Ucl, Belgium

This paper presents the CATS Benchmark and the results of the competition organized during the IJCNN'04 conference in Budapest. Twenty-four papers and predictions have been submitted and seventeen have been selected. The goal of the competition was the prediction of 100 missing values divided into five groups of twenty consecutive values.

20.20 *Multi-resolution Time-Series Prediction Using Fuzzy Inductive Reasoning [#1802]*

Francois E, Cellier and Angela Nebot, University of Arizona, United States; Universitat Politecnica de Catalunya, Spain

The paper describes a new approach to multi-resolution prediction of time series using Fuzzy Inductive Reasoning. The time series is decomposed into a trend series and another series describing the deviation from the trend. The two time series are then predicted independently of each other, and the two predictions are superposed in the end. The trend series is obtained by means of a moving average, whereas the deviation series is obtained by a process of de-trending using "daily return" calculations. The paper deals both with interpolation and with extrapolation problems.

20.40 *Time Series Prediction with Ensemble Models [#1807]*

Joerg Wichard and Maciej Ogorzalek, AGH - Krakow, Poland

We describe the use of ensemble methods to build proper models for time series prediction. Our approach extends the classical ensemble methods for neural networks by using several different model architectures. We further suggest an iterated prediction procedure to select the final ensemble members.

21.00 *Prediction of the CATS benchmark exploiting time-reversal symmetry [#1793]*

Pablo F. Verdes, Pablo M. Granitto, Maria Ines Szeliga, Alejandro Rebola and H. Alejandro Ceccatto, Institut fur Umweltphysik, Univ. Heidelberg, Germany; Instituto de Fisica Rosario, CONICET-UNR, Argentina

We present a possible strategy for filling the missing data of the CATS benchmark time series prediction competition. Our approach builds upon a time-symmetric embedding of this time series and the use of bagging of artificial neural networks (ANNs). One-shot forecasting is performed for each missing value from distant-enough delays. The suitability of the proposed embedding is assessed empirically by t-testing the goodness-of-fit of models built in symmetric versus asymmetric input spaces. In the right end we perform standard, non-iterated forward predictions. Expected error levels are provided according to performance on test data.

21.20 *Double Quantization Forecasting Method for Filling Missing Data in the CATS Time Series [#1804]*

Geoffroy Simon, John A. Lee, Michel Verleysen and Marie Cottrell, Machine Learning Group, UCL, Belgium; SAMOS-MATISSE, Univ. Paris I - Pantheon Sorbonne, France

The double vector quantization forecasting method based on Kohonen self-organizing maps is applied to predict the missing values of the CATS Competition data set. As one of the features of the method is the ability to predict vectors instead of scalar values in a single step, the compromise between the size of the vector prediction and the number of repetitions needed to reach the required prediction horizon is studied. The long-term stability of the double vector quantization method makes it possible to obtain reliable values on a rather long-term forecasting horizon.

21.40 *IJCNN 2004 Challenge Problem: Time Series Prediction with a Weighted Bidirectional Multi-stream Extended Kalman Filter [#1799]*

Xiao Hu and Donald Wunsch, University of Missouri-Rolla, United States

This paper describes the use of a multi-stream Extended Kalman Filter (EKF) to tackle the IJCNN 2004 challenge problem - Time Series Prediction on CATS benchmark. A weighted bidirectional approach was adopted in the experiments to incorporate the forward and backward predictions of the time series.

22.00 *Time Series Prediction with Recurrent Neural Networks Using a Hybrid PSO-EA Algorithm [#1801]*

Xindi Cai, Nian Zhang, Ganesh K. Venayagamoorthy and Donald Wunsch, University of Missouri-Rolla, United States

To predict the 100 missing values from the time series consisting of 5000 data, we design a recurrent neural networks trained by a new evolutionary learning algorithm. This new evolutionary learning algorithm is based on a hybrid of particle swarm optimization (PSO) and evolutionary algorithm (EA). By combining the searching abilities of these two global optimization methods, the evolution of individuals is no longer restricted to be in the same generation, and better performed individuals may produce offspring to replace those with poor performance. The experimental results show that our approach gives good performance in predicting the missing values from the time series.

22.20 *Time Series Prediction by Kalman Smoother with Cross Validated Noise Density [#1794]*

Simo Sarkka, Aki Vehtari and Jouko Lampinen, Mr, Finland

This article presents a classical type of solution to the time series prediction competition, the CATS benchmark, which is organized as a special session of the IJCNN 2004 conference. The solution is based on sequential application of the Kalman smoother, which is a classical statistical tool for estimation and prediction of time series. The Kalman smoother belongs to the class of linear methods, because the underlying filtering model is linear and the distributions are assumed Gaussian. Because the time series model of the Kalman smoother assumes that the densities of noise terms are known, these are determined by cross-validation.

Wednesday, 28 July, 8.30–9.50

Special Track: Plenary IJCNN

Wednesday, 28 July, 8.30–9.50, Room: A, Chair: Joel Davis

8.30 *Implantable Biomimetic Microelectronics for the Replacement of Hippocampal Memory Function Lost Due to Damage or Disease*

Theodore Berger, University of Southern California LA, United States

Dr. Berger and his colleagues at the University of Southern California are working to develop a microchip-based neural prosthetic for the hippocampus, a region of the brain responsible for the formation of long-term memories, and that frequently is damaged as a result of head trauma, epilepsy, stroke, and Alzheimer's disease. The various goals of this effort include: (1) experimental study of neuron and neural network function -- how does the brain encode information?, (2) formulation of biologically realistic models of neural system dynamics -- can that encoding process be described mathematically so that we can predict how the brain will respond to a particular event?, (3) microchip implementation of neural system models -- can the mathematical model be realized as a set of electronic circuits to achieve rapid computational speed and miniaturization?, and (4) hybrid neuron-silicon interfaces -- can electronic devices be "connected" to neural tissue for bi-directional communication with the brain?. Described as part of the latter effort are recent successes in growing living neurons directly onto silicon-based computer chips. Dr. Berger will describe a proof-of-principle of the vision of utilizing biomimetic electronics to restore lost brain function using a hippocampal brain slice preparation. Dr. Berger also will describe how the current work in brain slices will be extended to behaving animals in the near future.

9.10 *Reinforcement Learning in the Real World*

Andrew Barto, Dept of Computer Science Univ of Mass., United States

Reinforcement learning refers to improving performance through trial-and-error experience. Although modern computational approaches to reinforcement learning were inspired by animal learning, they have now branched out in several very different directions. Some researchers are interested in finding high-quality approximate solutions to large-scale stochastic planning problems that are important for industry and government. Others are pursuing the goal of building intelligent, resourceful autonomous agents that, like animals, can succeed while acting in real-time in complex environments. While these goals have much in common---and they both involve the real world---they represent two very different perspectives on reinforcement learning and related methods. After first reviewing the major elements of modern reinforcement learning and its relationship to optimal control, other types of machine learning, and to neuroscience, I present several striking example applications and describe some of the latest research directed toward scaling up to ever more complex problems. I conclude by laying out a view of the future of reinforcement learning research, emphasizing that the issues that need to be addressed depend strongly on which type of reinforcement learning one has in mind.

Wednesday, 28 July, 10.10–12.10

Bioinformatics

Wednesday, 28 July, 10.10–12.10, Room: A, Chair: Lipo Wang

10.10 *Localized Neural Network Based Distributional Learning for Knowledge Discovery in Protein Databases [#1643]*

Dragoljub Pokrajac, Aleksandar Lazarevic, Teresa Singleton and Zoran Obradovic, Delaware State University, United States; University of Minnesota, United States; Temple University, United States

In this paper, we investigate localized neural network-based distributional learning techniques for characterizing potentially new types of disorder proteins. Clustering techniques are first applied independently to both ordered and disordered labeled data set to identify regions of similar characteristics. Subsequently, local autoassociators are employed on labeled data to learn distribution of each cluster. Experimental results on a labeled database of confirmed order and disorder proteins and unlabeled data extracted from SWISS_PROT database are consistent with related literature and can provide further insight into relationship between protein similarity, keyword labeling and the disorder property.

10.30 *Gene Trajectory Clustering with a Hybrid Genetic Algorithm and Expectation Maximization Method [#1510]*
Zeke S. H. Chan and Nikola Kasabov, KEDRI, Auckland University of Technology, New Zealand

Clustering time course gene expression data (gene trajectories) is an important step towards solving the complex problem of gene regulatory network (GRN) modeling and discovery as it significantly reduces the dimensionality of the gene space required for analysis. This paper introduces a novel method that hybridizes Genetic Algorithm (GA) and Expectation Maximization algorithms (EM) for clustering with the mixtures of Multiple Linear Regression models (MLRs). The proposed method is applied to cluster gene expression time course data into smaller number of classes based on their trajectory similarities. Its performance and application as a generic clustering method to other complex problems are discussed.

10.50 *A Feature_Core and SVM-based Algorithm for Identification of Bioprocess-specific Genome Features [#1048]*
HongQiang Wang, De-Shuang Huang, Guangzheng Zhang and Xing-Ming Zhao, University of Science and Technology of China, China; Hefei Institute of Intelligent Machines, CAS, China

This paper presents a SVM and feature_core-based algorithm for identification of key genome features. The significant difficulty in selecting key features from a high dimensional space of features is the curse of dimensions in searching. For this reason, a feature_core-based search strategy is proposed in this algorithm. The strategy integrates the forward selection and backward elimination techniques. In this algorithm all key genome features are formed through the agglomeration and expansion of the feature core based on potential information about relevance in a SVM classifier. The application given proves that the algorithm is faster and more efficient than other methods such as clustering, and the single SVM-based method.

11.10 *Unsupervised Gene Selection via Spectral Biclustering [#1431]*
Bing Liu, Chunru Wan and Lipo Wang, Nanyang Technological University, Singapore

Selection of significant genes via expression patterns is an important problem in microarray data processing. In this article, we propose and study a new method for selecting relevant genes obtained by spectral biclustering and based on similarity between genes and eigenvectors. The proposed algorithm can select a much smaller gene subset to make accurate predictions. The unsupervised gene selection method suggested in this paper is demonstrated on two microarray cancer data sets, i.e., the Lymphoma and the Liver cancer data sets. In both examples, our method is able to identify two-gene combinations which can lead to prediction with very high accuracy.

11.30 *Residue Spatial Distance Prediction of Soybean Protein Sequences by Genetic Algorithm Optimized Radial Basis Function Neural Networks [#1041]*
Guangzheng Zhang and De-Shuang Huang, Hefei Institute of Intelligent Machines, CAS, China

The spatial distance of amino acids in a protein sequence is one of important factors, which determine the three-dimension structure (tertiary structure). In this paper, we describe a Genetic Algorithm (GA) based Radial Basis Function Neural Networks (RBFNN), whose hidden centers and radial basis function widths is optimized by the GA, to learn how primary structure (residue sequence) affects the spatial proximity of the amino acids in the soybean protein sequences and predict the residues spatial distance in three- dimensional space. Experiment results indicate that the proposed network has a good performance in soybeanprotein sequences residue spatial distance prediction.

11.50 *Protein Fold Class Prediction using Neural Networks with Tailored Early-Stopping [#1302]*
Thomas Wiebringhaus, Christian Igel and Jutta Gebert, University of Applied Sciences of Gelsenkirchen, Germany; Ruhr-University Bochum, Germany; University of Cologne, Germany

Predicting the three-dimensional structure of a protein from its amino acid sequence is an important problem in bioinformatics and a challenging task for machine learning algorithms. We describe an application of feed-forward neural networks to the classification of the protein fold class given the primary sequence of a protein. Different feature spaces for primary sequences are investigated, a tailored early-stopping heuristic for sparse data is introduced, and the achieved prediction results are compared to those of various other machine learning methods.

Invited session

Wednesday, 28 July, 10.10–12.10, Room: B, Chair: Tamás Roska

10.10 *A Comparison of CNN and LEGION Networks [#1164]*
DeLiang Wang, The Ohio State University, United States

CNN and LEGION networks have been extensively studied. They both employ continuous-time dynamics, are nonlinear, and emphasize local connectivity. This paper investigates the relations between the two frameworks. We present their standard versions, and contrast the underlying dynamics and connectivity. We also describe several tasks where both CNN and LEGION have been applied. The comparison reveals fundamental differences between them. CNN is good for early visual processing, whereas LEGION is good for midlevel visual processing. Furthermore, the comparison suggests that a combined network will likely enhance the overall processing capability.

10.40 *A CNN Model of Multi-dimensional Stimulus Selectivity in Primary Visual Cortex [#1682]*
Bertram Shi, Hong Kong Univ. of Science and Tech., Hong Kong

We describe a neuromorphic approach to implementing model visual cortical neurons using a network four-layer cellular neural network (CNN) chips. A key challenge is that visual cortical neurons are simultaneously selective along many stimulus dimensions, including retinal position, spatial frequency, orientation, temporal frequency, direction of motion, and binocular disparity. The ubiquity of intra-cortical feedback interconnections also implies that the neurons should operate in parallel and in continuous time. We discuss the modeling and implementation considerations that lead naturally to four layer networks, and describe the current status of our work in building silicon networks of tens of thousands of neurons.

11.10 *Implantable Probe Systems for Cortical Neuroprostheses*
Daryl R. Kipke, Dep. of Biomedical Engineering, United States

Next-generation neuroprostheses are likely to involve monitoring or stimulating selective regions of the brain to restore neurological function or treat disease. An enabling technology for these devices is a microscale implantable neural probe system that provides a reliable interface with the brain at the cellular level for long periods of time. We have developed a silicon-based probe technology that has proven to be effective for recording neural activity from neuronal populations for sustained time periods. This technology is currently being extended to include a combined chemical interface for drug delivery, advanced coatings for improved biocompatibility, and integrated electronics for wireless communication to the outside world.

11.40 *Vertically-Integrated Photonic Multichip Module Architecture*
A.R. Tanguay, B.K. Jenkins, C. von der Malsburg, B. Mel, J. O'Brien and I. Biederman, Univ. of Southern California, United States

Hardware Implementations of Vision Models and Algorithms, Photonic Implementations of Neural Networks, Hybrid Electronic/Photonic Multichip Module

Integration, Diffractive Optical Elements, Hybrid Analog/Digital Silicon VLSI, Flip Chip Bonding, Cellular Neural Networks. Adaptive vision applications that involve rapid object identification and moving object tracking increasingly place stringent upper bounds on processing latency and therefore computational throughput in order to accomplish the desired visual task in times significantly less than human perception and/or reaction times. In many such applications, several hierarchical stages of processing must be accomplished within the requisite latency.

Reinforcement learning & approximate dynamic progr.

Wednesday, 28 July, 10.10–12.10, Room: C, Chair: Danil Prokhorov

10.10 *Theory of Functional Systems, Adaptive Critics and Neural Networks [#1212]*

Vladimir Red'ko, Danil Prokhorov and Mikhail Burtsev, Institute of Optical Neural Technologies, Russian Federation; Ford Research and Advanced Engineering, United States; Keldysh Institute for Applied Mathematics, Russian Federation

We propose a general scheme of intelligent adaptive control system based on the Petr K. Anokhin's theory of functional systems. This scheme is aimed at controlling adaptive purposeful behavior of an animat (a simulated animal) that has several natural needs (e.g., energy replenishment, reproduction). The control system consists of a set of hierarchically linked functional systems and enables predictive and goal-directed behavior. Each functional system includes a neural network based adaptive critic design. We also discuss schemes of prognosis, decision making, action selection and learning that occur in the functional systems and in the whole control system of the animat.

10.30 *Hybrid Model for Multiagent Reinforcement Learning [#1282]*

Ville Kononen, Helsinki University of Technology, Finland

In this paper we propose a new method for reducing space and computational requirements of multiagent reinforcement learning based on Markov games. The proposed method estimates value functions by using two Q-value tables or function approximators. We formulate the method for symmetric and asymmetric multiagent reinforcement learning and discuss also some numerical approximation techniques. Additionally, we present a brief literature survey of multiagent reinforcement learning and test the proposed method with a simple example application.

10.50 *A Hybrid Dynamical System with Robust Switching Control by Action Dependent Heuristic Dynamic Programming [#1092]*

Thomas Hanselmann, Anthony Zaknich, Noakes Lyle and Savkin Andrey, The University of Western Australia, Australia; University of New South Wales, Australia

A hybrid dynamical system with linear plant characteristics but unknown state, disturbance and observation inputs is considered and controlled by switching between fixed linear output feedback controllers. Using state estimation based on Kalman filtering and solving a Riccati equation, a dynamic programming (DP) solution based on the estimated state can be obtained and a switching sequence for the output feedback controllers can be deduced. However, solving the DP equation is difficult in practice due to the 'curse of dimensionality'. Action Dependent Heuristic Dynamic Programming is applied to achieve an approximate DP solution based on piecewise quadratic interpolation and explicit determination of extremal values.

11.10 *Learning With Binary-Valued Utility Using Derivative Adaptive Critic Methods [#1587]*

Shari Matzner, Thaddeus Shannon and George Lendaris, NWCIL, Portland State University, United States

This paper discusses binary reinforcement in the context of three Adaptive Critic methods: HDP, DHP, and GDHP. Binary reinforcement arises when the qualitative measure of success is simply "pass" or "fail". We implement binary reinforcement with Adaptive Critic methods for the pole-cart benchmark problem. Results demonstrate two qualitatively dissimilar classes of controllers: those that replicate the system stabilization achieved with quadratic utility, and those that merely succeed at not dropping the pole. It is found that the GDHP method is effective for learning approximately optimal solutions, producing results comparable to those obtained via DHP using a quadratic utility function.

11.30 *A reinforcement learning algorithm to improve scheduling search heuristics with the SVM [#1258]*

Kai Gersmann and Barbara Hammer, Research Group LNM, University of Osnabrueck, Germany

The Regret-Based Biased Random Sampling Scheme (RBRS) is a simple but powerful priority-rule based method to solve the Resource Constrained Project Scheduling Problem (RCPSP), a well-known NP-hard benchmark problem. We present a generic machine learning method to improve results of RBRS. The rout-algorithm of reinforcement learning is combined with the support vector machine (SVM) to learn an appropriate value function which guides the search strategy given by RBRS. The specific properties of the SVM allow to reduce the size of the training set and show improved results even after a short period of training as demonstrated for benchmark instances of the RCPSP.

11.50 *A Solving Method for MDPs by Minimizing Variational Free Energy [#1409]*

Junichiro Yoshimoto and Shin Ishii, Japan Science and Technology Agency, Japan; Nara Institute of Science and Technology, Japan

In this article, we propose a novel approach to acquiring the optimal policy for a continuous Markov decision process. Based on an analogy from statistical mechanics, we introduce a variational free energy over a policy. A good policy can be obtained by minimizing the variational free energy. According to our approach, the optimal policy in linear quadratic regulator problems can be obtained by using Kalman filtering and smoothing techniques. Even in non-linear problems, a semi-optimal policy can be obtained by Monte Carlo technique with a Gaussian process method.

Signal and Image processing for intelligent vehicles

Wednesday, 28 July, 10.10–12.10, Room: G, Chair: Dan Hammerstrom

10.10 *Biologically Inspired Enhanced Vision System (EVS) for Aircraft Landing Guidance [#1361]*

Chiu Hung Luk, Changjian Gao, Dan Hammerstrom, Misha Pavel and Dick Kerr, OGI School of Science and Engineering, OHSU, United States; Max Viz, Inc., Portland, Oregon, United States

A useful Enhanced Vision System (EVS) for aircraft landing guidance not only has to provide the pilots a reliable image of the scene by fusing several sensor images in real time, but should also give them additional information such as attitude, navigation and hazard signals for safe landing in all weather conditions. Here a biologically inspired EVS is proposed. The algorithms of the core modules of the systems, namely, the pre-processing and image retrieval are discussed in this paper. A FPGA version of the association network algorithm used in the application is discussed and its performance compared with the PC system.

10.30 *A Collision Avoidance Model Based on the Lobula Giant Modevemt Detector Neuron of the Locust [#1532]*
Sergi Bermudez i Badia and Paul F.M.J. Verschure, Institute of Neuroinformatics, ETH/Uni Zurich, Switzerland

In insects we can find very complex and compact neural structures that are task specific. These neural structures allow them to perform complex tasks like visual navigation, what implies obstacle avoidance,landing,self- stabilization,etc. Obstacle avoidance is fundamental in order to perform successful navigation, and it can be combined with more systems to make up more complex behaviors. In this paper we present a model for collision avoidance based on the Lobula Giant Movement Detector (LGMD) cell of the Locust. This is a wide-field visual neuron that responds to looming stimulus, and it is supposed to trigger avoidance reactions whenever a collision is detected.The model has been tested and successfully applied to control a flying robot.

10.50 *Topographic and Non-topographic Neural Network Based Computational Platform for UAV Applications [#1719]*
Csaba Rekeczky, Gergely Tímár, Dávid Bálya, István Szatmári and Ákos Zarándy, Computer and Automation Institute of the HAS, Hungary; Analogic and Neural Computing. Lab. MTA-SZTAKI, Hungary

In this work, we present an architecture and algorithmic framework where topographic and non-topographic computation is combined on the basis of several artificial neural network models. The proposed framework makes the acquisition of a spatially and temporally consistent image flow possible even in case of extreme variations in the environment. We will illustrate how multi-channel visual flow analysis and classifier driven visual attention-selection mechanisms can be efficiently supported by an analogic architecture. The experiments performed on an analogic CNN hardware prototype will highlight some of the application potentials for unmanned air vehicle (UAV) applications.

11.10 *Robust Control System Design by Use of Neural Networks and Its Application to UAV Flight Control [#1537]*
Hiroaki Nakanishi and Koichi Inoue, Kyoto University, Japan; Osaka Sangyo University, Japan

Stochastic uncertainty are the most typecal in flight control system, because wind direction and wind speed, which have significant effect on the flight, vary stochastically. We propose methods to design robust control systems by training a neural network against stochastic uncertainties. Numerical simulations of flight control of an autonomous unmanned helicopter demonstrate the effectiveness of proposed methods.

11.30 *Context-based Tracking of Object Features [#1642]*
Jigang Wang, Predrag Neskovic and Leon Cooper, Brown University, United States

In this work, we present a biologically inspired context-based model for tracking object features. More specifically, the context is defined as a collection of features within the local region that surrounds the feature that is being tracked. The model doesn't rely on any knowledge about the object, and therefore the collection of contextual features in one frame is just a hypothesis that is then reconfirmed or rejected in subsequent frames. We applied the model to tracking horizontal and vertical edges extracted from real-time video streams that contain moving vehicles. Our results show that the performance of the system improves as the number of the contextual features increases.

11.50 *Intelligent Landing Control Based on Neural-Fuzzy-GA Hybrid System [#1154]*
Jih-Gau Juang and Kuo-Chih Chin, National Taiwan Ocean University, Taiwan

This paper present three intelligent aircraft automatic landing controllers that use fuzzy system, hybrid fuzzy-neural system and hybrid fuzzy-GA system to improve the performance of conventional automatic landing system. In this study a multi-layered fuzzy modeling network is used as the controller. Control gains are selected by a combination method of a nonlinear control design, a neural network, and genetic algorithm. Comparisons on different control schemes are given. Simulation results show that the proposed automatic landing controllers can successfully expand the safety envelope of an aircraft to include severe wind disturbance environments without using the conventional gain scheduling technique.

Neuromorphic Chips and Hardware

Wednesday, 28 July, 10.10–12.10, Room: I, Chair: Péter Szolgay

10.10 *Recurrently Connected Silicon Neurons with Active Dendrites for One-Shot Learning [#1603]*
John V. Arthur and Kwabena Boahen, University of Pennsylvania, United States

We describe a neuromorphic chip designed to model active dendrites, recurrent connectivity, and plastic synapses to support one-shot learning. Specifically, it is designed to capture neural firing patterns (short-term memory), memorize individual patterns (long-term memory), and retrieve them when primed (associative recall). It consists of a recurrently connected population of excitatory pyramidal cells and a recurrently connected population of inhibitory basket cells. In addition to their recurrent connections, the excitatory and inhibitory populations are reciprocally connected. The model is novel in that it utilizes recurrent connections and active dendrites to maintain short-term memories as well as to store long-term memories.

10.30 *Analog Auditory Perception Model for Robust Speech Recognition [#1714]*
Yunbin Deng, Shantanu Chakrabartty and Gert Cauwenberghs, Johns Hopkins University, United States

An auditory perception model for noise-robust speech feature extraction is presented. The model assumes continuous-time filtering and rectification, amenable to real-time, low-power analog VLSI implementation. A 3mm x 3mm CMOS chip in 0.5um CMOS technology implements the general form of the model with digitally programmable filter parameters. Experiments on the TI-DIGIT database demonstrate consistent robustness of the new features to noise of various statistics, yielding significant improvements in digit recognition accuracy over models identically trained using Mel-scale frequency cepstral coefficient (MFCC) features.

10.50 *A New VLSI Model of Neural Microcircuits Including Spike Time Dependent Plasticity [#1524]*
Johannes Schemmel, Karlheinz Meier and Eilif Mueller, University of Heidelberg, Germany

This paper presents a new VLSI model for biological neural systems, a unified research tool for neuro- as well as computer science. It allows construction of neural microcircuits close to the biological specimen while maintaining a speed several orders faster than real time. The synapse model includes an implementation of spike time dependent plasticity (STDP). Additionally, this system is a research tool for new concepts of information processing like liquid or any-time computing. The analog, continuous-time operation of the neuron is implemented in a contemporary deep-submicron process technology. Thereby it realizes a powerful computing system that is not based on the Turing paradigm.

11.10 *Mixed Analog/Digital Chaotic Neuro-Computer Prototype:400-Neuron Dynamical Associative Memory [#1477]*
Horio Yoshihiko, Okuno Takahide and Mori Koji, Tokyo Denki University, Japan

We construct the dynamical associative memory on the switched-capacitor (SC) 400-neuron chaotic neuro-computer prototype. We observe a variety of associative dynamics from the prototype. The chaotic behavior of the dynamical association

comes from complexity in real number. The analog SC chaotic neurons can handle real numbers through their continuous variables, and therefore, they would faithfully reproduce the chaotic behavior. In construct, digital computers cannot handle almost all real numbers. In this respect, we analyze the measured results from the hardware system in comparison with those from computer simulations. In the computer simulation, we take into account the analog circuit characteristics and noise.

11.30 *On-Chip Contrastive Divergence Learning in analogue VLSI [#1536]*

Patrice Fleury, Hsin Chen and Alan Murray, Edinburgh University, United Kingdom

We have mapped the contrastive divergence learning scheme of the Product of Experts (PoE) onto electrical circuits. The issues raised during that hardware translation are discussed in this paper and some circuits presenting our solutions described. The entire learning rule is implemented in mixed-signal VSLI on a 0.6um CMOS process. Chips results validating our approach and methodology are also presented.

11.50 *A New Mixed-Signal Feed-Forward Neural Network with On-Chip Learning [#1200]*

Mitra Mirhassani, Majid Ahmadi and William C. Miller, Univeresity of Windsor, Canada; University of Windsor, Canada

A new time-multiplexed neural network is proposed. Time-multiplexing reduces the design complexity, allows to implement larger size networks. Learning is performed on-chip without the host computer, to lower the cost of learning, to speed-up the learning phase and to be able use the chip in variable conditions. Neurons are distributed in the network for their self-scaling property to provide a general purpose neural network. Weights are stored digitally to ensure their stability, and inputs and outputs to the chips are in analog. MRIII is used for training the network which is more robust for mixed-signal designs. The problem of node addressing and routing is solved by using two counters and performing the operations in current mode.

Wednesday, 28 July, 14.00–16.00

Neural network control

Wednesday, 28 July, 14.00–16.00, Room: A, Chair: Jih-Gau Juang

14.00 *Neural Network Stabilizing Control of Single Machine Power System with Control Limits [#1742]*

Wenxin Liu, Jagannathan Sarangapani, Ganesh K. Venayagamoorthy, Donald Wunsch and Mariesa Crow, University of Missouri - Rolla, United States; University of Missouri- Rolla, United States; University of Missouri-Rolla, United States

This paper proposes a stable NN controller for stabilization of single machine infinite bus power system. In the power system control literature, controller designs are usually not based on rigorous stability analysis. This paper overcomes this problem by using an analytical model for controller development and proving the closed-loop stability. The weights of the NN can be initialized to zeros and trained online to approximate the nonlinear power system. Magnitude constraint of the activators is modeled as saturation nonlinearities and included in stability analysis. Simulation results demonstrate that the proposed design can successfully damp out oscillations. This control algorithm can also be applied to other similar control problems.

14.20 *Adaptive Critic Network for Prey-Predator Systems [#1206]*

Angelica Calu and Claudia-Lidia Badea-Simionescu, University of Salzburg, Austria

Calculus of variations provide useful information about the form of the optimal control law for a special class of optimal control problems. Nevertheless, the difficult task still remains to determine the times were the optimal control switches between its admissible boundaries. Using the theoretical results of the Pontryagin's Minimum Principle we propose an adaptive critic architecture, which determines the optimal control strategy using approximate dynamic programming and neural networks. The application of the proposed method on a challenging problem of ecology, the optimal control of a prey-predator system, is presented.

14.40 *Robust Feedback Error Learning Method for Controller Design of Nonlinear Systems [#1024]*

Hongping Chen, Kotaro Hirasawa and Jinglu Hu, Kyushu University, Japan; Wasada University, Japan; Waseda University, Japan

This paper presents a new robust controller design method for nonlinear system based on feedback error learning (FEL) method and higher order derivatives of Universal Learning Networks (ULNs). Our idea is to make an inverse model robust to signal noise by adding the sensitivity terms to the standard criterion function. Through feedback error learning, the sensitivity term can be minimized as well as usual criterion functions using the higher order derivatives of ULNs. As a result, it is confirmed by using simulation results that NNC robust against system disturbances can be obtained.

15.00 *Recurrent Neural Control for Rollover Prevention on Heavy Vehicles [#1108]*

Edgar Sanchez, Luis Ricalde, Reza Langari and Danial Shahmirzadi, CINVESTAV, Unidad Guadalajara, Mexico; Texas A M University, College Station, United States

An active control system is developed to prevent rollover in heavy vehicles. A high order recurrent neural network is used to model the unknown tractor semitrailer system; a learning law is obtained using the Lyapunov methodology. Then a control law, which stabilizes the reference tracking error dynamics, is developed using Control Lyapunov Functions. The control scheme is applied to the spped and speed-yaw rate trajectory tracking in a tractor-semitrailer during a cornering situation.

15.20 *Real-time Control of Variable Air Volume System Based on a Robust Neural Network Assisted PI controller [#1193]*

Chengyi Guo, Qing Song and Wenjian Cai, Nanyang Technological University, Singapore; School of EEE, Nanyang Technological University, Singapore

In this paper, we propose a novel neural network assisted PI control strategy to improve the supply air pressure control performance of variable air volume (VAV) system. The neural network is trained on-line with a normalized training algorithm, which eliminates the requirement of a bounded regression signal to the system. To ensure the convergence of the training algorithm, an adaptive dead-zone scheme is employed. Stability of the proposed control scheme is guaranteed based on the conic sector theory. To demonstrate the applicability of the proposed method, real-time tests were carried out on a pilot VAV air- conditioning system and good experimental results were obtained.

15.40 *An Adaptive Learning Control Approach Based on Constructive Function Approximation [#1411]*

Jian-Xin Xu and Rui Yan, Nat. University of Singapore, Singapore

A constructive function approximation approach is proposed for adaptive learning control which handles finite interval tracking problems. Unlike the well established adaptive neural control which uses a fixed neural network structure as a complete system, in our method the function approximation network consists of a set of bases and the number of bases can be increased when learning repeats. The nature of basis allows the continuously adaptive tuning or learning of parameters when the

network undergoes a structure change, consequently offers the flexibility in tuning the network structure. The expansibility of the basis ensures the function approximation accuracy, and removes the ad hoc processes in pre-setting the network size.

Applications in Diagnostics and Quality Control

Wednesday, 28 July, 14.00–16.00, Room: B, Chair: Vicenzo Piuri

14.00 *Tool Wear Monitoring Using Radial Basis Function Neural Network [#1270]*

Danko Brezak, Toma Udiljak, Kristijan Mihoci, Dubravko Majetic, Branko Novakovic and Josip Kasac, FSB, University of Zagreb, Croatia

This paper considers the application of Radial Basis Function neural network (RBFNN) for tool wear determination in the milling process. Tool wear, i.e. flank wear zone widths, have been estimated in two phases using two types of RBFNN algorithms. In the first phase, RBFNN pattern recognition algorithm is used in order to classify tool wear features in three wear level classes (initial, normal and rapid tool wear). On behalf of these results, in the second phase, RBFNN regression algorithm is utilized to estimate the average amount of flank wear zone widths. Tool wear features were extracted in time and frequency domain from three different types of signals: force, acoustic emission and nominal currents of feed drives.

14.20 *Content-Based Image Retrieval of Web Surface Defects with PicSOM [#1290]*

Rami Rautkorpi and Jukka Iivarinen, Helsinki University of Technology, Finland

This paper describes the application of PicSOM, a content-based image retrieval (CBIR) system based on self-organizing maps, on a defect image database containing 2004 images from a web inspection system. Six feature descriptors from the MPEG-7 standard and a shape descriptor developed for surface defect images are used in the experiments. The classification performance of the descriptors is evaluated using K-Nearest Neighbor (KNN) leave-one-out cross-validation and PicSOM's CBIR analysis system. The KNN results show good performance from three MPEG-7 descriptors and our shape descriptor. The CBIR results using these descriptors show that PicSOM's SOM-based indexing engine yields efficient and accurate retrieval of similar defect images.

14.40 *Fault Detection and Isolation Based on Hybrid Modelling in an AC Motor [#1349]*

Maria J. Fuente, Eduardo Moya, Carlos Alvarez and Gregorio Sainz, Universidad de Valladolid, Spain

A hybrid scheme is used in this paper, to model an induction motor and to develop a fault detection and isolation (FDI) scheme. The hybrid model combines a partial first principles model, with a neural network which serves as an estimator of unmeasured process parameters. A fault detection and isolation scheme has been defined based on this hybrid model. The detection scheme is based on the the residuee, i.e., the difference between the real system and the hybrid model, and the isolation scheme is based on neural networks. An AC motor was simulated using this methodology, and faults in some internal parameters have been simulated and detected with the FDI scheme, with quite good results.

15.00 *On the Approach to Synthesis of Forecasting Markov Networks [#1127]*

Sergey Baranov, Russian Aviation Co, Russia

An approach to synthesis of Markov networks for forecasting fatigue failures is proposed. The technique is based on processing of observed spectral structure characteristics. Both statistical modeling and data analysis with the aid of Kohonen self-organizing feature maps are used. The synthesis may be carried out in case of uncertainties: absence of complete information on damage types and their connections is assumed.

15.20 *Constructing a Neural System for Surface Inspection [#1304]*

Carl-Henrik Grunditz, Martin Walder and Lambert Spaanenburg, Lund University, Sweden

Visual quality assurance techniques focus on the detection and qualification of abnormal marks in the image of an object. The features of abnormality are extracted through image mining, whereupon classification is performed on judicious feature combinations. Many techniques for feature extraction have been proposed with the notable exception of feed-forward neural networks. This paper shows an alternative, where a multi-tier feed-forward network is constructed to model normality using only the physical properties of the image domain. This generic architecture can easily be adapted for different applications, as in metal plate inspection and protein detection, with mean error rate below 5 percent.

15.40 *Fault Diagnosis of Pneumatic Actuator Using Adaptive Network-Based Fuzzy Inference System Models and a Learning Vector Quantization Neural Network [#1037]*

Shi Li and Nariman Sepehri, Shanghai University, China; University of Manitoba, Canada

Fault diagnosis in pneumatic actuators is a very difficult task due to the inherent high nonlinearity and uncertainty. In this paper, we first set up a group of adaptive network-based fuzzy inference systems models which, corresponding to various highly nonlinear situations of a pneumatic actuator, including normal, low and high supply pressure. These models overcome the disadvantages of ordinary fuzzy modeling and can be very suitable for generalized modeling of nonlinear plants. Next, we utilize a learning vector quantization (LVQ) neural network as a tool for fault classification by abstracting the data from the models as the input vectors. The effectiveness is demonstrated via experiments on a pneumatic actuator.

Biomedical Applications

Wednesday, 28 July, 14.00–16.00, Room: C, Chair: Nik Kasabov

14.00 *Computer Aided Diagnosis of CT Focal Liver Lesions by an Ensemble of Neural Network and Statistical Classifiers [#1601]*

Ioannis Valavanis, Stavroula Mougiakakou, Konstantina Nikita and Alexandra Nikita, National Technical University of Athens, Greece; Medical School, University of Athens, Greece

A Computer Aided Diagnosis (CAD) system for the characterization of four types of hepatic tissue from Computed Tomography images is presented. Regions of Interest (ROI's) are drawn by an experienced radiologist. For each ROI, five sets of texture features are extracted and combined to provide input to the CAD system. If the dimensionality of a feature set is greater than a predefined threshold, feature selection based on a Genetic Algorithm (GA) is applied. Classification of the ROI is then carried out using an ensemble of neural network and statistical classifiers. The final decision of the CAD system is based on the application of a voting scheme across the outputs of the primary classifiers of the ensemble.

14.20 *Prediction of EMG Signals of Trunk Muscles in Manual Lifting Using a Neural Network Model [#1766]*

Yanfeng Hou, Jacek Zurada and Waldemar Karwowski, University of Louisville, United States

An EMG (electromyography) signal prediction model is built using artificial neural network. Kinematics variables and subject variables are selected as inputs of this model. A novel structure of feedforward neural network is proposed in this paper to obtain better accuracy of prediction. By adding regional connections between the input and the output, the new architecture of the neural network can have both global features and regional features extracted from the input. The global connections put more emphasis on the whole picture and determine the global trend

of the predicted curve, while the regional connections concentrate on each point and modify the prediction locally. Back-Propagation Algorithm is used in the modeling.

14.40 *Optimized classification of multiclass problems applied for EMG-control of hand prostheses [#1240]*
Markus Reischl, Lutz Groell and Ralf Mikut, Forschungszentrum Karlsruhe, Germany

This article proposes a new control scheme for a multifunctional myoelectric control of hand prostheses. Therefore, switch signals are introduced for movement selection. A finite state automaton changes to corresponding movement states after having analyzed the switch signal. This is done by data processing algorithms like MANOVA, discriminant analysis and maximum-likelihood estimation. However, implementations using recorded data are not able to discriminate all switch signals. Therefore, modifications have been developed to increase classification accuracy, using modified transformation matrices and hierarchical classifiers. These algorithms are tested and compared with data of two above elbow amputees and two below elbow amputees.

15.00 *Clustering of Dependent Components: A New Paradigm for fMRI Signal Detection [#1373]*
Anke Meyer-Baese, Oliver Lange, Axel Wismueller and Dorothee Auer, Florida State University, United States; Max-Planck Institute, Germany

Recently,a new paradigm in ICA emerged, that of finding "clusters" of dependent components. This striking philosophy found its implementation in two new ICA algorithms: tree-dependent and topographic ICA. For fMRI, this represents the unifying paradigm of combining two powerful exploratory data analysis methods,ICA and unsupervised clustering techniques. For the fMRI data, a comparative quantitative evaluation between the two methods, tree- dependent and topographic ICA was performed. The comparative results were evaluated by (1)task-related activation maps,(2) associated time-courses and (3) ROC study.

15.20 *Mammographic Mass Detection by Vicinal Support Vector Machine [#1030]*
Aize Cao, Qing Song, Xulei Yang, Sheng Liu and Chengyi Guo, School of EEE, Nanyang Technological University, Singapore

In this paper, we proposed a Vicinal Support Vector Machine (VSVM) according to the vicinal risk minimization (VRM) principle as an enhancement learning scheme for the mammographic mass detection on digital mammograms. The proposed detection scheme includes two steps. First, one-class Support Vector Machine (SVM) is investigated for the abnormal cases detection. Second, VSVM is proposed for the malignant cases detection. We tested the proposed scheme by using 90 clinical mammograms from MIAS database. The experimental results show that the two-step detection scheme works effective and the proposed VSVM is a promising classifier for breast mass detection.

15.40 *Kernel-PCA Denoising of Artifact-free Protein NMR Spectra [#1244]*
Kurt Stadlthanner, Elmar W. Lang, Ana Maria Tome, Ana Rita Teixeira and Carlos G. Puntonet, University of Regensburg, Germany; University of Regensburg, Institute of Biophysic, Germany; University of Aveiro, Portugal; University of Aveiro, IEETA, Portugal; University of Granada, Spain

Multidimensional 1H NMR spectra of biomolecules dissolved in light water are contaminated by an intense water artifact. Generalized eigenvalue decomposition methods using congruent matrix pencils are used to separate the water artefact from the protein spectra. Due to the statistical separation process, however, noise is introduced into the reconstructed spectra. Hence Kernel - based denoising techniques are discussed to obtain noise- and artifact - free 2D NOESY NMR spectra of proteins.

Brain inspired emerging nanoarchitectural design and techn. challenges (special session)

Wednesday, 28 July, 14.00–16.00, Room: F, Chair: Valeriu Beiu and Ulrich Rueckert

14.00 *Fault-Tolerant PLA-styleCircuit Design for Failure-Prone Nanometer CMOS and Quantum Devices Technologies [#1661]*
Alexandre Schmid and Yusuf Leblebici, Swiss Federal Institute of Technology - Lausanne, Switzerland

This paper addresses the functional robustness and fault-tolerance capability of very-deep submicron CMOS and single-electron transistor (SET) circuits. A set of guidelines is identified for the design of very high-density digital systems using inherently unreliable and error-prone devices. Empirical results based on SPICE simulations show that the proposed design method improves fault immunity at transistor level. Graceful degradation of circuit performance allows recovery of information, where classical circuits would fail.

14.20 *Emergence of Computational Chaos in Asynchronous Neurocomputing [#1364]*
Sarit Barhen, Vladimir Protopopescu, Jack Wells, Neena Imam and Jacob Barhen, Emory University, United States; Oak Ridge National Laboratory, United States

One of the most important features of artificial neural networks in emerging nanoarchitectural designs, is their inherent ability to perform massively parallel, nonlinear signal processing. When operating in a system-wide asynchronous regime, such networks may exhibit a phenomenon referred to as "computational chaos", which impedes the efficient retrieval of information usually stored in the system's attractors. In this paper, we illustrate the emergence of computational chaos from fixed point and limit cycle attractors for node communication delays in a widely used neural network model. The complete Lyapunov spectrum associated with the network dynamics is computed, and conditions that prevent the emergence of chaos are derived.

14.40 *Architectural Requirements for Threshold Logic Gates based on Resonant Tunneling Devices [#1664]*
Peter Kelly, Martin Mcginnity and Liam Maguire, University of Ulster, United Kingdom; Univwerity of Ulster, UK

Threshold Logic Gates (TLGs) based on Resonant Tunneling Diodes (RTDs) allow the implementation of simple McCulloch-Pitts (MCP) neuron models. Whilst they have been demonstrated implementing a wide range of binary logic circuits the gates are also theoretically capable of implementing artificial neural networks. The conventional operation of RTD based logic circuits with many cascaded stages has inherent disadvantages associated with the requirement of an evaluation period at each stage and the resultant use of multiple clocks. The authors propose that highly parallel structures similar to those found in artificial neural networks are better suited to RTD based TLGs and offer the way forward for future large scale designs.

15.00 *Reconfigurable Subthreshold CMOS Perceptron [#1433]*
Snorre Aunet, Bengt Oelmann, Suliman Abdalla and Yngvar Berg, University of Oslo, Norway; Mid-Seden University, Sweden; Mid-Sweden University, Sweden

We present an idea for a new real-time reconfigurable perceptron, also called threshold element. The circuit example contain three inverters with shorted outputs. Spice simulations for a 0.6 micron CMOS implementation operating in the subthreshold region are shown. The threshold voltages of the active devices, seen from driving nodes, may be dynamically changed by adjusting their substrate potentials. This enables a change of the threshold of the perceptron circuit in real-time. In terms of Boolean logic the functionality may be changed between 3-input NOR, CARRY' for the FULL-ADDER function and 3-input NAND, in real-time.

15.20 *CHIMERA: Creating a New Generation Chip by Brain Guidance [#1494]*
John Taylor, King's College London, United Kingdom

We will present an outline for an adaptive chip architecture, based on general principles of global brain processing. The chip will be composed of sets of single neurons, which are initially grouped into columns, and these further grouped into modules. The overall architecture of the chip will be based on the attention control system of the brain, together with its division into posterior low-level processing and classifying modules (of SOM type) and high- level cognitive modules (of recurrent type). Various balances and neuron complexity will be discussed, as will further aspects of the processing styles to be used (causal learning laws, salience maps and emotionality, working memory structures, inhibitory competition, neuromodulators).

15.40 *A Charge Recycling Differential Noise Imune Perceptron [#1709]*
Jabulani Nyathi, Valeriu Beiu, Suryanarayana Tatapudi and David J. Betowski, Washington State University, United States

This paper proposes a new low-power differential neural inspired gate with improved noise immunity. The charge recycling differential noise-immune threshold logic (CRD-NTL) perceptron is based on combining the split-level precharge differential logic (SPDL), with a technique for enhancing noise immunity of threshold logic gates: noise suppression logic. Another idea included in the design of the CRD-NTL gate is the use of two threshold logic banks implementing the function (f) and its inverse (f_bar), and working in conjunction with the noise suppression logic blocks for enhanced performance. Characterization of the new gate has been performed by extensive simulation in 0.25 um CMOS technology at 2.5 V.

N N & Kernel methods for structured domains (ENNS special session)

Wednesday, 28 July, 14.00–16.00, Room: G, Chair: Alessandro Sperduti

14.00 *Recursive PCA and the Structure of Time Series [#1308]*
Thomas Voegtlin, Humboldt University, Berlin, Germany

A recurrent linear network can be trained with Oja's constrained Hebbian learning rule. As a result, the network learns to represent the temporal context associated to its input. The operation performed by the network is a generalization of Principal Components Analysis (PCA) to time-series, called Recursive PCA. During learning, the weights of the network are adapted to the temporal statistics of its input, in a way that maximizes the information retained by the network. Sequences stored in the network may be retrieved in the reverse order of presentation, thus providing a straight-forward implementation of a logical stack.

14.20 *On the Role of Long-Range Dependencies in Learning Protein Secondary Structure [#1394]*
Alessio Ceroni and Paolo Frasconi, Universita' di Firenze, Italy

Accuracy of protein secondary structure predictors has been slowly growing during the last decade. Although it is clear that a relatively large fraction of current errors is due to long-range interactions, current predictors are not able to exploit such information. We present a solution based on a generalized bidirectional neural network that learns from sequences and associated interaction graphs to improve secondary structure prediction.

14.40 *A mutual information kernel for sequences [#1590]*
Marco Cuturi and Jean-Philippe Vert, Ecole des Mines de Paris, France

We propose a new kernel for strings which borrows ideas and techniques from information theory and data compression. This kernel can be used in combination with any kernel method, in particular Support Vector Machines. By incorporating prior assumptions on the properties of the alphabet and using a Bayesian averaging framework, we compute the value of this kernel in linear time and space, benefiting from previous achievements proposed in the field of universal coding. Encouraging classification results are reported on a standard protein homology detection experiment.

15.00 *Recursive neural networks for object detection [#1337]*
Monica Bianchini, Marco Maggini, Lorenzo Sarti and Franco Scarselli, DII - University of Siena, Italy

In this paper, a new recursive neural network model, able to process directed acyclic graphs with labeled edges, is introduced, to address the problem of object detection in images. The proposed method assumes a graph--based representation of images, that combines both spatial and visual features. Such graphs are then processed by the recursive model in order to determine the eventual presence and the position of objects inside the image. Some experiments on face detection, carried out on scenes acquired by an indoor camera, are reported, showing very promising results. The proposed technique is general and can be applied in different object detection systems.

15.20 *Fisher Kernel for Tree Structured Data [#1599]*
Luca Nicotra, Alessio Micheli and Antonina Starita, Department of Computer Science, Univ. of Pisa, Italy

We introduce a kernel for structured data, which is an extension of the Fisher Kernel used for sequences. In our approach, we extract the Fisher score vectors from a Bayesian Network, specifically a Hidden Tree Markov Model, which can be constructed starting from the training data. Experiments on a QSPR (quantitative structure-property relationship) analysis, where instances are naturally represented as trees, allow a first test of the approach.

15.40 *A Supervised Self-Organizing Map for Structures [#1669]*
Markus Hagenbuchner and Ah Chung Tsoi, University of Wollongong, Australia

This paper proposes an improvement of a supervised learning technique for Self Organizing Maps. The ideas presented in this paper differ from Kohonen's approach to supervision in that a rejection term is used, and that rejection affects the training only locally. This approach produces superior results because it prevents the addition of noise to the learning process. We implemented the ideas into Self-Organizing Maps for Structured Data (SOM-SD) which is a form of Self-Organizing Maps capable of processing graphs. The capabilities of the proposed ideas are demonstrated by utilizing a relatively large real world learning problem from the area of image recognition.

Wednesday, 28 July, 16.00–19.00

Plenary Poster Session: Support Vector Machines and Kernel Methods

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W001 *A New Momentum Minimization Method for Support Vector Machines [#1011]*

Daniel Lai, Mani Nallasamy and Palaniswami Marimuthu, Monash University, Australia; Melbourne University, Australia

The Support Vector Machine (SVM) classifier is an optimization problem applied to large data.In limited processing memory situations, the SVM formulation can be solved by first decomposing the main problem into a series of sub problems. However, the speed of the method depends on the sequence of sub problems solved. The optimal sequence is difficult to determine since the algorithm does not iterate on the entire variable space at once. We propose a measure called momentum to account for constraint violation. We then derive a heuristic to approximately minimize the momentum. We show that this rough heuristic improves the speed of the original Sequential Minimal Optimization algorithm by about 20-50 percent.

W002 *Learning Probabilistic Kernel Feature Subspace with Side-information for Classification [#1020]*

Jianguo Lee, Changshui Zhang and Zhaoqi Bian, Tsinghua University, China

KPCA is an efficient method for nonlinear feature extraction. We address two issues in KPCA based feature extraction and classification. First, it extracts features without utilizing sample label information. Second, it does not provide a practical way to choose the dimensionality for principal subspace. In this paper, one kind of side-information is incorporated into KPCA to solve the first problem. And a complete probabilistic density function is estimated in kernel space so that the choice of dimensionality for principal subspace becomes less important. The proposed model is named Probabilistic Kernel Feature Subspace (PKFS). Experiments show that it achieves promising performance and outperforms many other algorithms in classification.

W003 *Least Squares Support Vector Machine Ensemble [#1043]*

Bing-Yu Sun and De-Shuang Huang, Hefei Institute of Intelligent Machines, Chinese, China; Hefei Institute of Intelligent Machines, CAS, China

In this paper, the LS-SVM ensemble is proposed to improve the performance of single LS-SVM. During the constructing the LS-SVM ensemble, bagging algorithm is used because it is more suitable than boosting algorithm in high noise regime. Furthermore, in this paper a novel aggregation method of LS-SVM ensemble is also proposed. Traditionally the aggregation of the ensemble always uses all the available individual LS-SVM, while our approach can exclude the ones which may degrade the performance of the ensemble. Finally, the simulating results demonstrate the effectiveness and efficiency of our approach.

W004 *Robust Outlier Detection using SVM for Regression [#1065]*

Elsa Jordaan and Guido Smits, Dow Benelux BV, Netherlands

The occurrence of outliers in industrial data is often the rule rather than the exception. Many standard outlier detection methods fail to detect outliers in industrial data because of the high dimensionality of the data. Outlier detection in the case of chemical plant data can be particularly difficult since these data sets are often rank deficient. These problems can be solved by using robust model-based methods that do not require the data to be of full rank. In this paper, we explore the use of a robust model-based outlier detection approach that makes use of the characteristics of the support vectors obtained by the Support Vector Machine method.

W005 *Unsupervised Clustering and the Capacity of Support Vector Machines [#1077]*

Davide Anguita, Sandro Ridella, Fabio Rivieccio and Rodolfo Zunino, DIBE - University of Genoa, Italy; University of Genoa, Italy

In the framework of Support Vector Machine (SVM) classifiers, an unsupervised analysis of empirical data supports an ordering criterion for the families of possible functions. The approach enhances the Structural Risk Minimization paradigm by sharply reducing the number of admissible classifiers, thus tightening the associate generalization bound. The paper shows that kernel- based algorithms, allowing efficient optimization, can support both the unsupervised clustering process and the generalization-error estimation. The main result of this sample-based method may be a dramatic reduction in the predicted generalization error, as demonstrated by experiments on synthetic testbeds as well as real-world problems.

W006 *SVM-Based Blind Beamforming of Constant Modulus Signals [#1079]*

Ignacio Santamaria, Javier Via and Javier Merino, University of Cantabria, Spain

Recent work has shown how the SVM framework can be used for blind equalization of constant modulus signals. In this paper, we extend this idea to encompass the problem of separating and estimating multiple CM signal mixed through an unknown matrix. The quadratic inequalities derived from the CM property are transformed into linear ones, thus yielding a quadratic programming problem. Once a signal is recovered, its contribution to the original observations is removed and the iterative procedure can be applied again to extract another CM signal. The proposed SVM-based algorithm offers better performance than the algebraic constant modulus algorithm, mainly when only a small number of snapshots is available.

W007 *Model Selection of SVMs Using GA Approach [#1113]*

Peng-Wei Chen, Jung-Ying Wang and Hahn-Ming Lee, National Taiwan University of Science and Techno, Taiwan

We develop a new automatic search methodology for model selection of support vector machines. The proposed method is based on the GA-based tuning algorithm. This is done by using the genetic algorithm to search for the adequate hyperameters of SVMs. Each chromosome indicates a group of hyperparameters, and the population is a collection of chromosomes. Experimental results show that our method performs superiorly on time cost, performance and stability. Our algorithm only requires the evaluation of an objective function to guide its search with no additional derivative or auxiliary knowledge required. In addition, the encoding of chromosomes makes the implementation of multiple hyperparameters tuning simpler.

W008 *Feature Subset Selection for Support Vector Machines by Incremental Regularized Risk Minimization [#1159]*

Holger Froehlich and Andreas Zell, University of Tuebingen, Germany

In this paper we present a novel feature selection algorithm for SVMs which works by decreasing the regularized risk in an iterative manner by using a combination of a backward elimination procedure together with an exchange algorithm. It is applicable to linear as well as to nonlinear problems. We test this new algorithm on toy and real life data sets and show its good performance in comparision to state-of-the-art feature selection methods.

W009 *Multi-class SVM with Negative Data Selection for Web Page Classification [#1199]*

Chen Chih-Ming, Lee Hahn-Ming and Kao Ming-Tyan, National Hualien Teachers College, Taiwan; Taiwan University of Science and Technology, Taiwan

Support Vector Machine (SVM) has been demonstrated its excellent performance in terms of solving document classification problem. In this paper, SVM with one-against-all structure is applied to solve web page classification problems with multi-class. However, the main problem of SVM with one-against-all structure is that the negative data might be too huge so that the training time will obviously increase. To solve this problem, a negative data selection method is presented to reduce a large amount of negative data for SVM. Experimental results show that the training time will obviously be reduced. Moreover, the proposed method also keeps a high accuracy rate for web page classification.

W010 *Kernel Principal Component Analysis and Support Vector Machines for Stock Price Prediction [#1243]*

Huseyin Ince and Theodre B. Trafalis, Gebze Institute of Technology, Turkey; University of Oklahoma, United States

Financial time series are complex, non stationary and deterministically chaotic. Technical indicators are used with Principal Component Analysis (PCA) in order to identify the most influential inputs in the context of the forecasting model. Neural networks (NN) and support vector regression (SVR) are used with different inputs. Our assumption is that the future value of a stock price depends on the financial indicators although there is no parametric model to explain this relationship. This relationship comes from the technical analysis. Comparison shows that SVR and MLP networks require different inputs. Besides that the MLP networks outperform the SVR technique.

W011 *Model Selection in Top Quark Tagging with a Support Vector Classifier [#1246]*

Davide Anguita, Sandro Ridella, Fabio Rivieccio, Rodolfo Zunino, Silvia Amerio and Ignazio Lazzizzera, DIBE - University of Genoa, Italy; University of Trento, Italy

The problem of tagging a Top Quark generation event in data coming from the Collider Detector at Fermilab is here considered and tackled through the use of a Support Vector Machine Classifier. In order to select a fitting model, a twofold procedure has been adopted. The SVC hyperparameters have been selected through the bootstrap technique and then an additional tuning of the bias value and the error relevance has been performed by means both of a Purity Vs. Efficiency curve and of the AUC value. The generalization capability of the model has been evaluated using the Maximal Discrepancy criterion.

W012 *MaxMinOver: an Incremental Learning Procedure for Support Vector Classification [#1261]*

Thomas Martinetz, Institute for Neuro- and Bioinformatics, Germany

The MinOver algorithm provides an arbitrarily close approximation of the maximum margin classifier in a linearly separable two class classification problem. In its dual formulation, selected training patterns have to be stored. However, this set of patterns does not consist only of support vectors. An extension of this algorithm by a simple forgetting procedure is introduced. This forgetting not only reduces the number of patterns which have to be stored, but also improves convergence bounds. After training, the set of stored training patterns will consist only of support vectors. This MaxMinOver algorithm can be extended to classification with soft margins. The SoftMaxMinOver algorithm exhibits close connections to the nu-SVM.

W013 *Denoising using local ICA and Kernel-PCA [#1296]*

Peter Gruber, Fabian J. Theis, Kurt Stadlthanner, Elmar W. Lang and Ana Maria Tome, University of Regensburg, Germany; University of Regensburg, Institute of Biophysic, Germany; University of Aveiro, Portugal

We present a denoising algorithm for enhancing noisy signals based on local ICA. This is done by applying ICA to the signal in localised delayed coordinates. The components resembling the signals can be detected by various criteria depending on the nature of the signal. Estimators of kurtosis or the variance of the autocorrelation have been considered. The algorithm proposed can favourably be applied to the problem of denoising multidimensional data like images or fMRI data sets. In comparison to denoising algorithms using wavelets, Wiener filters and kernel PCA the local PCA and ICA algorithms perform considerably better. We provide applications of the algorithm to images and the analysis of protein NMR spectra.

Plenary Poster Session: RBF and Wavelet Networks

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W014 *Intelligent Machine Fault Detection Using SOM Based RBF Neural Networks [#1060]*

Sitao Wu and Tommy W.S. Chow, City University of Hong Kong, Hong Kong

A radial-basis-function (RBF) neural network based fault detection system is developed for performing induction machine fault detection and analysis. The optimal network architecture of the RBF network is determined automatically by our proposed cell-splitting grid (CSG) algorithm. This facilitates the conventional laborious trial-and-error procedure in establishing an optimal architecture. In this paper, the proposed RBF machine fault diagnostic system has been intensively tested with unbalanced electrical faults and mechanical faults operating at different rotating speeds. The proposed system is not only able to detect electrical and mechanical faults, but the system is also able to estimate the extent of faults.

W015 *An Evolutionary Clustering Technique with Local Search to Design RBF Neural Network Classifiers [#1161]*

Leandro de Castro, Eduardo Hruschka and Ricardo Campello, Universidade Catolica de Santos - Unisantos, Brazil

Radial basis function neural networks constitute one type of feedforward neural net that requires a suitable determination of the basis functions so as to work properly. Among the many approaches available in the literature, the one proposed here combines a clustering genetic algorithm with K-means to automatically select the number and location of basis functions to be used in the RBF network. Preliminary simulation results suggest that the proposed hybrid algorithm can be successfully applied to classification problems, leading to parsimonious solutions, with competitive classification rates, when compared with other approaches from the RBF literature.

W016 *A Nonlinear Time-Varying Channel Equalizer Using Self-Organizing Wavelet Neural Networks [#1180]*

Cheng-Jian Lin, Chuan-Chan Shih and Po-Yueh Chen, Chaoyang University of Technology, Taiwan

This paper describes the self-organizing wavelet neural network (SOWNN) for nonlinear time-varying channel equalizers. The SOWNN model has a four-layer structure which is comprised of an input layer, a wavelet layer, a product layer and an output layer. The derivative online learning algorithm involves two kinds of learning. The structure learning is performed to determine the network structure and the parameter learning is to adjust the shape of the wavelet bases and the connection weights of a SOWNN. The proposed equalizer is enhanced in order to handle the highly nonlinear functionality. Computer simula- tion results show that the bit error rate of the SOWNN equalizer is very close to that of the optimal equalizer.

W017 *WDN-RBF: Weighted Data Normalization for Radial Basic Function Type Neural Networks [#1377]*

Qun Song and Nikola Kasabov, KEDRI, Auckland University of Technology, New Zealand

This paper introduces an approach of Weighted Data Normalization (WDN) for Radial Basis Function (RBF) type of neural networks. It presents also applications for medical decision support systems. The WDN method optimizes the data normalization ranges for the input variables of the neural network. A steepest descent algorithm (BP) is used for the WDN-RBF learning. The derived weights

have the meaning of feature importance and can be used to select a minimum set of variables (features) that can optimize the performance of the RBF network model. The WDN-RBF is illustrated on two case study prediction/identification problems.

W018 *An Approach employing Signal Sparse Representation in Wavelet domain for underdetermined Blind Source Separation [#1491]*
Eraldo Pomponi, Stefano Squartini and Francesco Piazza, DEIT Universita' Politecnica delle Marche, Italy

Several scientific contributions have recently proposed techniques based on assumption of source sparsity in some representation domain to give a solution to the problem of blind source separation in the underdetermined case. This paper investigates how to employ wavelet based sparse representation of signals in an already existing algorithm for the problem under study, in order to improve separability of sources, in comparison to application of STFT. Moreover, this approach allows to perform a denoising operation after the separation algorithm at a very low computational cost, resulting in a further improvement of source recovering when noise is present at mixture level. Experimental results confirm the effectiveness of what implemented.

W019 *Peak Stick RBF Network for Online System Identification [#1649]*
Hossein Mobahi and Farrokh Janabi-Sharifi, University of Tehran, Iran; Ryerson University, Canada

In many practical problems of online system identification, the distribution of observed samples is uneven. For instance, at points where system is idle or changes slowly, the sample density increases and where system moves quickly, it is reduced. This generally results in performance degradation of learning. We will propose a new algorithm for training RBF networks that is particularly developed for online learning with uneven sample distribution. The basic idea is to find peaks and stick to them. Experiments show a notable improvement in convergence rate, settling of weights and error minimization.

W020 *Frequency domain analysis based RBF networks and their applications to function approximations [#1658]*
Daqi Gao, Yan Ji and Changwu Li, East China University of Science and Technology, China

Time-domain analysis and frequency-domain analysis are two angles of view for us to study and survey a continuous function. In this paper, we observe the approximation problems from the frequency domain. We consider that a one-period sine function can be approximated by two Gasussian kernels. According to that, we present that the first maximum amplitudes as well as their frequencies and initial phases can be used to determine the initial number, centers and widths of radial basis function (RBF) kernels. After the initial structure of an RBF network is determined like that, a small number of RBF kernels can be added in order to further improve the local approximation accuracy. The above viewpoint is verified by two approximation examples.

W021 *Training Multilayer Perceptron and Radial basis Function Networks for Wavefront Sensing and Restoration of Turbulence-Degraded Imagery [#1691]*
Gautham Chundi, Michael Lloyd-Hart and Malur Sundareshan, University of Arizona, Tucson, AZ, United States; University of Arizona, United States

A computationally efficient neural network-based scheme for wavefront reconstruction and restoration of turbulence-degraded imagery in Adaptive Optics (AO)-based telescopes is described in this paper.Popular existing methods suffer from high computational complexity that preclude real-time implementation.For overcoming this "curse of dimensionality", a DCT-based feature extraction scheme to obtain reduced feature set to train a neural network estimator is described.Two neural network architectures (MLP and RBF) trained to estimate wavefront parameters are described and their relative performance in AO implementations is outlined.Performance differences indicate the differences in architecture and training for these two neural networks.

W022 *Improving Novelty Detection in Short Time Series through RBF-DDA Parameter Adjustment [#1733]*
Adriano Oliveira, Fernando Neto and Silvio Meira, Pernambuco University, Brazil; Federal University of Pernambuco, Brazil

Novelty detection in time series is an important problem with application in different domains such as machine failure detection, fraud detection and auditing. We have previously proposed a method for time series novelty detection based on classification of time series windows by RBF-DDA neural networks. This paper proposes a method to be used in conjunction with this time series novelty detection method whose aim is to improve performance by adequately selecting the window size and the RBF-DDA parameter values. The method was evaluated on six real-world time series and the results obtained show that it greatly improves novelty detection performance.

Plenary Poster Session: Principal Component and Independent Component Analysis

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W023 *ICA Photographic Encoding Gear: Image Bases Towards IPEG (special session S8) [#1141]*
Yasuo Matsuyama, Hiroaki Kataoka, Naoto Katsumata and Keita Shimoda, Waseda University, Japan

Independent component analysis (ICA) is applied to image coding. New design methods for ICA bases are presented. The new feature of this learning includes the weak guidance, or decreasing supervisory information. The weak guidance reduces the permutation indeterminacy which is unavoidable in usual ICA algorithms. In view of the image compression, this effect corresponds to the generation of image bases honoring the space frequency's neighborhood and 2D ordering. Following the presentation of this learning algorithm, experiments are performed to obtain serviceable ICA bases. Finally, image compression and restoration are demonstrated to show the eligibility for ``image.ipeg.'' Other applications including image retrieval are also commented.

W024 *An ICA Design of Intraday Stock Prediction Models With Automatic Variable Selection [#1157]*
P.Y. Mok, K. P. Lam and H. S. Ng, The Chinese University of Hong Kong, Hong Kong

In this paper, independent component analysis (ICA) is used to extract the underlying news factors from intraday stock data. A prediction algorithm is developed to improve stock index predictions using such extracted "news". Both linear regression model and nonlinear neural network model are proposed to predict stock indexes using the ICA extracted "news". They are compared with models using only raw intraday data as "news". The result demonstrated that ICA could help extracting market underlying affecting "news", and improve the prediction accuracy. It shows that the proposed ICA prediction algorithm is simple to use and versatile algorithm that automatically extracts the most relevant news for different predictions.

W025 *An On-line ICA-Mixture-Model-based Fuzzy Neural Network [#1498]*
Chin-Teng Lin and Wen-Chang Cheng, National Chiao-Tung University, Taiwan

This paper proposes a new fuzzy neural network (FNN) capable of parameter self-adapting and structure self-constructing to acquire a small number of fuzzy rules for interpreting the embedded knowledge of a system from the given training data set. The proposed FNN is inherently a modified Takagi-Sugeno- Kang (TSK)-type fuzzy rule-based model with neural network's learning ability. There are no rules initiated at the beginning and they are created and adapted through the newly proposed on-line independent component analysis (ICA) mixture model and back-propagation algorithm learning processing that performs simultaneous structure and parameter identification.

W026 *Semi-Invariant Function of Jacobi Algorithm in Independent Component Analysis [#1566]*

Yoshitatsu Matsuda and Kazunori Yamaguchi, The University of Tokyo, Japan

It has been known that several Jacobi algorithms (e.g. JADE, MaxKurt, EML, and so on) are useful in independent component analysis (ICA). This paper shows that the sum of 4th-order (iijj-) cumulants over all the pairs of components is a ``semi-invariant'' function of such Jacobi algorithms. Then we prove that MaxKurt algorithm converges monotonically without loss to a local minimum of the semi-invariant function. In addition, a new algorithm combining EML and JADE is proposed. The EML-JADE algorithm not only uses both maximization and minimization of kurtoses suitably like EML but also utilizes JADE in the cases where super- and sub-gaussian sources are highly mixed.

W027 *Nonlinear Principal Components: projection and reconstruction [#1684]*

Donald MacDonald and Colin Fyfe, University of Paisley, United Kingdom

We review a negative feedback implementation of a Principal Component Analysis artificial neural network and show how, by decoupling the feedforward and feedback mechanism, we may separately affect the projection and reconstruction stages of the network. We therefore introduce a nonlinearity into the projection stage and compare the resulting mapping with a mixture of linear principal components. Finally we derive learning rules which are more optimal for different types of noise and illustrate the resulting network's greater stability on an artificial data set corrupted by shot noise.

W028 *Real-Time PCA(Principal Component Analysis) implementation on DSP [#1707]*

Dongho Han, Yadunandana Rao, Jose Principe and Karl Gugel, University of Florida, United States; University of Florida, Gainesville, United States

PCA(Principal Component Analysis) is a well-known statistical technique used in many signal processing applications. An on-line temporal PCA learning algorithm is implemented on a floating-point DSP for real-time applications. This algorithm is coded in assembly language to optimize. The experimental results showed that the implemented on-line temporal PCA algorithm not only can accurately estimate the principal components from the input but also can track the principal components from the time varying input. And this algorithm can be applied in space easily by using spacial signals as its inputs instead of using the past inputs as in temporal PCA.

W029 *Practical Method for Blind Inversion of Wiener Systems [#1723]*

Kun Zhang and Lai-Wan Chan, The Chinese University of Hong Kong, Hong Kong

In this paper, firstly we show blind inversion of Wiener systems is a special case of blind separation of post-nonlinear mixtures, and derive the learning rule for the former problem. Secondly, we review the Gaussianization method for blind inversion of Wiener systems. This method roughly approximates the convolutive mixture by a Gaussian variable and constructs the inverse nonlinearity easily. Thirdly,to improve the performance, the Cornish-Fisher expansion is used to model the convolutive mixture, and the extended Gaussianization method is developed. We show that the performance of our method is insensitive to the nonlinearity in the Wiener system. Experimental results are presented to illustrate the validity and efficiency of our method.

W030 *Approximating Nonlinear Transformations of Probability Distributions for Nonlinear Independent Component Analysis [#1294]*

Antti Honkela, Helsinki University of Technology, Finland

The nonlinear independent component analysis method by Lappalainen and Honkela uses a truncated Taylor series representation to approximate the nonlinear transformation from sources to observations. The approach uses information only at the single point of input mean and can produce poor results if the input variance is large. This feature has been identified to cause instability of the algorithm with large source dimensionalities. In this paper, an improved approximation is presented. The derivatives used in the Taylor scheme are replaced with slopes evaluated by Gauss-Hermite quadrature. The resulting approximation is more accurate under high input variance and the new learning algorithm more stable with high source dimensionalities.

W031 *Estimation of Propagation Delays using Orientation Histograms for Anechoic Blind Source Separation [#1480]*

Junji Yamashita, Shigeki Tatsuta and Yuzo Hirai, University of Tsukuba, Japan

We proposed a BSS algorithm which exploited orientation histograms in joint distributions of observed mixtures. Although the algorithm worked well for simultaneous mixtures of sources, interaural source propagation delays almost always exist in natural environments. In this paper we extend the algorithm by introducing band-pass filters and various delays for mixture signals to estimate source propagation delays. It is shown that the extended algorithm can estimate source delays and separate mixtures satisfactorily. Since our algorithm does not contain learning and does not suffer from arbitrariness in permutation of recovered sources as ICA algorithms do, it could be much simpler and easier to construct a real-time BSS system.

W032 *Bayesian versus Constrained Structure Approaches for Source Separation in Post-Nonlinear Mixtures [#1513]*

Alexander Ilin, Sophie Achard and Christian Jutten, Helsinki University of Technology, Finland; Univ. of Grenoble, IMAG, France; Lab. des Images et des Signaux, INPG, France

The paper presents experimental comparison of two approaches introduced for solving the nonlinear blind source separation problem: the Bayesian methods developed at Helsinki University of Technology, and the BSS methods introduced for post-nonlinear mixtures at Institut National Polytechnique de Grenoble. The comparison is performed on artificial PNL mixtures both in the standard case of the equal number of sources and observations and in the case of overdetermined mixtures. A new interesting result of the experiments is that globally invertible PNL mixtures, but with non-invertible component-wise nonlinearities, can be identified and sources can be separated, which shows the relevance of exploiting more observations than sources.

W033 *Blind Source Separation Using Time-delayed Signlas [#1310]*

Ana Maria Tome, Ana Rita Teixeira, Elmar W. Lang, Kurt Stadlthanner and A.P. Rocha, University of Aveiro, Portugal; University of Aveiro, IEETA, Portugal; University of Regensburg, Institute of Biophysic, Germany; University of Regensburg, Germany; University of Porto, Portugal

In this work a modified version of AMUSE, called dAMUSE, is proposed. The main modification consists in increasing the dimension of the data vectors by joining delayed versions of the observed mixed signals. With the new data a matrix pencil is computed and its generalized eigendecomposition is performed as in AMUSE. We will show that in this case the output (or independent) signals are filtered versions of the source signals. Some numerical simulations using artificially mixed signals as well as biological data (RR and QT intervals of Electrocardiogram) are presented.

W034 *Committee of Spherical Probabilistic Principal Surfaces [#1306]*

Antonino Staiano, Roberto Tagliaferri, Giuseppe Longo and Piero Benvenuti, DMI, Univeristy of Salerno, Italy; DMI, University of Salerno, Italy; Univeristy of Napoli, Federico II, Italy; INAF, Roma, Italy

Probabilistic Principal Surfaces is a promising latent variable model which represents a powerful tool to be used in a large range of data mining applications, due to its valuable capabilities in data visualization and classification tasks. In this paper we focus our attention on the latter issue, proposing two combining schemes to build an ensemble of Probabilistic Principal Surfaces which is proved to be very effective in classifying very complex artificial and real-world astronomical data.

W035 *Postnonlinear Blind Source Separation via Linearization Identification [#1611]*

Fabian J. Theis and Elmar W. Lang, University of Regensburg, Institute of Biophysic, Germany

In the first part of the paper, the one-dimensional functional equation g(y(t)) =cg(z(t)) with known functions y and z and constant c is studied. Its indeterminacies are calculated, and an algorithm for approximating g is proposed. Then, this linearization identification algorithm is applied to the postnonlinear blind source separation (BSS) problem. In the case of bounded sources, a self-organizing map is used to approximate the boundary, and the postnonlinearity estimation is reduced to the one-dimensional equation from above. For supergaussian sources, the density maxima are interpolated by performing linear BSS within concentric rings. Again postnonlinearity estimation using the ring approximation separates the mixtures.

W036 *Initialization of Directions in Projection Pursuit Learning [#1429]*

Gábor Faddi, András Kocsor and László Tóth, Research Group on Artificial Intelligence, Hungary

The Projection Pursuit Learner is a classifier that resembles a two-layer neural network in which the sigmoid activation functions of the hidden neurons have been replaced by an interpolating polynomial. This modification increases the flexibility of the model but also makes it more inclined to get stuck in a local minimum during gradient-based training. This problem can be alleviated by replacing the random initialization of the parameters by employing feature space transformation methods such as independent component analysis, principal component analysis, linear discriminant analysis and springy discriminant analysis. We find that with this refinement the number of processing units can be reduced by 10 percent to 40 percent.

W037 *Sparse Representation from a Winner-take-all Neural Network [#1637]*

Nan Zhang and Juyang Weng, Michigan State University, United States

In this paper we introduce an incremental algorithm for independent component analysis (ICA) based on maximization of sparseness criteria. We propose using a new sparseness measure criteria function. The learning algorithm based on this criteria leads to a winner-take-all learning mechanism. It avoids the optimization of high order non-linear function or density estimation, which have been used by other ICA methods. We show that when the latent independent random variables are super-Gaussian distributions, the network efficiently extracts the independent components.

W038 *Information Criteria for Reduced Rank Canonical Correlation Analysis [#1674]*

Mohammed Hasan, University of Minnesota Duluth, United States

Canonical correlation analysis is an essential technique in the field of multivariate statistical analysis. In this paper, a framework involving unconstrained optimization criteria is proposed for extracting multiple canonical variates and canonical correlations serially and in parallel. These criteria are derived from optimizing three information based functions. Based on the gradient-ascent or descent methods, we derive many algorithms for performing the true CCA recursively. The main feature of this approach is that orthogonal basis for canonical variates is automatically obtained. The performance of the proposed algorithms is demonstrated through simulations.

Plenary Poster Session: Optimization

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W039 *Exponential Chaotic Tabu Search Hardware for Quadratic Assignment Problems Using Switched-Current Chaotic Neuron IC [#1449]*

Satoshi Matsui, Yukihiro Kobayashi, Watanabe Kentaro and Horio Yoshihiko, Graduate School of Engineering Tokyo Denki Unive, Japan; Graduate School of Engineering,Tokyo Denki Univ., Japan

The quadratic assignment problem (QAP) is one of the nondeterministic polynominal NP-hard combinatorial optimization problems. One of the heuristic algorithms for the QAP is the tabu-search. The exponential tabu-search has been implemented on a neural network, and further extended to be driven by chaotic dynamics based on a chaotic neural network. Moreover, chaotic dynamics has been used in the neural network to avoid the local minima problem. We propose a chaos driven tabu-search neural network hardware system with switched-current chaotic neuron ICs. We build a mixed analog/digital system for the size-10 QAP.

W040 *Chaotic Neuro-Computer Prototype for Quadratic Assignment Problems [#1475]*

Koji Mori, Takahide Okuno and Horio Yoshihiko, Graduate School of Engineering,Tokyo Denki Univ., Japan

Effectiveness of chaotic search dynamics on solving combinatorial optimization problems including the quadratic assignment problem (QAP) has been shown with numerical simulations with chaotic neural networks. The powerful searching ability of the chaotic neuro-dynamics comes from complexity in real number. Therefore, it is essential to implement the chaotic search dynamics with devices that can handle real numbers such as analog electrical circuits. In this paper, we construct a chaotic neuro-computer system consisting of 100 switched-capacitor (SC) chaotic neuron circuits connected via 10000 digital synapse circuits. We solve the QAPs with the prototype neuro-computer hardware system.

W041 *The Implementation of Neural Networks for The Optimization of The Production Scheduling [#1540]*

Tadeusz Witkowski, Pawel Antczak and Grzegorz Strojny, Warsaw University of Technology, Poland

The paper presents the application of the Constraints Satisfaction Adaptive Neural Network to job-shop scheduling problem. The main idea of the CSANN method has been described. Especially the capacity of the net for adaptation to constraints of specific problem has been presented. The computer experiment has been proceeded to find the Johnson criterion (the minimal total time of the performance of all operations). The criterion has mainly been found as a function of the number of iterations of the computing process. Achieved results have been compared with the genetic algorithm AGHAR worked out for the solving of such type of problems.

W042 *Computational Promise of Simultaneous Recurrent Neural Network with A Stochastic Search Mechanism [#1080]*

Jeffrey Geib and Gursel Serpen, The University of Toledo, United States

This paper explores the computational promise of enhancing simultaneous recurrent neural networks with a stochastic search mechanism as static optimizers. Two techniques are employed to assess the added value of a potential enhancement through a stochastic search mechanism: one method entails comparison of SRN performance with a stochastic search algorithm, the Genetic Algorithm, and the second method leverages estimation for the quality of optimal solutions through Held-Karp bounds. Simulation results suggest that there is likely to be significant improvement possible in the quality of solutions if the Simultaneous Recurrent Neural network is augmented with a stochastic search mechanism.

W043 *An Optimization Neural Network Model with Lossy [#1654]*

József Biró and Zalán Heszberger, Budapest Univ. of Techn. and Eco., Hungary

The paper is concerned with continuously operating optimization neural networks with lossy dynamics. As the main feature of the neural model timevarying nature of neuron activation functions is introduced. The model presented is general in the sense that it covers the cases of neural networks for combinatorial optimization (Hopfieldlike networks) and neural models for optimization problems with continuous decision variables (ie Kennedy and Chua's neural network). Besides the rigorous stability analysis of the proposed neural network it is also highlighted the importance of the lossy dynamics, it is shown how to derive lossy versions of improved Hopfield neural models from it and explored the relations to other optimization neural systems.

W044 *Non-feasible Gradient Projection Reccurent Neural Network for Equality Constrained Optimization [#1333]*

Maria Barbarosou and Nicholas Maratos, National Technical University of Athens, Greece

A recurrent neural network for equality constrained optimization problems is proposed, which makes use of a cost gradient projection onto the tangent space of the constraints. The proposed network constructs a generically non-feasible trajectory, satisfying the constraints only as t tends to infinity. Generalized convergence results are given which do not assume convexity of the optimization problem to be solved. Convergence in the usual sense is obtained for convex optimization problems. A circuit realization of the proposed architecture is given to indicate practical implementability of our neural network. Numerical results show that the proposed method is efficient and accurate.

W045 *An Algorithm for Finding Reliably Schedulable Plans [#1098]*

Bálint Takács, István Szita and András Lőrincz, Eötvös Loránd University, Hungary

For interacting agents in time-critical applications, learning whether a subtask can be scheduled reliably is an important issue. The identification of sub-problems of this nature may promote e.g. planning, scheduling and segmenting in Markov decision processes. We define a subtask to be schedulable if its execution time has a small variance. We present an algorithm for finding such subtasks.

W046 *Global Optimisation Methods for Choosing the Connectivity Pattern of N-tuple Classifiers [#1277]*

Luiz C. Garcia and Marcilio C. P. de Souto, Center of Informatics/UFPE, Brazil; Dept. of Informatics/UFRN, Brazil

In this paper, an experimental study on the use of global optimisation methods, such as Genetic Algorithms (GAs), Simulated Annealing (SA) and Tabu Search (TS), applied to the problem of choosing the connectivity pattern of N-tuple classifiers is presented. The results obtained with these methods, together with those achieved with the traditional random sampling, are compared by using statistical hypothesis tests in the context of a real world problem (classification of handwritten numeric characters). All this contrasts to previous work in which a toy problem was used and no statistical test was performed.

W047 *Analog Neural Networks as Asymptotically Exact Dynamic Solvers [#1612]*

József Biró and Zalán Heszberger, Budapest Univ. of Techn. and Eco., Hungary

The paper deals with analog neural networks which can be used for solving nonlinear constrained optimization tasks using the penalty function approach. The neural model developed can be regarded as asymptotically exact dynamic solver in a sense that the equilibrium state represents a solution which can be arbitrarily close to that of the original constrained optimization task. Although it is a quite natural requirement, generally it can be fulfilled only with infinitely large penalty multipliers. The neural network presented provides another way for generating solutions arbitrarily close to the exact one at finite penalty multipliers. The usefulness of the optimization neural network presented is also illustrated by numerical examples.

Plenary Poster Session: Evolutionary computation

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W048 *An Effective Approach to Nonlinear Hammerstein Model Identification Using Evolutionary Neural Networks [#1026]*

Ali Akramizadeh, Mojtaba Hakimi-M and Hamid Khaloozadeh, Ferdowsi University of Mashhad, Iran

In this paper, a new approach to nonlinear system identification using evolutionary Neural Networks and LMS algorithm has been proposed. System in our method is modeled as a Hammerstein model. NN, in the form of nonlinear function, is implemented to approximate nonlinear term, where GA is responsible for finding optimal weights of the NN. GA also offers linear system order, which is used to estimate linear system coefficients through LMS.AIC is used as the fitness function of the GA. Chebychev's polynomials and Taylor's power series are also employed, where simulation results present the effectiveness of the NN with respect to latter functions.

W049 *Application of Fuzzy Classification by Evolutionary Neural Network in Incipient Fault Detection of Power Transformer [#1027]*

Jingen Wang, Lin Shang, Shifu Chen and Yanfei Wang, Nanjing University, China; Artillery Academy of PLA, China

Aiming at the power transformer fault diagnosis, the paper proposes a novel fuzzy classification by evolutionary neural network. The method trains a group of neural networks by combining the modified Evolutionary Strategy with Levenberg-Marquardt optimization method. Thus each trained neural network denotes an "expert" model. The classification results obtained from all "expert" models are integrated. A lot of samples are tested,and the testing results demonstrate that the novel method is much better in neural network structure, classification accuracy, generalization capability,fault-tolerance ability and robustness than the other traditional methods.

W050 *On The Hybrid of Genetic Algorithm and Particle Swarm Optimization For Evolving Recurrent Neural Network [#1031]*

Chia-Feng Juang and Yuan-Chang Liou, Dept. of Electri. Eng., National Chunghsing Univ., Taiwan; Dept. of Electri. Eng., Chung Chou Inst of Tech, Taiwan

This paper describes a new evolutionary system for evolving recurrent neural network based on the hybrid of Genetic Algorithm (GA) and Particle Swarm Optimization (PSO), called HGAPSO. In HGAPSO, individuals in a new generation are created, not only by crossover and mutation operation as in GA, but also by PSO. The objective of PSO is to mimic and incorporate the maturing phenomenon in nature into GA. To test the performance of HGAPSO, a fully connected recurrent network is designed and applied to a temporal sequence production problem. In simulations, the performance of HGAPSO is compared to both GA and PSO, demonstrating its superiority.

W051 *Instinct-Based PSO with Local Search Applied to Satisfiability [#1073]*

Ashraf Abdelbar and Suzan Abdelshahid, American University in Cairo, Egypt

In particle swarm optimization (PSO), each particle stores a candidate solution, and stochastically modifies its candidate over time, based on the best solution found by neighboring particles, and based on the best solution found by the particle itself. In

instinct-based PSO, each particle's behavior is also influenced by a third component which is meant to represent the particle's innate instinct-level intelligence. The instinct component is a function of the intrinsic "goodness" of each dimension of the particle's candidate solution and has similarity to the goodness measure used in ant colony methods. In this paper, we introduce a hybrid of instinct-based PSO and stochastic local search and apply it to weighted max-sat.

W052 *Generational versus Steady-State Evolution for Optimizing Neural Network Learning [#1312]*

John A. Bullinaria, University of Birmingham, United Kingdom

The use of simulated evolution is now a commonplace technique for optimizing the learning abilities of neural network systems. Neural network details such as architecture, initial weight distributions, gradient descent learning rates, and regularization parameters, have all been successfully evolved to result in improved performance. In this paper I investigate which evolutionary approaches work best in this field. In particular, I compare the traditional generational approach with a more biologically realistic steady-state approach.

W053 *A Neural-genetic Algorithm for Feature Selection and Breast Abnormality Classification in Digital Mammography [#1486]*

Ping Zhang, Brijesh Verma and Kuldeep Kumar, Bond University, Australia; Central Queensland University, Australia

This paper proposes a neural-genetic algorithm for feature selection and breast abnormality classification in digital mammography. The proposed algorithm combines the computer-extracted statistical features from the mammogram with the human-extracted features for classifying different types of small size breast abnormalities. We obtained 90.5% accuracy rate for calcification cases and 87.2% for mass cases with different feature subsets. The obtained results show that different types of breast abnormality should use different features for classification.

W054 *Choosing a Starting Configuration for Particle Swarm Optimization [#1541]*

Mark Richards and Dan Ventura, Brigham Young University, United States

The performance of Particle Swarm Optimization can be improved by strategically selecting the starting positions of the particles. This work suggests the use of generators from centroidal Voronoi tessellations as the starting points for the swarm. The performance of swarms initialized with this method is compared with the standard PSO algorithm on several standard test functions. Results suggest that CVT initialization improves PSO performance in high-dimensional spaces.

W055 *Design of B-spline Neural Networks using a Bacterial Programming Approach [#1754]*

Cristiano Cabrita, János Botzheim, Antonio Ruano and László T. Kóczy, University of Algarve, Portugal; Budapest University of Technology and Economics, Hungary

The design phase of B-spline neural networks represents a very high computational task. For this purpose, heuristics have been developed, but have been shown to be dependent on the initial conditions employed. In this paper a new technique, Bacterial Programming, is proposed, whose principles are based on the replication of the microbial evolution phenomenon. The performance of this approach is illustrated and compared with existing alternatives.

W056 *A Combined Genetic optimization and Multilayer Perceptron Methodology for Efficient Digital fingerprint Modeling and Evaluation in Secure Communications [#1768]*

Dimitrios Karras, Chalkis Institute of Tech, Hellenic Open Univ, Greece

A novel procedure based on genetic algorithms and Multilayer Perceptron (MLP) neural networks (NN) is presented for the evaluation and production of digital fingerprints in the design of secure communication systems. The problem of evaluating the quality of such functions is formulated as a global optimization one in the space spanned by all possible messages and is approached from a practical viewpoint by involving genetic algorithms and MLP neural networks, contrary to the very few similar research efforts existing in the literature that are of only theoretical interest.The promising results herein obtained illustrate the importance of applying genetic algorithms and neural networks in communication systems security design.

W057 *Traffic Engineering in Multi-service Networks comparing Genetic and Simulated Annealing Optimization Techniques [#1777]*

Dimitrios Karras, Vasilios Pasias and Rallis Papademetriou, Chalkis Institute of Tech, Hellenic Open Univ, Greece; Portsmouth Univ., United Kingdom

Three new methods for solving the off-line Traffic Engineering (TE) problem in multi-service networks based on genetic optimisation and simulated annealing optimization techniques are presented and compared. In the first method the problem is formulated as an optimisation model with linear constraints and then solved using the Genetic Algorithm for Numerical Optimisation for Constraint Problems (GENOCOP). In the second method it is solved using Simulated Annealing. Besides, a third hybrid method involving GENOCOP and a heuristic TE algorithm is also provided. The performance of the above methods against a standard LP-based optimisation method is examined in terms of two different network topologies and numerical test results are provided.

W058 *Neural Networks with Branch Gates [#1233]*

Kenichi Goto, Kotaro Hirasawa and Jinglu Hu, Waseda University, Japan

In this paper, a new architecture of layered neural networks is proposed named Neural Networks with branch gates (NN-bg). It aims at improving the generalization ability of neural networks by controlling the connectivity of neurons adaptively depending on the input information. To realize such architecture, we use a branch control system having low calculation costs. The parameters of the branch control system are trained by a random searching method, RasID, to realize an adaptive optimization with very small number of training steps. Through some simulations, the usefulness of the three-layered NN-bg is shown compared with conventional layered neural networks.

W059 *Hierarchical Hopfield Neural Network in Solving the Puzzle Problem [#1089]*

Javid Taheri, The University of Sydney, Australia

In this paper, two new approaches based on Artificial Neural Networks for solving the Puzzle Problem are presented. To do this, a Hopfield Neural Network (HNN) is used in a certain constraint satisfaction problem of the puzzle so that the energy of a state can be interpreted as the extent to which a hypothesis fits the underlying neural formulation model. Thus, low energy values indicate a good level of constraint satisfaction. Then, inspired by the way a human being, as an intelligent system, solves a puzzle, two new hierarchical schemes are proposed. In these approaches, some intermediate stage puzzles are designed to guarantee reaching the answer.

W060 *Hybrid Inductive Models: Deterministic Crowding Employed [#1715]*

Pavel Kordik, Miroslav Snorek and Marko Genyk-Berezovskyj, CTU Prague, Czech Republic; Czech Technical University, Czech Republic

Our research draws on experience with Group Method of Data Handling (GMDH) introduced by Ivachknenko in 1966. We have modified Multilayered Iterative Algorithm (MIA) that is commonly used to generate inductive models of real- world systems. In our algorithm heterogeneous units are used instead of units with given polynomial transfer function and therefore Hybrid Inductive Models (HIMs) are generated. This paper shows how to improve the efficiency of search for optimal HIMs. This is attained by employing Deterministic Crowding (DC) method proposed by Mahfoud in 1995. As a by-product of using DC method, we can estimate the importance of input variables for modeled output (sensitivity analysis).

Plenary Poster Session: Adaptive resonance theory

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W061 *Integrating Phrases to Enhance HSOMART-based Document Clustering [#1115]*

Mahmoud Hussin and Mohamed Kamel, University of Alexandria, Egypt; University of Waterloo, Canada

Document clustering is one of the popular techniques that assist users in organizing collections of documents. Two successful models of unsupervised neural networks, SOM and ART have shown promising results in this task. Most of the existing NN-based document clustering techniques rely on a "bag of words" document representation. In this paper, we investigate the use of phrases rather than words as document features applied to our proposed document clustering technique, Hierarchical SOMART, which is a hierarchical network built up from independent SOM and ART neural networks. The experimental results using the extracted phrases as features show an improvement in the clustering performance evaluated using the entropy and F-measure.

W062 *Mahalanobis Distance-Based ARTMAP Network [#1162]*

Hongyu Xu and Marko Vuskovic, San Diego State University, United States

A new ARTMAP-based network is proposed. The training of the new network is based on activation and match functions that are equal and identical to Mahalanobis distance. The training process has improved its efficiency due to the fact that the repeated searches for the resonant node have been eliminated. In addition, the inverse covariance matrices are computed recurrently. The new network is analyzed and compared with the fuzzy ARTMAP and Gaussian ARTMAP. The results from the new network have shown much better hit rates at fewer output nodes on several benchmark problems. A complexity analysis of the three networks is also provided.

W063 *MS-TSKfnn: Novel Takagi-Sugeno-Kang Fuzzy Neural Network Using ART Like Clustering [#1440]*

Di Wang, Chai Quek and Geok-See Ng, Nanyang Technological University, Singapore

In this paper, we propose a novel architecture of neuro-fuzzy system called Modified Self-organizing Takagi-Sugeno-Kang Fuzzy Neural Network (MS-TSKfnn) that uses ART-like clustering called Discrete Incremental Clustering (DIC). The network is able to handle online data input with significant high performance. Its ability of entirely self-organizing to form the network structure without any human supervision is the main advantage over other TSK type fuzzy rule based neuro-fuzzy systems, such as ANFIS and DENFIS. Extensive simulations were conducted using MS-TSKfnn and its performance was encouraging when benchmarked against other established neural and neuro-fuzzy system.

W064 *A Data Partitioning Approach to speed up the Fuzzy ARTMAP algorithm using the Hilbert space-filling Curve [#1520]*

Jose Castro, Michael Georgiopoulos, Ronald DeMara and Avelino Gonzalez, University of Central Florida, Costa Rica; University of Central Florida, United States

FAM, can produce new neurons (templates) on demand to represent classification categories. This allows FAM to automatically adapt to the database without having to specify network structure, but it also has the undesirable effect that, on large databases, it can produce a large network size that can slow down the algorithm. For this we propose the use of the Hilbert space--filling curve (HSFC). Our results indicate that the HSFC can reduce the training time of FAM by partitioning the training. This approach does not affect the classification performance or the network size, and can be used in a parallel setting. We test our results on a Beowulf cluster of workstations on 3 large databases.

W065 *A Comparative Investigation of the RePART Neural Network in Pattern Recognition Tasks [#1360]*

Anne Canuto and Araken Medeiros, Federal University of Rio Grande do Norte, Brazil

This paper presents a comparative investigation of the performance of the RePART model with the ARTMAP-IC model, when applied to two tasks of pattern recognition. Such investigation has as its main objective to verify whether the RePART model presents higher recognition rate than the performance presented by the other model. Also, a statistical method is applied to the results of the neural networks in order to analyse the significance, from a statistical point of view, of the neural network performances.

Plenary Poster Session: Neuro-fuzzy systems

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W066 *A Hybrid n-tuple Neuro-Fuzzy Classifier for handwritten Numerals Recognition [#1602]*

Raida Al-Alawi, University of Bahrain, Bahrain

A hybrid neuro-fuzzy system applied to the classification of handwritten numerals is presented. The system combines the advantages of the n-tuple sampling technique and fuzzy inference system. The n-tuple unit is used as a preprocessing unit for extracting the feature vector from the input pattern. The outputs of the n-tuple unit are fed to a fuzzy inference unit that applies a set of fuzzy rules on the feature vectors and aggregates them to generate its classification response. The classification accuracy of the n-tuple neuro- fuzzy system and the classical n-tuple classifier is compared using handwritten numerals from NIST database. The n-tuple neuro-fuzzy classifier achieves an accuracy of 98.5% on classifying unseen numerals.

W067 *Improving the Interpretability of Takagi-Sugeno Fuzzy Model by Using Linguistic Modifiers and a Multiple Objective Learning Scheme [#1053]*

Shang-Ming Zhou and John Q. Gan, Depart. of Computer Science,University of Essex, United Kingdom

A new TS fuzzy model is presented,in which membership functions(MFs) are characterized by linguistic modifiers. As a result, the trained local models tend to become the tangents of the global model, leading to good model interpretability. Furthermore, an index of fuzziness is proposed to evaluate linguistic modification for MFs with adjustable crossover points.A new learning scheme is also developed, which uses the combination of global approximation error and the fuzziness index as its objective function. By minimizing the multiple objective performance measure, a tradeoff between the global approximation and local model interpretation can be achieved. Experimental results verify good performance of the proposed method

W068 *Fourier fuzzy neural network for clustering of visual objects based on their gross shape and its appliation to handwritten character recognition [#1087]*

Pradeep Patil, Manish Deshmukh, P.v Bonde, Priyadarshan Dhabe and Trimbak Sontakke, Research student, India; Professor, India

In this paper an unsupervised feed forward Fourier fuzzy neural network (FFNN) is proposed which is suitable for clustering of object images based on their gross shapes. This 3-layer feed forward neural network is described along with its training. Its performance is tested for synthetic image database containing objects of various shapes and with realistic image database of handwritten Devanagari digits. FFNN is found superior than the fuzzy min-max neural network (FMN) clustering .

W069 *The Dynamic Fuzzy Method to Tune the Weight Factors of Neural Fuzzy PID Controller [#1230]*
Yongquan Yu, Ying Huang and Bi Zeng, Guangdong University of Technology, China

The new method to modify the weight factors of PID neural network (PIDNN) in neural fuzzy PID controller is presented in this paper. The parameter fuzzy inference base (PFIB) is the structure to carry out the weight-value improving. The principle of PFIB is described and the neural fuzzy PID controller has been used to the steel tube pressure detecting system. The result of running shows that the neural fuzzy PID controller with PFIB has the better and satisfactory behavior for real time industrial control processing.

W070 *A Fuzzy Inference Neural Network Based Method for Short-term Load Forecasting [#1234]*
Hiroyuki Mori and Tadahiro Itagaki, Meiji University, Japan

This paper proposes a fuzzy inference neural network (FINN) based method for short-term load forecasting in electric power systems. FINN focuses on the classification of input and output variables and optimizes the fuzzy membership function and consequence parameter. As the classification technique, FINN makes use of the Kohonen self-organization map and has better performance of extracting the features of input variables due to the addition of the output variable. The proposed method is successfully applied to load forecasting. To demonstrate the effectiveness, it is tested for real data of daily maximum load forecasting in electric power systems.

W071 *Dynamic Bandwidth Allocation Using A Two-Stage Fuzzy Neural Network Based Traffic Predictor [#1383]*
Nayera Sadek and Alireza Khotanzad, Southern Methodist University, United States

The paper presents a predictive dynamic bandwidth allocation (PDBA) scheme that updates the allocated bandwidth periodically to minimize the queue's build- up process. It requires an accurate traffic predictor so we use a two-stage predictor. The first stage includes FARIMA and FNN models running in parallel to predict the traffic data. While FARIMA captures the self-similarity, FNN captures the non-stationarity. The second stage combines the two forecasts using FNN to enhance the prediction accuracy. The performances of the PDBA scheme and the predictors are tested on MPEG and JPEG data. The results show that the two-stage predictor outperforms the individual ones. The proposed PDBA results in lower CLR compared to non-predictive schemes.

W072 *Prior Knowledge for Fuzzy Knowledge-Based Artificial Neural Networks from Fuzzy Set Covering [#1552]*
Jacobus van Zyl and Ian Cloete, International University in Germany, Germany

Prior knowledge in a symbolic form can serve to initialize a knowledge-based neural network. We present a method for encoding fuzzy classification rules derived from a machine learning algorithm based on a fuzzy set covering framework. The inductive bias of the encoding can be adjusted to allow further rule refinement and acquisition. We investigate the effect of these parameters, and show that the classification results correspond exactly to the prior knowledge.

W073 *Map Building and Localization on Autonomous Mobile Robot Using Graph and Fuzzy Inference System [#1677]*
Gyu-Jong Choi and Doo-Sung Ahn, Pukyoung National University, Korea (South)

We propose a new localization and map-building method similar to that of human being in the navigation problem. Human being is assumed to solve a problem through four processes : Exploration Process(EP),Decision Process{DP),Behavior Process(BP) and Learning Process{LP}. We call the processes as human being's capability for solving problems. In this paper, we try to solve navigation problems by transferring this human being's capability into a mobile robot. We show that this method is promising for the mobile navigation problems through a number of simulations.

W074 *The Challenge of using Unsupervised Learning Algorithms for Fuzzy Cognitive Maps [#1735]*
Elpiniki Papageorgiou, Chrysostomos Stylios and Peter Groumpos, University of Patras, Greece; University of Ioannina, Greece

Fuzzy Cognitive Maps (FCMs) is a hybrid method that lies in some sense between Fuzzy Systems and Neural Networks. The methodology of developing FCMs is easily adaptable and relies on human expert experience and knowledge, but till today exhibits weaknesses in utilization of learning methods. The external intervention (typically from experts) for the determination of FCM parameters and the convergence to undesired steady states are significant FCM deficiencies. Thus, it is necessary to overcome these deficiencies in order to improve efficiency and robustness of FCM. Weight adaptation methods can alleviate these problems by allowing the creation of less error prone FCMs where causal links-weights are adjusted through a learning process.

W075 *Determining In-Situ Stress Profiles of Hydrocarbon Reservoirs from Geophysical Well Logs Using Intelligent Systems [#1739]*
Shahab Mohaghegh, Andrei Popa, Razi Gaskari, Steve Wolhart and Robert Siegfried, West Virginia University, United States; ChevronTexaco, United States; Pinnacle Technologies, United States; Gas Technology Institute, United States

This paper presents a new and novel technique for determining the in-situ stress profile of hydrocarbon reservoirs from geophysical well logs using a combination of fuzzy logic and neural networks. It is well established, that in- situ stress cannot be generated from well logs alone. This is because two sets of formations may have very similar geologic signatures but possess different in-situ stress profiles because of varying degrees of tectonic activities in each region. By using two new parameters as surrogates for tectonic activities, fuzzy logic to interpret the logs and rank parameter influence, and neural network as a mapping tool, it has become possible to accurately generate in- situ stress profiles.

Plenary Poster Session: Biomedical applications

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W076 *Neural Network Fusion Strategies for Identifying Breast Masses [#1068]*
Yunfeng Wu, Jingjing He, Yi Man and Juan Ignacio Arribas, Beijing Univ of Posts and Telecommunications, China; Universidad de Valladolid, Spain

In this work, we introduce the Perceptron Average neural network fusion strategy and implemented a number of other fusion strategies to identify breast masses in mammograms as malignant or benign with both balanced and imbalanced input features. To judge from the experimental results, the Weighted Average approach outperforms the other fusion strategies with balanced input features, while the Perceptron Average is superior and achieves the goals with lowest standard deviation with imbalanced ensembles. We concretely analyze the results of above fusion strategies, state the advantages of fusing the component networks, and provide our particular broad sense perspective about information fusion in neural networks.

W077 *Analysis of features for efficient ECG signal classification using neuro-fuzzy network [#1069]*
Stanislaw Osowski and Linh Tran Hoai, Warsaw University of technology, Poland; Hanoi University of Technology, Viet Nam

The paper considers the problem of optimizing the set of features following from Hermite representation of the QRS complex of the electrocardiogram signals for the classification of the heart arrhythmias. The principal component analysis as well as

specially defined quality measure have been applied to verify the discriminative ability of the proposed feature set. As the classifier we have used Takagi-Sugeno-Kang neuro-fuzzy network of the modified structure and learning algorithm, well suited for large size problems. The numerical results of recognition of 7 types of different heart rhythms are presented and discussed.

W078 *Breast MRI data analysis by LLE [#1213]*

Claudio Varini, Tim Nattkemper, Andreas Degenhard and Axel Wismueller, University of Bielefeld, Germany; University of Munich, Germany

Locally Linear Embedding (LLE) has recently been proposed as a powerful algorithm for unsupervised learning and dimensional data reduction. For a first time we apply LLE to a problem of medical data analysis. Magnetic resonance imaging (MRI) is considered as an essential imaging modality in the detection and classification of breast cancer. In dynamic contrast enhanced MRI (DCE-MRI) the data set of each patient is composed of a sequence of images and each data point in the image is associated with one time-series feature vector. Our results show that LLE is capable of revealing the heterogeneity of malignant tumors from the data structure of DCE-MRI signals.

W079 *Classification of Magnetic Resonance Spectra using Parallel Randomized Feature Selection [#1318]*

Nicolino Pizzi and Witold Pedrycz, National Research Council of Canada, Canada; University of Alberta, Canada

Feature selection is a useful preprocessing strategy when dealing with the classification and interpretation of high-dimensional biomedical data, especially when the sample size is small. A classification technique, exploiting parallelization efficiencies, is presented where a set of multi- layer perceptrons are trained on randomly selected feature subsets with varying cardinality. This technique is tested using high-dimensional biomedical spectra acquired from a magnetic resonance spectrometer. The classification results are benchmarked against a conventional multi-layer perceptron architecture as well as linear discriminant analysis. The new technique had a significantly lower classification error than either of the benchmarks.

W080 *Nonlinear analysis and selection of relevant parameters in assesing the treatment results of reducing tremor, using DBS procedure [#1435]*

Oana Voroneanu, Horia-Nicolai Teodorescu and Ciprian Zamfir, Technical University of Iasi, Romania

The DBS (Deep Brain Stimulation) is an invasive method of applying electrical stimulus to a sum of thalamic nucleus.The aim of this research is to find a method to determine if there are abnormal responses to DBS for patients with Parkinson. Being an invasive method it is indicated that before we pursuit with this neurosurgical procedures, we must know if the method will give good results in a specific case. We computed the Lyapunov exponent, the fractal dimension and self-correlation function to asses the relevance of nonlinear dynamic parameters in tremor analysis. To model a nonlinear process like Parkinsonian tremor we considered an iterated nonlinear function, easy to software and hardware implement.

W081 *Characterization of the Temporal Pattern of Cerebral Blood Flow Oscillations [#1703]*

Balázs Benyő, Gábor Lenzser and Béla Palancz , Szechenyi Istvan University, Dep. of Informatics, Hungary; Semmelweis University, Inst. of Human Physiology, Hungary; Budapest University of Technology and Economics, Hungary

Oscillation of the cerebral blood flow (CBF) is a common feature in several physiological or pathophysiological states of the brain. It is a promising opportunity to identify the state of the brain based on the classification of CBF signals. In order to carry out the classification, a feature vector has been extracted from the signals. Unsupervised classification showed that the extracted feature vector is an acceptable representation of the signals. The difference between normal signal and a signal indicating drug injection effect was significant. For the signal classification an Artificial Neural Network model based on supervised backpropagation network has been developed and successfully applied.

W082 *Classification of Fetal Heart Rate during labour using Hidden Markov Models [#1737]*

George Georgoulas, George Nokas, Chrysostomos Stylios and Peter Groumpos, University of Patras, Greece; Univerity of Patras, Greece

Intrapartum Electronic Fetal Monitoring (EFM) is an indispensable mean for fetal surveillance. However the early enthusiasm followed scepticism, since the introduction in every day practise resulted in an increase in operative deliveries. However the drawbacks of EFM relate not so much to the technique itself but more to the difficulties in reading and interpreting the Fetal Heart Rate (FHR). In this study we present an approach to automatic classification of FHR tracings belonging to hypoxic and normal newborns. The classification was performed using a set of parameters extracted form the FHR signal and two Hidden Markov Models (one for each class).

W083 *An Efficient Sequential RBF Network for Bio-Medical Classification Problems [#1242]*

Runxuan Zhang, Narasimhan Sundararajan, Guang-Bin Huang and Paramasivan Saratchandran, Nanyang Technological University, Singapore

GAP-RBF algorithm is a newly developed sequential growing and pruning algorithm for RBF networks for function approximation problems. In this paper, the performance of GAP-RBF for bio-medical classification problems is investigated. Its classification performance is compared with the conventional Multilayer Feed Forward Network and a well-known sequential learning algorithm- MRAN based on two benchmark problems from the bio-medical classification area from PROBEN1 database. The results indicate that GAP-RBF algorithm can achieve a higher or at least similar classification successful rate with a more compact network structure and faster learning speed. Some limitations of this algorithm are also identified.

W084 *Classification of Medical Data with a Robust Multi-Level Combination Scheme [#1525]*

Georgios Tsirogiannis, Dimitris Frossyniotis, Ioannis Stoitsis, Spyretta Golemati, Andreas Stafylopatis and Konstantina Nikita, National Technical University of Athens, Greece

Computer Aided Diagnosis is based on classification of medical data by intelligent classifiers. Especially for medical purposes, the classification must be very efficient, as diagnosis demands a high rate of reliability. Under most circumstances, single classifiers, such as Neural Networks, Support Vector Machines and Decision Trees, exhibit worse performance than ensemble combinations of them, as Bagging and Boosting are. In order to further enhance performance, we propose here a combination of these combination methods in a multi-level combination scheme. After experimentation by using four medical diagnosis problems, the proposed approach seems to be efficient in decreasing the error, compared to the best combining method standalone.

W085 *Neural Network Based Light Attenuation Model for Monitoring Seagrass Health [#1577]*

Habtom Ressom, Padma Natarajan, Siva Srirangam, Mohamad Musavi and Robert Virnstein, Georgetown University, United States; University of Maine, United States; St Johns River Water Management District, United States

Light availability to seagrasses is a major criterion limiting the distribution of seagrasses. Decreased water clarity and resulting reduced light penetration have been cited as major factors responsible for the decline in seagrasses. Light attenuation coefficient is an important parameter that indicates the light attenuated by the water column and can thereby be an indicator of seagrass health. This paper presents a neural network-based light attenuation model for monitoring the seagrass health in the Indian River Lagoon, FL. For performance evaluation, results of the developed neural network model are compared with linear regression models, model trees, and support vector machines.

W086 *3D Spatial Analysis of fMRI Data - A Comparison of ICA and GLM Analysis on a Word Perception Task [#1314]*
Ingo R. Keck, Fabian J. Theis, Peter Gruber, Elmar W. Lang, Karsten Specht and Carlos G. Puntonet, University of Regensburg, Institute of Biophysic, Germany; University of Regensburg, Germany; Research Center Juelich, Institute of Medicine, Germany; Dept. Archi.Techn.Comp., Universidad de Granada, Spain

We discuss a comparative 3D spatial analysis of fMRI data taken during a combined word perception and motor task. We show that a classical GLM analysis using SPM does not yield reasonable results. Only with BSS techniques using the FastICA algorithm can we get meaningful and interesting results. The event - based experiment was part of a study to investigate the network of neurons involved in the perception of speech and the decoding of auditory speech stimuli. Corresponding to 4 different stimuli different independent components (IC) could be identified in the auditory cortex and, most interesting, an IC representing a network of 3 simultaneously active areas in the inferior frontal gyrus could be detected.

Plenary Poster Session: Vision and image processing

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W087 *Self Organising Neural Place Codes for Vision Based Robot Navigation [#1368]*
Kaustubh Chokshi, Stefan Wermter, Christo Panchev and Kevin Burn, University of Sunderland, United Kingdom

Autonomous robots must be able to navigate independently within an environment. In the animal brain so-called place cells respond to the environment an animal is in. In this paper we present a model of place cells based on Self Organising Maps. The aim of this paper is to show how image invariance can improve the performance of the neural place codes and make the model more robust to noise. The paper also demonstrates that localisation can be learned without having a pre-defined map given to the robot by humans and that after training, a robot can localise itself within a learned environment.

W088 *Homomorphic Processing System And Ratio Rule For Color Image Enhancement [#1606]*
Vijayan Asari and Ming-Jung Seow, Old Dominion University, United States

Homomorphic filter is an illumination-reflectance model that can be used to develop a frequency domain procedure for improving the appearance of an image by simultaneous gray-level range compression and contrast enhancement. In this paper, we present a novel color image enhancement process to overcome this limitation. The color image enhancement process involved using a neural network algorithm, namely Ratio Rule, to pre-process and post-process the color image in the homomorphic system. Both color rendition and dynamic range compression are achieved using this method.

W089 *A New Accelerated EM Based Learning of the Image Parameters and Restoration [#1613]*
Faruk Sari and Mehmet Celebi, Tubitak MAM, Turkey; Istanbul Technical University, Turkey

We propose a new method based on the accelerated Expectation Maximization (EM) algorithm to learn the unknown image parameters and restoration. Acceleration is provided using Fisher Scoring (FS) optimization in the M step. Only a small number FS iteration is required for each M step. Our proposed algorithm reaches to the local minima in few steps whereas conventional EM needs more iteration. We also estimate the regularization parameter in the same single structure. Thanks to the FS optimization, it is possible to avoid complicated second derivative of the log-likelihood function by using only the gradient values.

W090 *Feature Extraction and Coding-Reconstruction of the Images Using Neuron-Like Algorithms [#1769]*
Vladimir G. Yakhno and Irina Nuidel, Institute of Applied Physics RAS, Russia

Procedures of various feature extraction in synchronous modes, segmentation for the subsequent coding and reconstruction of the initial gray-tone image are realized. The model of a two-dimensional layer describing a one-layer (one-component) distributed neuron-like system is used for the computer simulation. The system consists of active neuron-like elements with a nonlocal coupling function between them. Analysis of possible collective activity patterns in such a system is carried out. The developed algorithm of image segmentation and reconstruction belongs to the class of synchronous data-processing algorithms.

W091 *Design and Optimization of Amari Neural Fields for Early Auditory-Visual Integration [#1505]*
Carsten Schauer and Horst-Michael Gross, Ilmenau Technical University, Germany; Technical Universtiy Ilmenau, Germany

We introduce a computational model of sensor fusion based on the topographic representations of a two-microphone and one camera configuration to perform a robust multimodal attention-mechanism in artificial systems. We consider neurophysiological findings to discuss the biological plausibility of the coding and extraction of spatial features, but also meet the demands and constraints of applications in the field of human-robot interaction. After introducing a modified Amari-neural field architecture for the audio-visual integration, we place emphasis on a novel method of evaluation and parameter-optimization based on biology-inspired specifications and real-world experiments.

W092 *Sparse coding and NMF [#1288]*
Julian Eggert and Edgar Koerner, HRI Honda Research Institute, Germany

Non-negative matrix factorization (NMF) is a very efficient parameter-free method for decomposing multivariate data into strictly positive activations and basis vectors. However, the method is not suited for overcomplete representations, where usually sparse coding paradigms apply. In this paper, we show how to merge the concepts of non-negative factorization with sparsity conditions. The result is a multiplicative algorithm that is comparable in efficiency to standard NMF, but that can be used to gain sensible solutions in the overcomplete cases.

W093 *Transformation-invariant representation and NMF [#1291]*
Julian Eggert, Heiko Wersing and Edgar Koerner, HRI Honda Research Institute, Germany

Non-negative matrix factorization (NMF) is a method for the decomposition of multivariate data into strictly positive activations and basis vectors. Here, instead of using unstructured data vectors, we assume that something is known in advance about the type of transformations.The key idea is that we factorize the data into activations and basis vectors modulo the transformations. We show that this can be done by extending NMF in a natural way. The gained factorization provides a transformation-invariant and compact encoding that is optimal for the given transformation constraints.

W094 *A Novel Mixed Pixels Unmixing Method for Multispectral Images [#1034]*
Jun-Hua Han, De-Shuang Huang, Zhan-Li Sun and Yiu-ming Cheung, Hefei Institute of Intelligent Machines, CAS, China; Hong Kong Baptist University, Hong Kong

The key to mixed pixels unmixing is to determine a set of spectral endmembers that are representative of the surface components in the area covered by multispectral images. In this paper, we propose a geometric method utilizing the spectrum of two or three bands to determine the endmembers under the assumption that the endmembers are the pure surface components that lie in the extremities of the scatter plot of 2- or 3-band reflectance. If there more bands than endmembers, no additive noise and signature spectral matrixS has full column rank, we can estimate the endmember abundances by unconstrained least squares method. Finally, the validity and feasibility of the algorithm are demonstrated by simulation results.

W095 *Multiple Regression Estimation for Motion Analysis and Segmentation [#1036]*

Vladimir Cherkassky, Yunqian Ma and Harry Wechsler, University of Minnesota, United States; George Mason University, United States

This paper describes multiple model estimation for motion analysis and segmentation, from point correspondences in two successive images. However, the correspondence between data samples and different models (motions) is unknown. Hence, the goal of learning (motion estimation) is two-fold, i.e. estimation (learning) of unknown motions (models) and separation (segmentation) of available data into several subsets corresponding to different motions. We present the mathematical formulation for multiple motion estimation, as a problem of learning several (regression) mappings, from a single data set, and then show a constructive (SVM-based) learning algorithm developed for this setting.

W096 *A Novel Self-Organizing Neural Network for Defect Image Classification [#1305]*

Jussi Pakkanen and Jukka Iivarinen, Helsinki University of Technology, Finland

In this paper a novel self-organizing neural network called the Evolving Tree is applied to classification of defect images. Experiments present a comparison between a normal SOM, a supervised SOM, and the Evolving Tree algorithm for classification of defect images that are taken from a real web inspection system. The MPEG-7 standard feature descriptors are applied. The results show that the Evolving Tree provides better classification accuracies and reduced computational costs over the normal SOMs.

W097 *Histogram Coding For Recognition Of Contours Presented By Bezier Curves [#1564]*

Michael Kussul and Alla Galinskaya, Institute of Mathematical Machines and Systems, Ukraine

In the pattern recognition area, one of the most important tasks is ability of a neural network to classify objects regardless of affine transformations. Contoured objects can be described with Bezier curves and the description is affine transformation invariant. Direct use of the curves for a neural network input isn't applicable because it's possible that descriptions of the same objects consist of different number of Bezier curves. We propose histogram coding, decomposing a list of Bezier curves, which can be used as an input for a neural network. Experiments show that proposed coding gives good results to solve formulated problem.

W098 *Recognizing Objects in Non-Controlled Backgrounds by an Appearance Two-Step Approach [#1203]*

M. Asuncion Vicente, Cesar Fernandez and Oscar Reinoso, Miguel Hernandez University, Spain

This paper presents a method for identifying real three-dimensional objects in non-controlled backgrounds using independent component analysis to eliminate redundant image information present in each object image. The proposed method is a two-step process that allows a coarse color-based detection and an exact localization using shape information. The paper describes an efficient implementation, making this approach suitable for real-time applications.

W099 *A face detection system using shunting inhibitory convolutional neural networks [#1422]*

Fok Hing Chi Tivive and Abdesselam Bouzerdoum, Edith Cowan University, Australia

A face detection system using Shunting Inhibitory Convolutional Neural Networks (SICoNNets) is presented. The topology of these networks is a flexible feedforward architecture with three different connections schemes. SICoNNets were trained, using a hybrid method, to discriminate between face and non-face patterns. All three connection schemes achieve a 99 percent detection accuracy at 5 percent false alarm rate, based on a validation set of 7000 face and non- face patterns. A face detection system is built based on the trained SICoNNets.

W100 *Image Enlargement as an Edge Estimation [#1428]*

Chi-kin Chow and Hung-Tat Tsui, The Chinese University of Hong Kong, Hong Kong

A robust image enlargement algorithm is presented in this paper. We formulate the image enlargement process as an edge information estimation process. In order to achieve a higher resolution, we first perform Pixel Duplication [1] on the target image to form an initial high resolution image. Then the edge details of the enlarged image are estimated by using a novel neural network called "Agent Swarm Regression Network ASRN", which is trained by a set of low resolution (LR) / high resolution (HR) image patch pairs. Two benchmark images were used to verify the performance of the proposed algorithm. The results show that the enlarged images by the proposed algorithm are sharper than those by the conventional methods.

W101 *Unsupervised NN and Graph Matching Approach to Compare Data Sets [#1445]*

Giuseppe Acciani, Girolamo Fornarelli and Luciano Liturri, DEE Politecnico di Bari Via E. Orabona, 4 Bari, Italy

In this paper we describe a technique to compare two data partitions of two different data sets as frequently occurs in defect detection. The comparison is obtained dividing each data set in partitions by means of an unsupervised neural network and associating an undirected complete weighted graph structure to these partitions. Then, a graph matching operation returns an estimation of the level of similarity between the data sets.

W102 *Iris Recognition by a Rotation Spreading Neural Network [#1454]*

Hironobu Takano, Maki Murakami and Kiyomi Nakamura, Toyama Prefectural University, Japan

Rotation spreading neural network (R-SAN net) can recognize the orientation of an object irrespective of its shape, and its shape irrespective of its orientation. The R-SAN net is suitable for the shape and orientation recognition of a concentric circular pattern, because it uses polar conversion. We attempted real-time individual identification by the iris patterns. In the recognition experiment, the R-SAN net was able to simultaneously recognize the orientation and shape of iris images of learned persons. We suggest application of the R-SAN net as an iris recognition system.

W103 *Effect of Noise on the Performance of Temporally-Sequenced Intelligent Block-Matching and Motion-Segmentation Algorithm [#1626]*

Xiaofu Zhang and Ali A. Minai, University of Cincinnati, United States

Block-matching is often used for motion estimation and segmentation, but it faces the problems of noise-sensitivity and texture-insufficiency. Recently, we proposed a two-pathway approach based on locally coupled neural networks to address this issue. The system uses a pixel-level (P) pathway to perform robust block-matching in regions with sufficient texture, and a region-level (R) pathway to estimate motion from feature matching in low-texture regions. The fused optic-flow from the P and R pathways is then segmented by a pulse-coupled neural network (PCNN). The algorithm has produced very good results on synthetic and natural images. In this paper, we show that its performance shows significant robustness to additive noise in the images.

W104 *Video Summarization and Browsing Using Growing Cell Structures [#1676]*

Irena Koprinska and James Clark, University of Sydney, Australia

We present a new approach for video summarization and browsing of MPEG-2 compressed video based on the Growing Cell Structures (GCS) neural algorithms. It first applies GCS to select keyframes for each shot and then clusters them using TreeGCS to form a hierarchical view of the video for efficient browsing. The keyframe selection is based on histogram features of the dc-images for I frames. It captures well the video content and outperforms two other approaches. The main advantage of the TreeGCS module is the ability to form dynamically a flexible hierarchy depending on the video content.

Plenary Poster Session: Hardware implementations

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W105 *Pulsed Neural Networks Based on Delta-Sigma Modulation Suitable for Hardware Implementation [#1133]*

Yoshimitsu Murahashi, Hirohisa Hotta, Shinji Doki and Shigeru Okuma, Nagoya University, Japan

Pulsed Neural Networks based on Delta-Sigma Modulation (DSM-PNN) suitable for digital hardware implementation are introduced in this paper. Using Delta-Sigma modulation, which is a method to convert a signal into a 1-bit pulse-stream, it becomes possible to realize compact hardware implementation and accurate signal processing for pulsed neural networks. Since the proposed method has high versatility, various neural networks can be easily implemented in the hardware. In this paper, two pulsed neural networks, performing PCA or ICA, are introduced and their performance evaluated.

W106 *FPGA Implementation of Bayesian Neural Networks for a Stand Alone Predictor of Pollutants Concentration in the Air [#1196]*

Salvatore Marra, Francesco Carlo Morabito, Pasquale Corsonello and Mario Versaci, University Mediterranea of Reggio Calabria, Italy

In this paper we exploit the potentials of Bayesian Neural Networks(NNs) combined with the advantages of a VLSI implementation to design a stand-alone predictor system of air pollutants time series. NNs are powerful tools to predict air pollutants time series, but usually they run by software programs on PC, which makes difficult their use when are present constraints such as portability and low power dissipation and limited physical size. In this cases, Field Programmable Gate Arrays(FPGAs) represent a suitable platform to realize these models for their reprogrammability. The achieved results have highlighted the efficient design of the hardware network, obtained also using a new circuit to compute the activation function of the neurons.

W107 *A MOS Circuit for Depressing Synapse and its Application to Contrast-Invariant Pattern Classification and Synchrony Detection [#1225]*

Tetsuya Asai, Yusuke Kanazawa, Tetsuya Hirose and Yoshihito Amemiya, Hokkaido University, Japan

A compact complementary metal-oxide semiconductor (CMOS) circuit for depressing synapses is designed for demonstrating applications of spiking neural networks for contrast-invariant pattern classification and synchrony detection. Although the unit circuit consists of only five minimum-sized transistors, they emulate fundamental properties of depressing synapses. The results of the operations are evaluated by both experiments and simulation program with integrated circuit emphasis (SPICE).

W108 *An FPGA Implementation of 1,024-Neuron System for PAPR Reduction of OFDM Signal [#1279]*

Masaya Ohta, Atsushi Mori and Katsumi Yamashita, Osaka Prefecture University, Japan

The aim of this paper is to reduce computational complexity of the neural network for PAPR reduction of OFDM signal, and to implement the neural network including 1,024-neurons by FPGA for practical OFDM transmitter of the terrestrial digital broadcast. A couple of IDFTs reduce computational complexity of neuron updating from O(N^2) to O(NlogN). This neural network is designed by VHDL for Xilinx FPGA device, XC2V6000, and 1,024-neuron system is implemented by less than 30 percent of resources of the device.

W109 *The Library of Building Blocks for an "Integrate and Fire" Neural Network on a Chip [#1780]*

Daniel Hajtas and Daniela Durackova, Slovak University of Technology, Slovakia

This paper is dealing with the design of a library of basic building cells for an "Integrate and Fire" neural network hardware implementation. Each cell of this library consists of transistor level schematic, mathematic model for quick system level simulations, abstracted layout for automatic layout generation and fully checked layout of the cell. The main cells: neuron and a synapse were designed according to their biological counterparts conceptually as close as possible to better mimic the real neural networks. The switched capacitor design technique was involved in the main cells to save the design area. Using this library a test chip was designed and produced and at the end of this paper few measurements are described and shown.

W110 *RTD-based Compact Programmable Gates (special session Sc) [#1145]*

Jose M Quintana, Maria J Avedillo and Hector Pettenghi, Instituto de Microelectronica de Sevilla -CNM, Spain; Instituto de Microelectronica de Sevilla-CNM, Spain

This paper presents novel and extremely compact implementations of programmable gates on the basis of the multi-threshold threshold gate concept. The circuit consists of resonant tunnelling diodes (RTDs) and heterostructure field effect transistors (HFETs) and its operating principle is based on the controlled quenching of clocked series-connected RTDs. The proposed generic circuit topology is presented and the methodology to design specific programmable gates is introduced. A number of programmable gates are shown and their operation is validated.

W111 *Tools and Techniques for Evaluating Reliability of Defect-Tolerant Nano Architectures (special session Sc) [#1102]*

Debayan Bhaduri and Sandeep Shukla, Virginia Tech, United States; Virgina Tech, United States

It is expected that Nano-scale devices will introduce unprecedented level of defects in the substrates. This motivates the search for new architectural paradigms based on redundancy based defect-tolerant designs. However, redundancy is not always a solution to the reliability problem. The key challenge is in determining the level of redundancy and 1the granularity at which defect tolerance is designed to achieve optimal reliability. Analytical probabilistic models to evaluate these levels are error prone and cumbersome. We have developed automated methodologies that can evaluate the reliability measures of Boolean networks and can be used to analyze trade-offs between reliability and redundancy for different architectural configurations.

W112 *Training Fast Mixed-Signal Neural Networks for Data Classification [#1350]*

Steffen Hohmann, Johannes Fieres, Karlheinz Meier, Johannes Schemmel and Tillmann Schmitz, Kirchhoff Institute for Physics, Germany; University of Heidelberg, Germany

This paper presents an incremental training approach that allows for the use of evolutionary algorithms to efficiently train the weights of fast mixed-signal hardware neural networks. The training strategy is tested on a set of common classification benchmark problems and the results demonstrate that the used hardware neural network architecture can successfully be trained to solve real-world problems. It is also shown that the presented training strategy is suited for use in conjunction with a specialized coprocessor that speeds up evolutionary algorithms by performing the genetic operations within a configurable logic.

W113 *A Simple MOSFET Model Of An Artificial Synapse [#1414]*

Momchil Milev, Technical University of Sofia, Bulgaria

A simple analog-signal synapse model is developed and later implemented on a standard 0.35um CMOS process to provide for large scale of integration, high processing speed and manufacturability of a multi-layer artificial neural network. Synapse non-linearity with respect to synapse weight is studied. Demonstrated is the capability of the circuit to operate in both feed-forward and learning (training) mode. The effect of the synapse's inherent quadratic nonlinearity on learning convergence and on the optimization of weight vector update direction is analyzed and found to be beneficial. The suitability of the proposed implementation for very large-scale artificial neural networks is confirmed.

W114 *Prototype Optoelectronic Hamming Neural Network [#1448]*

Marta Ruiz-Llata, David Cambre and Horacio Lamela, Universidad Carlos III de Madrid, Spain

In this paper we describe the hardware implementation of a Hamming classifier using an optoelectronic architecture. It is composed of two layers, the first layer is an optoelectronic matrix-vector multiplier based on the optical broadcast architecture; it is a novel architecture composed of a set of electronic neurons that receive the input sequentially by means of an optical broadcast interconnection. The second layer is an electronic winner take all circuit. The main characteristics of the system it is readily scalable in speed and size to large numbers of pixel neurons. We will describe the optoelectronic architecture, the hardware implementation of a prototype and evaluation of its performance characteristics.

W115 *Digital Pulse Mode Neuron with Robust Nonlinear Activation Function [#1579]*

Hiroomi Hikawa, Oita University, Japan

This paper proposes a new type of digital synchronous pulse mode neuron with robust nonlinear activation function. Proposed neuron employs additive Gaussian random noise and exponential averaging for input signals to have stable internal potential. Theoretical analysis and simulations are carried out to verify the feasibility of the neuron. The results show that the activation function is invariable against the change of the number of inputs to the neuron. Experimental multilayer neural network is fabricated with the proposed neurons to perform binary classification problems. Experimental results show that the proposed neuron has comparable performance to other neurons while requiring less hardware and providing faster operation.

W116 *Implementation of a Large Scale Hardware Neural Network System based on Stochastic Logic [#1679]*

Akiyoshi Momoi, Shunsuke Akimoto, Shigeo Sato and Koji Nakajima, Tohoku University, Japan

In this paper, we present a large scale hardware neural network system which consists of 16 chips, 1024 neurons. The system is realized by using stochastic logic. Stochastic logic make possible to implement numerous neurons on a VLSI chip and to build a system comprising multiple chips easily. In addition, stochastic logic has a characteristic as some noise is generated while coding operations. This noise is effective for escaping from the local minima in a Hopfield network. The availability of this noise is confirmed in the measurement of our system.

W117 *Reversible Logic Neural Networks [#1747]*

Anas N. Al-Rabadi, Portland State University, United States

Novel Reversible Neural Network (RevNN) architecture is introduced, and a RevNN paradigm using supervised learning is presented. The application of RevNN to multiple-output feedforward plant control is shown. Since the reduction of power consumption is a major requirement for circuit design of future technologies such as in quantum computing, the main features of several future technologies will include reversibility, and thus the new RevNN circuits can play an important role in the design of circuits that consume minimal power for applications such as low-power control of autonomous robots.

W118 *Self-Organizing Map Hardware Accelerator System and its Application to Realtime Image Enlargement [#1471]*

Hakaru Tamukoh, Takashi Aso, Keiichi Horio and Takeshi Yamakawa, Kyushu Institute of Technology, Japan; Kyushu Institute of Information Sciences, Japan

In this paper, we propose a new fast learning algorithm for SOM and its digital hardware design. The maximum performance is 17500 MCUPS when it is realized by using Xilinx XCV6000-6 FPGA. The system achieves SOM up to 256 competing units (16*16 map) can be implemented in the FPGA. Each competing unit have weight vector which is represented by 128 elements of 16 bits accuracy. Furthermore, we applied a proposed hardware to realtime digital image enlargement system. In the case of full color (24 bits) image enlargement from QQVGA (160*120 pixel) to QVGA (320*240 pixel), the proposed hardware requires only 0.12 second per an image, while the personal computer (Intel XEON, 2.8GHz Dual) requires more than 5 second per an image.

W119 *CPCA: A Multiplierless Neural PCA [#1499]*

Radu Dogaru, Ioana Dogaru and Manfred Glesner, University "Politehnica" of Bucharest, Romania; BC Microsystems S.R.L. - Bucharest, Romania; Technical University of Darmstadt, Germany

A multiplierless neural architecture for PCA is proposed. The aim is to reduce the VLSI complexity of its implementation by eliminating the multipliers. Comparisons with standard PCA methods show no degradation in performances (in most cases they are even improved) while the reduced hardware complexity allows for efficient low power implementations.

Plenary Poster Session: Signal processing

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W120 *Deployment of Head-Related Transfer Function using All-Pole Filters and Neural Network-Based Storage Devices [#1016]*

Wai Chu, DoCoMo USA Labs, United States

The present study is concerned with the use of neural networks as storage devices for the deployment of head-related transfer function (HRTF) in three- dimensional (3D) audio applications. There are two main advantages for this proposition: reduced storage cost and direct interpolation. The network structure, training procedure, and experimental results are provided to illustrate the effectiveness of our approach. It is shown that by using thirty five percent of the original number of filter parameters, a relatively low average spectral distortion of 1.62dB can be obtained.

W121 *TLS Linear Prediction with Optimum Root Selection for Resolving Closely Space Sinusoids [#1117]*

C. F. So, S. C. Ng and S. H. Leung, The Hong Kong Polytechnic University, Hong Kong; The Open University of Hong Kong, Hong Kong; City University of Hong Kong, Hong Kong

Total least square linear prediction has been successfully applied to frequency estimation for closely spaced sinusoids. In low signal to noise ratio, the resolving ability of TLS is degraded and extraneous roots of the predictor are close to unit circle. Hence the performance of total least square is severely degraded in low SNR. In this paper, a generalized total least squares method with a new root selection criterion, which is based on the envelope of the signal spectrum, is presented. An optimum procedure is introduced to provide a TLS solution that can perform closer to Cramer-Rao Bound, particularly in low SNR.

W122 *Expert Systems and Artificial Neural Networks applied to Stellar Optical Spectroscopy: A Comparative Analysis [#1299]*

Carlos Dafonte, Alejandra Rodriguez, Bernardino Arcay, Minia Manteiga and Iciar Carricajo, University of A Coruna, Spain

This paper presents a comparative study of two computational techniques -expert systems and artificial neural networks- applied to a specific field of Astrophysics, the classification of the optical spectra of stars. We present a description of various expert systems and neural networks models, and the comparison of the results obtained by each technique individually and by a combination of both. We do not only intend to analyse the efficiency of these two approaches in the classification of stellar spectra; our final objective is the integration of several techniques. This system is capable of applying the most appropriate classification method to each spectrum, which widely opens the research in the field of automatic classification.

W123 *A Loudspeaker Response Model using Tuneable Approximate Piecewise Linear Regression [#1075]*
Anthony Zaknich, The University of Western Australia, Australia

A practical loudspeaker frequency response interpolation model is developed using a Tuneable Approximate Piecewise Linear Regression (TAPLR) model that can provide a complete amplitude and phase response over the full frequency range of the loudspeaker. This is achieved by taking a finite number of standard one-twelfth octave frequency amplitude measurements at a one meter distance in front of the loudspeaker. The Hilbert transform can be used to compute corresponding phase response from the amplitude response.

W124 *Information-Theoretic Approach to multi channel Signal Extraction by Multiple Interference Cancellation in Electrochemical Array Data [#1681]*
Guillermo Bedoya, Sergio Bermejo and Joan Cabestany, Technical University of Catalonia (UPC), Spain

An information-theoretic approach oriented to develop on-line algorithms for electrochemical array data processing is presented.We deal with the multi channel processing of the signals acquired by an array of non linear silicon- based chemical sensors. The objective is to extract multiple desired signals by the cancellation of multiple interferences in high noisy environments. The nonlinear mixture separation is achieved in the presence of interference and strong cross nonlinearities, by minimizing the output mutual information, considering mutually independent sources . Numerical results demonstrate the viability of the proposed source separation approach in the context of array signal extraction.

W125 *Continuous Time Delay Neural Networks for Detection of Temporal Patterns in Signals [#1751]*
Reza Derakhshani and Stephanie Schuckers, West Virginia University, United States; Clrakson University, United States

A method for temporal pattern recognition for continuous time signals is addressed. It is shown how a simple form of back-propagation can be used in conjunction with a temporal error signal to adapt both the weights and path delays of a continuous time delay feed forward multi-layer neural network with hard- limited output. An instance of such a network is simulated and some of the results are discussed. During the initial tests the network showed robust capabilities for detection of temporal patterns, including fast recognition of onsets of new waveforms in presence of moderately heavy noise and phase and frequency distortions.

Plenary Poster Session: Time-series analysis

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W126 *Interdisciplinary Research and Speech Rhythm [#1090]*
Oleg Skljarov, St.Petersburg Res. Institute of ETN and Speech, Russian Federation

Speech rhythm is defined as sequence of durations for segments obtained as "Voiced segment - Unvoiced segment". Rhythm evolution is described as the logistic mapping on this set. Rhythm has chaotic nature in normal speech and it has regular and chaotic features at stuttering. It turned out that the nets offered by van der Maas have exactly same route to chaos in dependence on the changing control parameter or parameter of "learning" in the net as the logistic map with the same control parameter has. Moreover, within the framework of the offered mathematical model the causes which change these rhythm regimes are established. It allowed to apply in clinic optimal course of treatment for each stutterer individually.

W127 *Financial Forecasting using Random Subspace Classifier [#1125]*
Dmitry Zhora, Institute of Software Systems, Ukraine

Random Subspace Classifier is used for prediction of a stock price return. While obtaining interesting results with a basic model it's possible to construct more competitive network by using several approaches for improving the prediction accuracy and performance characteristics. The following methods are considered in this work: normalizing input data, generating a sensitive classifier structure and variance structure selection. The best average success rate achieved in the prediction of the stock price change direction is 58.1%.

W128 *Option Pricing and Trading With Artificial Neural Networks and Advanced Parametric Models With Implied Parameters [#1149]*
Panayiotis Andreou, Spiros Martzoukos and Chris Charalambous, University of Cyprus, Cyprus

We combine parametric models and neural networks to price and trade European SP500 options. Neural networks are optimized on a hybrid target function of the residual term between market price and parametric option estimate. Parametric models include: (i) Black and Scholes; (ii) Corrado and Su that additionally allows for excess skewness and kurtosis; (iii) analytic models that incorporate multiple sources of Poisson distributed jumps; and (vi) stochastic volatility and jump models. Daily average implied parameters of these models are estimated with options transaction data. These structural average implied parameters are used to validate the out-of sample pricing and trading (with transaction costs) ability of all models developed.

W129 *Enhanced Forecasting Approach -- An Integration of NGARCH and Hybrid BPNN-Weighted Grey-C3LSP [#1174]*
Bao Rong Chang, National Taitung University, Taiwan

Hybrid BPNN-weighted Grey-C3LSP (BWGC) prediction has been introduced earlier to overcome the crucial problem of overshooting phenomenon. However, some predicted values have been shown not precisely enough as the observations are really far away from both GM(1,1,alpha) and cumulated 3 points least squared linear prediction (C3LSP) outputs. Therefore, this study proposes a new prediction approach, incorporating non-linear generalized conditional heteroscedasticity (NGARCH) to integrate hybrid BPNN-weighted GREY-C3LSP prediction, in which the smoothness of the final predicted output has been improved. In this way, the model's generalization is enhanced so as to further improve the prediction accuracy.

W130 *A Retraining Neural Network Technique for Glass Manufacturing Data Forecasting [#1352]*
Iulian Nastac and Adrian Costea, Turku Centre for Computer Science, Finland

This paper advances a retraining-neural-network-based forecasting mechanism that can be applied to complex prediction problems, such as the estimation of relevant process variables for glass manufacturing. The main purpose is to obtain a good accuracy of the predicted data by using an optimal feedforward neural architecture and well-suited delay vectors. The artificial neural network's (ANNs) ability to extract significant information provides a valuable framework for the representation of relationships present in the structure of the data. The evaluation of the output error after the retraining of an ANN shows that the retraining technique can substantially improve the achieved results.

W131 *Demand Forecasting by the Neural Network with Fourier Transform [#1482]*
Makiko Saito and Yoshitsugu Kakemoto, Japan Research Institute, Japan

This paper proposes a new demand forecasting method using the Neural Network and Fourier Transform. In this method, time series data of sales results considered as a combination of frequency are transformed into several frequency data. They are identified from objective indexes that consist of product properties or economic indicators and so forth. This method is efficient for demand forecasting aimed at new products that have no historical data.

W132 *Daily Peak Temperature Forecasting with Elman Neural Networks [#1529]*

Salvatore Vitabile, Mose' Pernice and Salvatore Gaglio, ICAR - Italian National Research Council, Italy; DINFO - University of Palermo, Italy

This paper presents a forecaster based on an Elman Artificial Neural Network trained with Resilient Backpropagation algorithm for predicting the daily peak temperatures one day ahead. The available time series was recorded at Petrosino (TP), in the west coast of Sicily, Italy and it is composed by temperature (min and max values), the humidity (min and max values) and the rainfall value between January 1st, 1995 and May 14th, 2003. Performances and reliabilities of the proposed model were evaluated by a number of measures, comparing different neural models. Experimental results show very good prediction performances.

W133 *Electric Load Demand Prediction using Neural Networks Trained by Kalman Filtering [#1582]*

Edgar Sanchez, Alma Alanis and Jesus Rico, CINVESTAV, Unidad Guadalajara, Mexico; Universidad MIchoacana, Mexico

This paper presents the application of recurrent multilayer perceptron neural networks to electric load demand prediction; the respective training is performed by extended Kalman filtering. The goal is to obtain a 24 hours horizon prediction for the electric load demand; data from the State of California, USA is utilized.

W134 *A SVCA Model for The Competition on Artificial Time Series [#1789]*

Federico Palacios-Gonzalez, Universidad de Granada, Spain

This paper predicts the 100 missing values proposed in the CATS Benchmark detailing my approach and results in the construction of a FCA model. An autoregressive model with coefficients that are smooth and fluctuant functions on time is fitted by minimizing the residual squared sum under four restrictions for the first difference of the given series. The coefficient functions are built by sin(.) and cos(.) functions with parameters playing as amplitude, phase and semi-period

W135 *Prediction of the CATS benchmark using a Business Forecasting Approach to Multilayer Perceptron Modelling [#1795]*

Sven F. Crone, Heiko Kausch and Dieter Pressmar, Lancaster University, United Kingdom; University of Hamburg, Germany

Various heuristic approaches have been proposed to limit design complexity and computing time in artificial neural network modelling and parameterisation for time series prediction, with no single approach demonstrating robust superiority on arbitrary datasets. In business forecasting competitions, simple methods robustly outperform complex methods and expert teams. To reflect this, we follow a simple neural network modelling approach, utilising linear autoregressive lags and an extensive enumeration of important modelling parameters, effectively modelling a miniature forecasting competition. Experimental predictions are computed for the CATS benchmark using a standard multilayer perceptron to predict 100 missing values in five datasets.

W136 *Forecasting Electricity Market Prices: A Neural Network based Approach [#1441]*

Y. Y. Xu, Rex Hsieh, Y. L. Lu, Y. C. Shen, S. C. Chuang, H. C. Fu, Christoph Bock and H.T. Pao, CSIE, National Chiao Tung University, Taiwan; National Chiao-Tung University, Taiwan; ICM, Universities Mannheim and Heidelberg, Germany; Department of Management, NCTU, Taiwan

This paper presents a neural network to forecast the Phelix Base electricity market prices for European Energy Exchange (EEX). Up to now there has been little scientific work on forecasting the price development on the electricity markets. In this study, multilayer feed-forward neural networks (MLNN) are used to predict various period for 7, 14, 21, 28, 63, 91, 182, and 273 days ahead of electric prices. The experimental results of forecasting by MLNNs and linear methods (autoregressive error model) are compared. The MLNNs outperform from 11.4 percent to 64.6 percent superior to the traditional linear regression method. It seems that the proposed MLNN can be very useful in predicting the electricity market prices of EEX.

W137 *Counterpropagation with delays for financial prediction [#1551]*

Carmen Fierascu and Claudia-Lidia Badea-Simionescu, University of Salzburg, Austria

The counterpropagation network was obtained by combining Kohonen learning and Grossberg learning. By adding of dynamical elements in the Kohonen learning, we obtained a new network, the counterpropagation neural network with delays. This network is suitable to be applied for solving problems in the domain of temporal sequence processing. An application to a financial prediction problem, the forecasting of the currency exchange rate is shown.

W138 *Neural Network Prediction of the Wave Influence on the Yaw Motion of a Ship [#1734]*

Viorel Nicolau, Dorel Aiordachioaie and Rustem Popa, "Dunarea de Jos" University, Romania

Knowing the wave influence on the yaw motion of a ship, a more complex heading control law for autopilot system can be implemented. The time series prediction of the yaw angle's measured values using neural networks has been investigated in this paper. Several neural networks are analyzed using different training data sets and noise conditions. The predictor is working well even if both the training and testing sets are affected by measurement noise.

Plenary Poster Session: Probabilistic and information theoretical methods

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W139 *Systematic Testing of Generalization Level During Training in Regression-Type Learning Scenarios [#1156]*

Pablo Zegers and Malur Sundareshan, Universidad de los Andes, Chile; University of Arizona, United States

In training a Learning Machine (LM) it is important to determine when an adequate level of generalization has been reached. This is a problem for which no satisfactory solution has been found yet. However, it can be observed that as a LM becomes consistent and reaches an acceptable generalization threshold, finding samples that make the system fail and trigger a new cycle of the training algorithm becomes more infrequent. Moreover, it is observed that this happens at a faster than exponential pace. The existence of this behavior is proven true for a broad class of LMs. An algorithm is designed to exploit this characteristic of LMs in order to easily determine the degree of generalization attained by a LM from its training behavior.

W140 *Clustering using neural networks and Kullback-Leibler divergency [#1208]*

Allan Medeiros, Adriao D. Doria Neto, Jorge Dantas de Melo and Alfredo Costa, Potiguar University, Brazil; Federal University of Rio Grande do Norte, Brazil

In this work we develop a clustering algorithm based on Kullback-Leibler divergence as the dissimilarity measurement. That measure is used with an algorithm that uses the classical vector quantization with competitive neural networks to perform the clustering of spatially complex data sets. The algorithm is also presented as an alternative tool to obtain a model based on gaussian mixture of complex data sets. The clustering algorithm is tested with several data sets generated artificially. All sets in the data set is also modelled with a gaussian mixture using the proposed algorithm.

W141 *Randomized Approach to Verification of Neural Networks [#1217]*

Radoslaw Zakrzewski, Goodrich Corporation, United States

Rigorous verification of neural nets is needed in safety-critical applications. This paper investigates feasibility of randomized verification. The previously developed deterministic method suffers from exponential dependence on dimensionality. In contrast, complexity of the randomized method is independent from the problem dimension. The problem is formulated as Monte Carlo estimation of failure probability. Instead of the Chernov-based bound for the required number of samples, a much better condition is found for the special case with zero observed failures. The method is already practically feasible with the currently available computers. Possible acceptance of statistical verification by certification authorities is briefly discussed.

W142 *Partially Observed Values [#1340]*

Tapani Raiko, Helsinki University of Technology, Finland

It is common to have both observed and missing values in data. This paper concentrates on the case where a value can be somewhere between those two ends, partially observed and partially missing. To achieve that, a method of using evidence nodes in a Bayesian network is proposed. Different ways of handling inaccuracies are discussed in examples and the proposed approach is justified in the experiments with real image data. Also, a justification is given for the standard preprocessing step of adding a tiny amount of noise to the data, when a continuous-valued model is used for discrete-valued data.

W143 *Teacher-Directed Information Maximization [#1348]*

Ryotaro Kamimura, Tokai University, Japan

In this paper, we propose a new method for information-theoretic competitive learning that maximizes information about input patterns as well as target patterns. The method is called "teacher-directed information maximization", because target information directs networks to produce appropriate outputs. We use information-theoretic competitive learning with Gaussian activation functions. Teacher information is added by distorting the distance between input patterns and connection weights. We applied our method to two problems: a road classification problem and a voting attitude problem. In both problems, we could show that training errors could be significantly decreased and better generalization performance could be obtained.

W144 *Greedy Network-Growing by Minkowski Distance Functions [#1464]*

Ryotaro Kamimura and Osamu Uchida, Tokai University, Japan

We propose a new network-growing method to accelerate learning and to extract explicit features in complex input patterns. We have so far proposed a network-growing algorithm called greedy network growing algorithm. In the algorithm, the inverse of the square of the ordinary Euclidean distance is used to produce competitive unit outputs. When applied to some problems, the method has shown slow learning. To remedy this shortcoming, we introduce here Minkowski distance between to produce competitive unit outputs. We applied our new method to the analysis of some economic data. In the experiment, results confirm that a new method with Minkowski distance can significantly accelerate learning, and clearer features can be extracted.

W145 *Accuracy of Joint Entropy and Mutual Information Estimates [#1625]*

Fülöp Bazsó, Andrea Petroczi and László Zalányi, KFKI Res. Inst. for Particle and Nuclear Physics, Hungary; School of Life Sciences, Kingston University, Great Britain

In practice, researchers often face the problem of being able to collect only one, possibly large, dataset, and they are forced to make inferences from a single sample. Based on the results of the polarisation operator technique of Bowman et al, we computed the dependence of joint entropy and mutual information estimates on the sample size in terms of asymptotic series. These expressions enabled us to control the bias of the estimates caused by finite sample sizes and obtain an expression for the accuracies. The result is important in data mining when joint entropy and mutual information are used to find interdependencies within large data sets with unknown underlying structures.

W146 *A Quick Learning Method That Gambles --A Learning System that Hates Learning-- [#1675]*

Koichiro Yamauchi, Oshima Ryuji and Omori Takashi, Hokkaido University, Japan

This paper presents a quick machine learning system inspired by Human learning behavior. Data-mining systems usually need a large number of iterations to acquire correct solutions, whereas people usually find appropriate hidden rules after only a small number of observations of the instances in a dataset. We think that this quick learning is the result of using tentative hypothesis as the data-model in the early steps of the learning. If the hypothesis happens to be accurate, the learning will be completed immediately after the hypothesis is applied. Our new machine learning system emulates this process by minimizing an objective function that represents not only the likelihood of error but also the predicted learning-cost.

W147 *A Training-time Analysis of Robustness in Feed-Forward Neural Networks [#1689]*

Cesare Alippi, Daniele Sana and Fabio Scotti, Politecnico di Milano, Italy; University of Milan, Italy

The paper addresses the analysis of robustness over training time issue. Robustness is evaluated in the large, without assuming the small perturbation hypothesis, by means of Randomised Algorithms. We discovered that robustness is a strict property of the model -as it is accuracy- and, hence, it depends on the particular neural network family, application, training algorithm and training starting point. Complex neural networks are hence not necessarily more robust than less complex topologies. An early stopping algorithm is finally suggested which extends the one based on the test set inspection with robustness aspects

Plenary Poster Session: Cognitive information processing

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W148 *Scene Learning and Glance Recognizability based on Competitively Growing Spiking Neural Network [#1091]*

Masayasu Atsumi, Soka University, Japan

We have been building the competitively growing spiking neural network for quick one-shot object learning and glance object recognition, which is the core of our saliency-based scene memory model. This neural network represents objects using latency-based temporal coding and grows size and recognizability through learning and self-organization. Through simulation experiments of a robot equipped with a camera, it is shown that object and scene learning and glance object recognition are well performed by our model.

W149 *Symbol Grounding Transfer with Hybrid Self-Organizing/Supervised Neural Networks [#1114]*

Thomas Riga, Angelo Cangelosi and Alberto Greco, University of Plymouth, United Kingdom; University of Genoa, Italy

This paper reports new simulations on an extended neural network model for the transfer of symbol grounding. It uses a hybrid and modular connectionist model, consisting of an unsupervised, self-organizing map for stimulus classification and a supervised network for category acquisition and naming. The model is based on a psychologically-plausible view of symbolic communication, where unsupervised concept formation precedes the supervised acquisition of category names. The simulation results demonstrate that grounding is transferred from symbols denoting object properties to newly acquired symbols denoting the object as a whole. The implications for cognitive models integrating neural networks and multi-agent systems are discussed.

W150 *Classifying Cognitive States from fMRI Data using Neural Networks [#1562]*

Iosif-Viorel Onut and Ali A. Ghorbani, University of New Brunswick, Canada

Since the discovery of Functional Magnetic Resonance Imaging (fMRI) studies have proved that this technique is one of the best for collecting vast quantities of data about activity of the human brain. Our aim is to use this information in order to predict the cognitive status of the subject given its fMRI activity. We present a new approach for creating Single-Subject classifiers using bagging from a pool of feed-forward backpropagation networks. Our experiments indicate that as the number of selected voxels increases, the accuracy of the system improves to about 70 percent. Eventually it reaches a (near) saturation point after which the increase in the accuracy is very slow.

W151 *On the Need for On-line Learning in Brain-Computer Interfaces [#1623]*

Jose del R. Millan, IDIAP Research Institute, Switzerland

In this paper we argue for on-line learning in brain-computer interfaces (BCI) and illustrate its benefits with the simplest method, namely fixed learning rates. However, this method is supported by the risk of hampering the user to acquire suitable control of the BCI if the classifier changes too rapidly. We report results with 3 beginner subjects in a series of consecutive recordings, where the classifiers are iteratively trained with the data of a given session and tested on the next session. These results show that on-line learning improves systematically the performance of the subjects. Moreover, performance with on-line learning is statistically similar to that obtained training the classifier off-line with the same amount of data.

W152 *Value System Development for a Robot [#1629]*

Xiao Huang and Juyang Weng, Michigan State University, United States

We present a refined model for online development of value system. As an indispensable part of a developmental robot, the value system signals the occurrence of salient sensory inputs, modulates the mapping from sensory inputs to action outputs, and evaluates candidate actions. No salient feature is predefined in the value system but instead novelty based on experience, which is applicable to any task. Furthermore, reinforcer is integrated with novelty. Thus, the value system of a robot can be developed through interactions with trainers. In the experiment, we treat vision-based neck action selection as a behavior guided by the value system. The robot's behavior is consistent with the attention mechanism in human infants.

W153 *Incremental Learning of Temporal Sequences Using State Memory and a Resource Allocating Network [#1653]*

Yoshio Konishi and Robert Fujii, University of Aizu, Japan

A network which can learn temporal patterns incrementally is proposed. The network uses a) gaussian functions to represent various output values and b) chunking to group similar patterns so that compact network can be realized. The learning capacity limits were evaluated for the worst case sequences. Learning of sequences can be performed using a simple one step algorithm.

Plenary Poster Session: Neural Techn. for Electronic and Power Systems

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W154 *A Double Integrated Neural Network for Identification of Geometrical Features Dependency in Lumped Models [#1481]*

Antonio Luchetta, Stefano Manetti and Luca Pellegrini, Department of Electronics and Telecommunications, Italy

A novel identification technique for lumped models of general electronic circuits (i.e. MOSFET, BJT, monolithic integrated circuits and filters) is presented. The approach is based on a neural network having a supplementary layer and an adapted learning process, whose convergence allows the validation of the device model. The supplementary layer is another neural network trained offline on the model under exam. The inputs of the network are geometrical parameters and the neural network output represents the lumped circuit parameter estimation.

W155 *Supervisory Level Neural Network Identifier for a Small Power System with a STATCOM and a Generator [#1210]*

Salman Mohagheghi, Ronald G. Harley and Ganesh K. Venayagamoorthy, Georgia Institute of Technology, United States; University of Missouri- Rolla, United States

A neural network based identifier is designed for effective control of a small power system. The power network in this work is considered from an external point of view, i.e., from a supervisory level. Such neuroidentifier can serve as a general model of such a plant, and then used for different neural network based control schemes.

W156 *Volterra series and Neural Networks to model an electronic device nonlinear behavior [#1497]*

Georgina Stegmayer, Politecnico di Torino, Italy

Electronic devices that have a dynamic nonlinear behavior are generally modeled by the so-called Volterra series model. The construction of such analytical model, however, is a complex and time-consuming task. In this work we propose a new approach to help in the building of a Volterra series model for modeling an electronic device, using a very simple Neural Network model. As an initial case of study, the proposed approach is applied to the modeling of a diode and the simulation results are presented. Conclusions are drawn from the comparison of the results obtained with different kernels approximations and network topologies.

W157 *Comparison between Backpropagation and RPROP Algorithms Applied to Fault Classification in Transmission Lines [#1570]*

Benemar Souza, Nubia Brito, Washington Neves, Kleber Silva and Ricardo Lima, Federal University of Campina Grande, Brazil

This paper is related to the results yielded by the implementation of software to identify and classify faults in transmission lines. The team incumbent on the duty utilizes artificial intelligence techniques, particularly neural networks. The proposed methodology uses sampled values of voltage and current what proceed from the DFR's analog channels, which monitor the transmission lines where they have been installed. For the methodology evaluation, phase- ground, phase-phase, phase-phase-ground and three-phase fault types were considered. RPROP and backpropagation algorithms were implemented with the batch mode for weight updating and their performance are evaluated.

W158 *Neural Block Control for a Synchronous Electric Generator [#1136]*

Victor Benitez, Edgar Sanchez and Alexander Loukianov, CINVESTAV, Unidad Guadalajara, Mexico

In this paper we present a novel identification and control scheme which is able to identify and to control a synchronous generator using a neural identifier. The generator is modelled as a full (eight) order one. A third order neural network such as the one presented in [3], is used to identify the dynamics of the synchronous generator. Moreover, a discontinuous control law based on the neural identifier is designed using the block control technique in order to track reference signals and reject external disturbances caused by generator terminal short circuits. Simulation results are presented in order to test the applicability of the proposed approach.

Plenary Poster Session: Pattern recognition II

Wednesday, 28 July, 16.00–19.00, Room: P, Chair: Joos Vandewalle and Gusztáv Hencsey

W159 *Neural Network Models for Fabric Drape Prediction [#1216]*

Antony Lam, Amar Raheja and Muthu Govindaraj, California State Polytechnic University, United States; Philadelphia University, United States

Neural networks are used to predict the drape coefficient (DC) and circularity (CIR) of many different kinds of fabrics. The neural network models used were the Multilayer Perceptron using Backpropagation (BP) and the Radial Basis Function (RBF) neural network. The BP method was found to be more effective than the RBF method but the RBF method was the fastest when it came to training. Comparisons of the two models as well as comparisons of the same models using different parameters are presented. It was also found that prediction for CIR was less accurate than for DC for both neural network architectures.

W160 *Neural neutron/gamma discrimination in organic scintillators for fusion applications [#1351]*

Basilio Esposito, Luigi Fortuna and Alessandro Rizzo, ENEA - C.R. Frascati, Italy; Universita di Catania, Italy; Politecnico di Bari, Italy

This work deals with the discrimination of neutrons and gamma-rays on the basis of their different pulse shapes in scintillator detectors; this technique is widely employed in nuclear fusion applications. After a thorough phase of data analysis, a Multi Layer Perceptron (MLP) is trained with the aim of processing the shape of light pulses produced by these ionizing particles in an organic liquid scintillator and digitally acquired. Moreover, fast superimposed events (called pile-ups) are detected and a further MLP is trained to analyze them and recover the original superimposed events. Satisfactory experimental results were obtained at the Frascati Tokamak Upgrade, ENEA-Frascati, Italy.

W161 *Adaptive task decomposition and modular multilayer perceptrons for letter recognition [#1457]*

Daqi Gao, Renliang Li, Guiping Nie and Changwu Li, East China University of Science and Technology, China

This paper proposes a task decomposition method, which divides a large-scale learning problem into multiple limited-scale pairs of training subsets and cross validation (CV) subsets. Correspondingly, modular multilayer perceptrons are set up. At first, one training subset only consists of its own class and several most neighboring categories, and then some classes in the CV subset are moved into it according to the generalization error of the module. This paper presents an empirical formula for selecting the initial number of hidden nodes, and a method for determining the optimal number of hidden units with the help of singular value decomposition. The result for letter recognition shows that the above methods are quite effective.

W162 *Recuperating Spectral Features Using Glottal Information and Its Application to Speaker Recognition [#1517]*

Pu Yang, Yingchun Yang and Zhaohui Wu, Zhejiang University, China

Most state-of-the-art speaker recognition systems do improve their performance when utilizing glottal information. Although they successfully model its changes as features for recognition task, they do not take into account the spectral variations caused by it. In this paper, a method that can lessen this influence, using both long-term and short-term glottal information, is proposed. Spectral features will behave more discriminative in text- independent automatic speaker recognition (ASR) through this recuperation. Our method was applied to YOHO corpus and our SRMC corpus. The experimental works show promising results.

W163 *Visual Comparison of Performance for Different Activation Functions in MLP networks [#1534]*

Leszek Rybicki and Filip Piekniewski, Faculty of Mathematics and Computer Science, Poland

Multi Layer Perceptron networks have been successful in many applications, yet there are many unsolved problems in the theory. Commonly, sigmoidal activation functions have been used, giving good results. The backpropagation algorithm might work with any other activation function on one condition though - it has to have a differential. In this paper we investigate some possible activation functions and compare the results they give on some sample data sets.

W164 *Learning Multiple Correct Classifications from Incomplete Data using Weakened Implicit Negatives [#1545]*

Stephen Whiting and Dan Ventura, Brigham Young University, United States

Classification problems with output class overlap create problems for standard neural network approaches. We present a modification of a simple feed-forward neural network that is capable of learning problems with output overlap, including problems exhibiting hierarchical class structures in the output. Our method of applying weakened implicit negatives to address overlap and ambiguity allows the algorithm to learn a large portion of the hierarchical structure from very incomplete data. Our results show a significant improvement over a standard backpropagation network on the hierarchical problem.

W165 *Performance comparison of Neural Networks and Maximum Likelihood for Supervised Classification of Agricultural Crops: Single Date and Temporal Analysis [#1622]*

Jose Marinaldo Gleriani, Jose Demisio S. Silva and Jose Carlos Neves Epiphanio, National Institute for Space Research, Brazil

Maximum likelihood, Backpropagation and RBF networks were used to classify agricultural crops. Ten Landsat images (bands 3, 4, 5) and the NDVI formed the input data. The NDVI indicates leaf area index changes and by correlation phenological cycle. In the study area, in the rain season, it is dfficult to spectrally characterize a crop due to flexible planting dates related to irrigation possibilities and the phenological stages in training polygons are rarely representative of the whole image. Kappa statistics showed temporal classification performed better than single spectral date, at a level of 5 percent in many dates. The Backpropagation and RBF networks had similar performance which was better than the Maximum likelihood.

W166 *Approach to Recognition of License Plate Numbers Using Neural Networks [#1668]*

Ihor Paliy, Volodymyr Turchenko, Vasyl Koval, Anatoly Sachenko and George Markowsky, Ternopil Academy of National Economy, Ukraine; University of Maine, United States

This paper describes the Smart Vehicle Screening System, which can be installed into a tollbooth for automated recognition of vehicle license plate information using a photograph of a vehicle. An automated system could then be implemented to control the payment of fees, parking areas, highways, bridges or tunnels, etc. There are considered an approach to identify vehicle through recognizing of it license plate using image fusion, neural networks and threshold techniques as well as some experimental results to recognize the license plate successfully.

W167 *Labeled and Unlabeled Data in Text Categorization [#1685]*

Catarina Silva and Bernardete Ribeiro, Leiria Polytechnic Institute, Portugal; Coimbra University, Portugal

There is a growing interest in exploring the use of unlabeled data as a way to improve classification performance in text categorization. The ready availability of

this kind of data in most applications makes it an appealing source of information. This work reports a study carried out on the Reuters-21578 corpus to evaluate the performance of Support Vector Machines when unlabeled examples are introduced in the learning process. The improvement achieved, especially in false negative values and therefore in recall values, demonstrates that the use of unlabeled examples can be very important for small data sets.

W168 *Single Categorizing and Learning Module for Temporal Sequences [#1746]*
Jan Koutnik and Miroslav Snorek, Czech Technical University, Czech Republic

Modifications of an existing neural network called Categorizing and Learning Module (CALM) that allow learning of temporal sequences are introduced in this paper. We embedded an associative learning mechanism which allows to look into the past when classifying present stimuli. We have built in the Euclidean metrics instead of the weighted sum found in the original learning rule. This improvement allows better discrimination in case of learning low dimensional patterns in the temporal sequences. Results were obtained from testing the enhanced module on simple artificial data. These experiments promise applicability of the enhanced module in a real problem domain.

W169 *A Modified Direction Feature for Cursive Character Recognition [#1748]*
Michael Blumenstein, Xin Yu Liu and Brijesh Verma, Griffith University, Australia; Central Queensland University, Australia

This paper describes a neural network-based technique for cursive character recognition applicable to segmentation-based word recognition systems. The proposed research builds on a novel feature extraction technique that extracts direction information from the structure of character contours. This principal is extended so that the direction information is integrated with a technique for detecting transitions between background and foreground pixels in the character image. The proposed technique is compared with the standard direction feature extraction technique, providing promising results using segmented characters from the CEDAR benchmark database.

Thursday, 29 July, 9.10–9.50

Special Track: Plenary IJCNN

Thursday, 29 July, 9.10–9.50, Room: A, Chair: Péter Érdi

9.10 *Artificial Neural Networks, Where Do We Go Next? [#1818]*
Dan Hammerstrom, Comp. Science and Engin. Oregon Health Science, United States

There has been significant research effort in Artificial Neural Networks (ANNs) over the last 15-20 years with many exciting results. However, we have arrived at a point where we need to begin to broaden our focus and move our ANN research to the next level. By "next level" I mean to larger and more complicated integrated systems. Computational Neuroscientists and Cognitive Psychologists are ahead of us and have already begun working with multiple module systems. The next big success in intelligent systems will come via the integration of diverse, complementary neuro-subsystems into complex entities. Such systems are required for us to address real applications and to do so with performance/price ratios that exceed existing methods.

Thursday, 29 July, 10.10–12.10

Support Vector Machines and Kernel Methods II

Thursday, 29 July, 10.10–12.10, Room: A, Chair: Yoshifusa Ito

10.10 *The Support Vector Machine Learning Using the Second Order Cone Programming [#1093]*
Rameswar Debnath, Masakazu Muramatsu and Haruhisha Takahashi, The University of Electro-Communications, Japan

In this paper we propose a data dependent method learning for the support vector machine. This method is based on the technique of second order cone programming. We reformulate the SVM's quadratic problem into the second order cone problem. The proposed method requires to decompose the kernel matrix of SVM optimization problem. Since the kernel matrix is positive semidefinite, some columns of the decomposed matrix diminish. The performance of the proposed method depends on the reduction of dimensionality of the decomposed matrix. Computational results show that when the columns of decomposed matrix are small enough, the proposed method is much faster than the quadratic programming solver LOQO.

10.30 *Support Vector Classifiers via Gradient Systems with Discontinuous Righthand Sides [#1547]*
Leonardo Ferreira, Eugenius Kaszkurewicz and Amit Bhaya, COPPE/NACAD/Federal University of Rio de Janeiro, Brazil

This paper implements support vector machines (SVMs) for the discrimination of nonseparable classes using gradient systems with discontinuous righthand sides. The gradient systems are obtained from an exact penalty method applied to the constrained quadratic optimization problems. Global convergence to the solution of the corresponding constrained problems is shown to be independent of the penalty parameters and of the regularization parameter of the SVM.

10.50 *Applications of Clifford Support Vector Machines and Clifford Moments for Classification [#1662]*
Eduardo (Edu) Bayro-Corrochano, Refugio Vallejo-Gutierrez and Nancy Arana-Daniel, CINVESTAV Unidad Guadalajara, Computer Science, Mexico; Escuela de Economia, Universidad Guanajuato, Mexico; CINVESTAV, Unidad Guadalajara, Computer Science, Mexico

This paper introduces the Clifford Support Vector Machines as a generalization of the real- and complex- valued Support Vector Machines using the Clifford geometric algebra. In this framework we handle the design of kernels involving the Clifford or geometric product for linear and nonlinear classification. We present an interesting application to classify mechanical tools using the concept of Clifford moments which is invariant under affine transformations.

11.10 *Texture Classification by Support Vector Machines with Kernels for Higher-Order Gabor Filtering [#1657]*
Keisuke Kameyama and Kei Taga, University of Tsukuba, Japan

A Support Vector Machine (SVM) which employs a kernel corresponding to feature extraction of local higher-order moment spectra (LHOMS) of an image, is introduced.

For utilizing LHOMS image features, an inner product kernel of LHOMS is derived. In the experiments, the SVM with LHOMS kernel is applied to image texture classification. It is shown that it can efficiently utilize the higher-order features, and that the classification ratio is improved due to the introduction of the Gaussian window function. Further, it is discussed that the kernels for higher-order moment spectra and higher-order moments in the same orders becomes identical, indicating the equivalence of the two types of features in the kernel-function level.

11.30 *kernels based on Weighted Levenshtein Distance [#1171]*

Jianhua Xu and Xuegong Zhang, Nanjing Normal University, China; Tsinghua University, China

In some applications, the sample could be described as a string rather than a vector. It is necessary to determine similarity of two strings in many algorithms. The useful notion is the weighted Levenshtein distance that implies the minimum total weights of single symbol insertions, deletions and substitutions. To incorporate prior knowledge of strings into kernels, we utilize variants of this distance to replace distance measure and inner product in the four common kernels, and form a new class of string kernels: Levenshtein kernels in this paper. Combining our new kernels with support vector machine, the error rate on UCI splice dataset over 20 run is 5.88, which outperforms the best result 9.5 from other five training algorithms.

11.50 *Kernel-Based Canonical Coordinate Decomposition of Two-Channel Nonlinear Maps [#1628]*

Ali Pezeshki, Mahmood Azimi-Sadjadi and Louis Scharf, Colorado State University, United States

A kernel-based formulation for decomposing nonlinear maps of two data channels into their canonical coordinates is derived. Each data channel is implicitly mapped to a high-dimensional feature space defined by a nonlinear kernel. The canonical coordinates of the nonlinear maps are then found by transforming the kernel maps with the eigenvector matrices of a coupled asymmetric generalized eigenvalue problem. This generalized eigenvalue problem is constructed in the explicit space of kernel maps. The measures of linear dependence and coherence between the nonlinear maps of the channels are also presented. These measures may be determined in the kernel domain, without explicit computation of the nonlinear mappings.

Noise in N N & Hippoc. Function (ENNS combined special session)

Thursday, 29 July, 10.10–12.10, Room: B, Chair: Allesandro Villa, Laura Sacerdote Roman Borysuk and Yamaguchi Yoko

10.10 *Noise induced phenomena in jump diffusion models for single neuron spike activity (special session S4) [#1571]*

Roberta Sirovich and Laura Sacerdote, Department of Mathematics, Univ. of Torino, Italy

Noise plays an important role in neural transmission and stochastic neuronal models can be employed to help the understanding of coding principles. The attempt to detect instances where the noise plays a positive role increasing the reliability of the signal or synchronizing the spike trains of different neurons requests the use of suitable biologically compatible mathematical models. A contribution in this direction is the use of jump-diffusion models to describe the time evolution of membrane potential of some neurons in the brain. This approach can be biologically justified with arguments based on different weights for the synaptic contribution impinging the neuron in any point of the membrane and synapses acting near the trigger zone.

10.30 *Nonlinear oscillation models for the spike sorting of single units recorded extracellularly (special session S4) [#1783]*

Tetyana Aksenova, Olga K. Chibirova and Alessandro E. P. Villa, Preclinical Neuroscience U318 INSERM, France; Lab. Neuroheuristics, Dept.Physiol Lausanne, Switzerland

The present study is devoted to the problem of automatic sorting of extracellularly recorded action potentials of neurons. The classification of spike waveform is considered as a pattern recognition problem of segments of signal that corresponds to the appearance of spikes. Nonlinear oscillating model with perturbation is used to describe the waveforms of spikes. It allows characterizing the signal distortions in both amplitude and phase. The spikes generated by one neuron assumed to be described by the same equation and should be recognized as one class.

10.50 *Stochastic Dynamics and Partial Synchronization of Stimulus-Driven Neural Activity (special session S4) [#1375]*

Roman Borisyuk, University of Plymouth, United Kingdom

We study a dynamical behaviour of neural population driven by stimulus. This dynamical response is considered in relation to the population coding. The hypothesis that neuronal code at some stages of information processing in the brain is based on synchronisation of neural activity is under intensive discussions. The dynamical regime of partial synchronisation is important and very useful for modelling of neural activity and we have found that the input driven neural assembly can demonstrate a dynamical regime of partial synchronisation. It is interesting to note that population dynamics has a stochastic nature and repetition of the same stimulus will cause a synchronous activity of different sub-populations.

11.10 *On Noise Induced Resonances in Neurodynamic Models [#1614]*

Robert Kozma and Derek Harter, University of Memphis, United States

This work aims at studying dynamical models of neural networks, which exhibit transitions between quasi-stable states of various complexities. We use the biologically motivated KIII model, which is a high-dimensional dynamical system with extremely fragmented boundaries between limit cycles, tori, fixed points, and chaotic attractors. We study the role of additive noise in the development of itinerant trajectories. Noise broadens the region of the dominance of chaotic attractors. This result is especially useful in the application of KIII and makes it possible to select parameter regions where KIII can operate as a robust dynamic system and associative memory device.

11.30 *Structural Hierarchies, Theta Rhythm, Hippocampal Function (special session S9) [#1696]*

Érdi Péter, KFKI Res. Inst. Part. Nucl. Phys. HAS, Hungary

The connection between different structures being at different hierarchical level of the cortico-hippocampal formation and their functional role is discussed. At least three different functions, code generation, mood regulation and navigation is being integrated into a coherent conceptual framework.

11.50 *Hippocampal Theta Phase Coding for Instantaneous Acquisition of Experienced Events (special session S9) [#1641]*

Yoko Yamaguchi, Aota Yoshito, Naoyuki Sato, Hiroaki Wagatsuma and Zhihua Wu, RIKEN Brain Science Institute, Japan; Japan Science and Technology Agency, Japan; Riken Brain Science Institute, Japan

Theta rhythm dependent activity of rat hippocampal cells "theta phase precession" was elucidated based on the hypothesis that theta phase coding enables instantaneous acquisition of experienced events. By using a neural network model of theta phase coding we demonstrate high acquisition abilities of spatil and temporal events. A theoretical qrerequisite for this computational power predicts a hippocampal- entorhinal network mechanism to regulate theta phase coding.

Computational Neuroscience

Thursday, 29 July, 10.10–12.10, Room: C, Chair: Shiro Usui

10.10 *Extracting information in a graded manner from a neural-network system with continuous attractors [#1239]*
Yukihiro Tsuboshita and Hiroshi Okamoto, Fuji Xerox Co., Ltd., Japan

Memory retrieval from neural networks has been described by dynamical systems with discrete attractors. However, recent neurophysiological studies suggest that information extraction in the brain is more likely to be described with continuous attractors. Here we put forward a neural-network system that provides continuous attractors with respect to the network state represented by a vector quantity. An attractor pattern continuously depends upon an initial pattern; it also reflects the embedded pattern. These suggest that, for each query encoded by an initial state, our model can extract different information from the network. To demonstrate the usefulness of this information, our model is applied to keyword extraction from a document.

10.30 *Design of Spatially Extended Neural Networks for Specific Applications [#1292]*
Rod Adams, Rene teBoekhorst, Alistair Rust, Maria Schilstra and Paul Kaye, University of Hertfordshire, United Kingdom; Institute for Systems Biology, United States

Biological neural systems are, in general, more effective in carrying out tasks such as face recognition than artificial neural networks. In this paper we present a model, inspired by the processes of neural development, which leads to the growth and formation of neuron-to-neuron connections. The neural architectures created have tree-shaped axons and dendrites and contain spatial information on branch and synapse positions. We have also prototyped a simple but efficient way of simulating signal transduction along neurites using a finite state automaton (FSA). We expect that the combination of our neuronal development method with the FSA will provide an effective tool for exploring the relationship between neural form and network function.

10.50 *Influence of dendritic spines shape changes by learning [#1324]*
Vadym Spravedlyvyy, Andreas Herzog, Karsten Kube, Bernd Michaelis, Katharina Braun and R. Schnabel, University of Magdeburg, Germany, Ukraine; University of Magdeburg, Germany, Germany

The role of dendritic spines in information processing of a neuron is still not clear. But it is known that they change its shape rapidly and fast during learning processes. These effects may be important for storing of information (memory). We will show the influence of shape variations on the electrical signal propagation trough dendritic spines by biologically realistic electrical simulation. Basic properties of electrical signal transmission of single spines are estimated and approximated depend on the individual shape. Learning processes to adjust specific electrical properties are discuss and a possible mechanism is introduced.

11.10 *Clustering with Minicolumnar Receptive Field Self-Organization [#1514]*
Jorg Lucke, Institut fuer Neuroinformatik, Bochum, Germany

We study clustering, i.e., unsupervised data classification, by a model of the cortical macrocolumn. Continuous valued input vectors are encoded using a population place code. The macrocolumn model self-organizes its minicolumnar receptive fields (RFs) such that the input is hierarchically subdivided into increasingly finer classes. If input superpositions are used for training, the system is able to find an appropriate classification of the input and a suitable representation of input superpositions. Together with fast reaction times the model satisfies major requirements of biological information processing and distinguishes itself from other suggested models of continuous value processing in biological neural networks.

11.30 *Synchronized Subthreshold Oscillations and Phase Coding in a Network Model of the Entorhinal Cortex [#1618]*
Jun Igarashi, Motoharu Yoshida, Katsumi Tateno and Hatsuo Hayashi, Kyushu Institute of Technology, Japan

A network model of the entorhinal cortex layer II that consisted of stellate cells and an interneuron was constructed. The subthreshold oscillations of the stellate cells were recurrently synchronized through an inhibitory interneuron, and theta rhythm was generated. Anatomical evidences suggest that the layers II and V of the entorhinal cortex and the hippocampus may form a loop circuit with a delay time of about 25 ms for signals going around. With the loop circuit introduced to the present model,the stellate cells that represent spatial information fired successively in a theta cycles. The present entorhinal cortex model with the loop circuits reproduced the phase precession.

11.50 *Dendritic Spiking Accounts for Rate and Phase Coding in a Biophysical Model of a Hippocampal Place Cell [#1478]*
Zsófia Huhn, Máté Lengyel, Gergő Orbán and Péter Érdi, Dept. Biophysics, KFKI R.I.P.N.P., HAS, Hungary; KFKI Res. Inst. Part. Nucl. Phys. HAS, Hungary

Hippocampal place cells provide prototypical examples of neurons firing jointly phase and rate coded spike trains. We propose a biophysical mechanism accounting for the generation of place cell firing at the single neuron level. An interplay between external theta-modulated excitation impinging the dendrite and intrinsic dendritic spiking as well as between frequency modulated dendritic spiking and periodic somatic hyperpolarization was a key element of the model. Through these interactions robust phase and rate coded firing emerged in the model place cell, reproducing salient experimentally observed properties of place cell firing.

Digital Impl. of Neural Networks (special session)

Thursday, 29 July, 10.10–12.10, Room: F, Chair: Lambert Spaanenburg

10.10 *Trends in Design of Massively Parallel Coprocessors Implemented in ASICs [#1730]*
Péter Földesy, Analogic and Neural Computing Laboratory - HAS, Hungary

This paper collects the most recent parallel coprocessors and highlights the recent trends. It is shown that the single chip massively parallel processor implementations seem to disappear from the scientific investigations (with the exception of low-level near-sensor image processing). Meanwhile, the formerly developed architectures have moved inside complex system-on-chips/microprocessors. The common aspect of the recent architectures is the advanced processing element and internal interconnection solutions, and the dominant mid-grain parallelism (i.e. up to a hundred processing element per chip).

10.30 *Emulated Digital CNN-UM Implementation of a Barotropic Ocean Model [#1728]*
Zoltán Nagy and Péter Szolgay, University of Veszprem, Hungary

The solution of partial differential equations (PDE) has long been one of the most important fields of mathematics, due to the frequent occurrence of spatio- temporal dynamics in many branches of physics, engineering and other sciences. One of the most exciting area is the simulation of compressible and incompressible fluids which appears in many important applications in aerodynamics, meteorology and oceanography. On the other hand the solution of these equations requires enormous computing power. In this paper a CNN-UM simulation of ocean currents will be presented. To improve the performance of our solution an emulated digital CNN-UM

is used where the cell model of the architecture is modified to handle the non-linearity of the model.

10.50 *FPGA Implementation of the Kernel CMAC [#1444]*
Gábor Horváth and Zsolt Csipak, Budapest University of Technology and Economics, Hungary; Budapest University of Technology and Econ., Hungary

CMAC neural network is a real alternative to MLP and has some advantageous features: its training is fast and its architecture is especially suitable for digital hardware implementation. The price of these attractive features is its rather poor capability. The poor capability can be improved if a recently proposed regularization and/or a kernel version of the CMAC is used. The paper presents the first results of a study about the efficient hardware realization of various versions of CMAC. Three versions have been developed: the classical Albus CMAC, its regularized version and a kernel CMAC. The solutions, that were developed using high-level synthesis, are based on Virtex FPGA.

11.10 *The Impact of Modern FPGA Architectures on Neural Hardware: A Case Study of the TOTEM Neural Processor [#1347]*
Stephanie McBader, Peter Lee and Alvise Sartori, University of Kent, United Kingdom; NeuriCam S.p.A., Italy

The implementation of neural processors in hardware is a very challenging task. However, recent advances in programmable architectures facilitate this task by providing the fundamental hardware blocks for building neural structures. Using the TOTEM neural processor as a case study, this paper reports on the main advantages of implementing neural hardware on programmable logic devices such as FPGAs.

11.30 *Neural Vision Sensors for Surface Defect Detection [#1667]*
Suleyman Malki, Lambert Spaanenburg and Nick Ray, Lund University, Sweden; Interay B.V., Netherlands

Vision sensors are built from a camera and intelligent hardware and/or software. Steadily decreasing microelectronic costs have spawned a large number of vision sensory applications, such as surface defect detection. A constructive method for defect detection will entail a mixture of mathematical and intelligent modules. Such a heterogeneous modular system can be realized in many ways. In this paper we will discuss a packet-switched implementation on a macro-enriched Field-Programmable Gate-Array.

11.50 *Hw-Sw codesign of a Flexible Neural Controller through a FPGA-based neural network programmed in VHDL [#1775]*
Eros Pasero and Massimiliano Perri, Polytechnic of Turin, Italy; Dip. Elettronica - Politecnico di Torino, Italy

This work describes a neural architecture which controls an "inverted pendulum" in a very flexible manner with a reusability prospective. The project was implemented through a "digital core" constituted of a FPGA, a microcontroller and a SRAM block which co-operate to the neural computation. The FPGA was programmed in VHDL to implement the neural architecture. The core was written in a recursive manner to permit the reconfigurability of the network and its reusability to all the systems which can be modelled through a similar neural network. Through these parameters the system combines the configurability (typical of a sw project) with the velocity guaranteed by the hw implementation of the mathematical algorithms.

Speech Recognition

Thursday, 29 July, 10.10–12.10, Room: G, Chair: Nik Kasabov

10.10 *Efficient Training of Large Neural Networks for Language Modeling [#1692]*
Holger Schwenk, Limsi-Cnrs, France

Recently there is increasing interest in using neural networks for language modeling. The probability estimation is performed in a continuous space, allowing be these means smooth interpolations. In this paper several techniques are presented that allow the use of the neural network language model in a large vocabulary speech recognition system, in particular very fast lattice rescoring and efficient training of large neural networks on training corpora of over 10 million words. The described approach achieves significant word error reductions with respect to a carefully tuned 4-gram backoff language model in a state of the art conversational speech recognizer for the DARPA rich transcriptions evaluations.

10.30 *Acoustic Model Combination for Recognition of Speech in Multiple Languages using Support Vector Machines [#1506]*
Suryakanth V. Gangashetty, Chandra Sekhar Chellu and Yegnanarayana Bayya, Indian Institute of Technology Madras, Chennai, India

In this paper, we study the performance of support vector machine based classifiers in acoustic model combination for recognition of subword units of speech in multiple languages. In acoustic model combination, the data for similar subword units across languages are shared to train acoustic models for multilingual speech. Sharing of data across languages leads to an increase in the number of training examples for a subword unit common to the languages. It may also lead to increase in the variability of the data for a subword unit. In this paper, we study the effect of data sharing on the classification accuracy and complexity of acoustic models built using support vector machines.

10.50 *Speech Recognition Based on Fundamental Functional Principles of the Brain [#1550]*
Alireza A. Dibazar, Dong Song, Walter Yamada and Theodore W. Berger, University of Southern California, United States

This paper describes application of biologically realistic dynamic synapse neural networks(DSNN)on speech recognition. The task is accomplished in three steps: first speech signal is decomposed into different frequency bands. Second, short term energy of signals is encoded into the train of spikes and finally, the classification of temporal patterns is done using DSNN. The nonlinear neurotransmitter release function of DSNN is replaced by F.D model. The simulation results showed that the performance degradation of DSNN in the presence of additive Gaussian white noise is less than Mel frequency cepstral coefficients.

11.10 *The Application of Polynomial Discriminant Function Classifiers to Isolated Arabic Speech Recognition [#1021]*
Mohammed Khasawneh, Khaled Assaleh, Wesam Sweidan and Monther Haddad, College of Information Systems, Zayed University, United Arab Emirates; EE Dept., American University - Sharjah, United Arab Emirates; Balqa Applied University, Jordan; ETISALAT Telecom, United Arab Emirates

In this paper, we apply polynomial discriminant function classifiers for isolated- word speaker-independent Arabic digit recognition. The performance of the polynomial classifier is evaluated for different implementations. We also provide a performance comparison between the polynomial classifier and Dynamic Time Warping (DTW). The polynomial classifier is found to outperform DTW in many aspects such as recognition rate, and computational and memory requirements.

11.30 *An Adaptive Recurrent Neuro-Fuzzy Filter for Noisy Speech Enhancement [#1438]*

Sheng-Nan Wu and Jeen-Shing Wang, National Cheng Kung University, Taiwan

This paper presents a novel adaptive recurrent neuro-fuzzy filter (ARNFF) for noisy speech enhancement problems. The proposed ARNFF is a connectionist network that can be translated effortlessly into a set of dynamic fuzzy rules and state-space equations as well. An effective learning algorithm, consisting of a clustering algorithm for the structure learning and a recurrent learning algorithm for the parameter learning, is adopted for the ARNNF construction. From our computer computer simulations, the advantages of the proposed ARNFF for noisy speech enhancement include: 1) a more compact filter structure, 2) no a priori knowledge needed for the exact lagged order of the input variables, 3) a better performance in long-delay environment.

11.50 *Two Neural Network Paradigms of Phoneme Transcription - a Comparison [#1155]*

Terje Kristensen, Bergen University College, Norway

In this work a Multi Layer Perceptron (MLP) and a Counterpropagation (CP) network for transcription of Norwegian text is presented. Both paradigms are described and compared. The corpus consists of about 50000 Norwegian words and their transcriptions, developed by the Norwegian Telecom Research Centre. The transcription scheme used is Sampa for Norwegian. The performance for each network has been tested on about 10000 unknown Norwegian words.

Thursday, 29 July, 14.00–15.40

Robotics and learning

Thursday, 29 July, 14.00–15.40, Room: A, Chair: Jeen-Shing Wang

14.00 *Developmental Learning on a Humanoid Robot [#1720]*

Artur Arsenio, Massachusetts Institute of Technology, United States

This paper addresses a broad spectrum of machine learning problems. Actions by embodied agents automatically generate training data for the learning mechanisms, so that a humanoid robot develops categorization autonomously. Cognitive capabilities of the humanoid robot are developmentally created, starting from abilities for detecting, segmenting, and recognizing objects. Such mature abilities are integrated with the deeper developmental learning mechanisms required to create those abilities out of the robot's physical experiences

14.20 *Evolving Adaptive, High-Dimensional, Camera-Based Speed Sensors [#1183]*

Ralf Salomon, University of Rostock, Dep. of Electrical Engine, Germany

This paper reviews some attempts that exploit a phenomenon, also known as motion parallax, to estimate the distance of closest approach of a moving object. Despite their success, the existing evolutionary methods lack some desirable properties, such as reasonable scalability and online learning. To overcome these practically-relevant limitations, this paper proposes a new model that is based on Hebbian learning. Due to its scalability and online learning capabilities, this model is especially suited to mobile robots.

14.40 *Locomotion of a Quadruped Robot Using CPG [#1757]*

Takayuki Ishii, Seiji Masakado and Kazuo Ishii, Kyushu Inst. of Tech., Japan

It is well known that the rhythm generator mechanism called Central Pattern Generator (CPG) controls rhythmic activities, such as locomotion, respiration, heart beat, etc in biological systems, and various mathematical neuron models are proposed. In this paper, a CPG network, which consists of the Matsuoka model neurons, is introduced to realize the locomotion of a quadruped walking robot and the response to disturbances is discussed. The outputs of neurons are utilized as the target angles of corresponding joints and the efficiency of the proposed method is examined through experiments with a quadruped walking robot.

15.00 *More Effective Reinforcement Learning by Introducing Sensory Information [#1515]*

Keiji Kamei and Masumi Ishikawa, Kyushu Institute of Technology, Japan

Among various reinforcement learning methods, Q-learning is particularly useful for mobile robots, because its value function is a function of a state and an action. The state here represents location and orientation of a mobile robot. We propose to introduce sensory signals into reinforcement learning to increase its learning speed and the probability of reaching a goal, and to decrease the probability of collision. A key idea is to directly reduce a value function at other states than the current state of a mobile robot based on sensory signals. Computer simulation demonstrates that the number of goals reached increases more than 2 times faster both in a simple environment and in a complex environment than that by conventional Q-learning.

15.20 *Biased Support Vector Machine for Relevance Feedback in Image Retrieval [#1646]*

Chu-Hong Hoi, Chi-Hang Chan, Kaizhu Huang, Michael Lyu and Irwin King, The Chinese University of Hong Kong, Hong Kong

Recently, SVMs have been engaged in relevance feedback tasks in CBIR. Typical approaches by SVMs treat the relevance feedback as a strict binary classification. However, these approaches do not consider an important issue of relevance feedback, i.e. imbalanced datasets problem, in which the negative instances largely outnumber the positive instances. For solving this problem, we propose a novel technique to formulate the relevance feedback based on a modified SVM called Biased Support Vector Machine (BSVM). Mathematical formulation and explanations are provided for showing the advantages. We conduct experiments to evaluate the performance of our algorithms, in which promising results demonstrate the effectiveness of our techniques.

Bioinformatics and Biomedical Comp. (ENNS special session)

Thursday, 29 July, 14.00–15.40, Room: B, Chair: Francesco Masulli and RobertoTagliaferri

14.00 *Neural-ICA and Wavelet Transform for Artifacts Removal in surface EMG [#1424]*

Francesco Carlo Morabito, Bruno Azzerboni, Mario Carpentieri and Fabio La Foresta, University Mediterranea of Reggio Calabria, Italy; Universita' degli Studi di Messina, Italy

Recent works have shown that artifacts removal in biomedical signals, like electromyographic (EMG) or electroencephalographic (EEG) recordings, can be performed by using Discrete Wavelet Transform (DWT) or Independent Component Analysis (ICA). Often, the removal of some artifacts is very hard because they are superimposed on the recordings and they corrupt biomedical signals also in frequency domain. In these cases DWT and ICA methods cannot perform artifacts cancellation. In this paper we present a method based on the joint use of wavelet transform and Independent Component Analysis. We show the obtained results and the comparisons among the proposed method, DWT and ICA techniques. An user interface is needed to identify the artifact.

14.20 *An Information Geometric Approach to Survival Analysis and Feature Selection by Neural Networks [#1181]*

Antonio Eleuteri, Roberto Tagliaferri, Leopoldo Milano and Michele De Laurentiis, DSF University of Napoli and INFN Sez. Napoli, Italy; DMI, University of Salerno, Italy; Secondo Policlinico, University of Napoli, Italy

In this paper an information geometric approach to survival analysis is described. It is shown how a neural network can be used to model the probability of failure of a system, and how it can be trained by minimising a suitable divergence functional in a Bayesian framework. By using the trained network, minimisation of the same divergence functional allows for fast, efficient and exact feature selection. Finally, the performance of the algorithms is illustrated on a synthetic dataset.

14.40 *HLA Typing Using a Fuzzy Approach [#1319]*

Giovanni Battista Ferrara, Francesco Masulli and Stefano Rovetta, Universita' di Genova, Italy; Universita' di Pisa, Italy

The Human Leukocyte Antigens (HLA) system consists of three regions in the human genome. The match between donor's and receiver's HLA is critical for histocompatibility. HLA typing problem consists in the donor's and receiver's HLA systems matching. We describe the image analysis module of a Decision Supporting System (DDS) supporting the application of the oligonucleotide microarray technology to the HLA typing. The DDS is based on a fuzzy modeling approach that allows the biologist to describe and classify the probe activations using its language and concepts in a natural way, and, at the same time, supports a robust interactive image filtering thanks to the usage of a Fuzzy Basis Functions network.

15.00 *Estimation of Bone Mineral Density Data Using MoG Neural Networks [#1338]*

Antonello Rizzi, Massimo Panella, Maurizio Paschero and Fabio Massimo Frattale Mascioli, INFO-COM Dpt., University of Rome "La Sapienza", Italy

In this paper we propose a low cost prevention strategy for osteoporosis. This disease has a very high cost for the public health expense all over the world. Its main diagnostic tool is a radiographic analysis called Computerized Bone Mineralometry, by which it is possible to measure the Bone Mineral Density (BMD). Starting from the BMD value it is possible to estimate the risk of contracting osteoporosis. The proposed prevention strategy is based on the assumption that BMD can be estimated by a neural model on the basis of some objective individual characteristics to be determined by the patient itself. We propose the use of MoG (Mixture of Gaussian) neural model, trained by an automatic procedure based on maximum likelihood approach.

15.20 *Neuro-Fuzzy Analysis of Dermatological Images [#1253]*

Ciro Castiello, Giovanna Castellano and Anna Maria Fanelli, University of Bari, Italy

The employment of image processing techniques appears to be wide-spreading in several application areas, with special reference to the medical context. In this paper a neuro-fuzzy approach for pixel classification is detailed and its application is proposed to the analysis of dermatological images of nevi. An ensemble of experimental results is provided to demonstrate the usefulness of the introduced methodology and to show the possible benefits deriving from its employment in clinical diagnosis.

Machine learning for text mining (ENNS special session)

Thursday, 29 July, 14.00–15.40, Room: C, Chair: Samuel Kaski

14.00 *On Text-Based Estimation of Document Relevance [#1503]*

Eerika Savia, Samuel Kaski, Ville Tuulos and Petri Myllymaki, Helsinki University of Technology, Finland; Helsinki Institute for Information Technology, Finland

This work is part of a proactive information retrieval project that aims at estimating relevance from implicit user feedback. The noisy feedback signal needs to be complemented with all available information, and textual content is one of the natural sources. Here we take the first steps by investigating whether this source is at all useful in the challenging setting of estimating the relevance of a new document based on only few samples with known relevance. It turns out that even sophisticated unsupervised methods like multinomial PCA (or Latent Dirichlet Allocation) cannot help much. By contrast, feature extraction supervised by relevant auxiliary data may help.

14.20 *Topic Based Language Models for ad hoc Information Retrieval [#1578]*

Leif Azzopardi, Mark Girolami and Keith van Rijsbergen, University of Paisley, United Kingdom; University of Glasgow, United Kingdom

We propose a topic based approach to language modelling for ad-hoc Information Retrieval (IR). Many smoothed estimators used for the multinomial query model in IR rely upon the estimated background collection probabilities. In this paper, we propose a topic based language modelling approach, that uses a more informative prior based on the topical content of a document. In our experiments, the proposed model provides comparable IR performance to the standard models, but when combined in a two-stage language model, it outperforms all other estimators.

14.40 *Context Based Identification of User Communities from Internet Chat [#1521]*

Ata Kaban and Xin Wang, School of CS, The University of Birmingham, United Kingdom

We study the temporal connectivity structure of single-channel Internet-based chat participation streams. Somewhat similar to bibliometric analysis, and complementary to topic-analysis, we base our study solely on context information provided by the temporal order of participants' contributions. Experimental results obtained by employing both network-analysis indicators and an aggregate Markov modelling approach indicate the existence of distinguishable communities in the about one day worth real-world chat dynamics analysed. .

15.00 *Modelling the Connectivity Between Terms in the Neuroscience Literature [#1328]*

Filip Deleus and Marc M. Van Hulle, Katholieke Universiteit Leuven, Belgium

We describe a method to model connectivity patterns between words in a document collection. These connnectivity patterns may be helpful to gain more insight in the meaning of the document collection as a whole and in the semantics of the field. Structural Equation Modelling (SEM) has been used for modelling the connectivities between terms. Furthermore, in order to validate the goodness-of-fit of the models, we adopt a bootstrapping approach since the data encountered in text mining applications are likely to violate the underlying assumptions of SEM. We applied the described method on a corpus of journal articles taken from the neuroscience literature.

15.20 *FALCON: A Fusion Architecture for Learning, COgnition, and Navigation [#1543]*

Ah-Hwee Tan, Nanyang Technological University, Singapore

This paper presents a natural extension of self-organizing neural network architecture for learning cognitive codes across multi-modal patterns involving sensory input, actions, and rewards. The proposed cognitive model, called FALCON, enables an autonomous agent to adapt and function in a dynamic environment. Simulations based on a minefield navigation task indicate that the system is able to adapt amazingly well and learns rapidly through it's interaction with the environment in an online and incremental manner. The scalability and robustness of the system is further enhanced by an online code evaluation and pruning procedure, that maintains the number of cognitive codes at a manageable size without degradation of system performance.

Quantum Computing and Neural Networks

Thursday, 29 July, 14.00–15.40, Room: G, Chair: Valeriu Beiu

14.00 *A Study on Neuromorphic Quantum Computation [#1686]*

Shigeo Sato, Mitsunaga Kinjo, Osamu Takahashi, Yuuki Nakamiya and Koji Nakajima, Tohoku University, Japan

A quantum computer employing a single quantum as a qubit executes real parallel computation. Several algorithms have been proposed for quantum computation. However, these algorithms are applicable only to a limited number of applications. Therefore, a general purpose algorithm should be studied and developed for practical use in the near future. In this paper, we focus on the adiabatic evolution algorithm in order to incorporate an artificial neural network(ANN)-like method and discuss how to use this algorithm for solving an optimization problem.

14.20 *Vector Quantization Complexity and Quantum Computing [#1039]*

Paolo Gastaldo, Sandro Ridella and Rodolfo Zunino, DIBE - Genoa University, Italy; University of Genoa, Italy

A dichotomy between analogue modeling and digital implementation is often encountered when designing vector quantizers. In the case of digital systems, the requirement of optimality can bring about NP-hard problems. The paper discusses the possibility of using advanced paradigms such as Quantum Computing for digital optimization processes in order to overcome the limitations of conventional machinery. The presented research provides analytical criteria determining the relative advantages of conventional over quantum-computing approaches.

14.40 *A Self-Adaptive Quantum Radial Basis Function Network for Classification Applications [#1178]*

Cheng-Jian Lin, Cheng-Hung Chen and Chi-Yung Lee, Chaoyang University of Technology, Taiwan; Nankai College, Taiwan

In this paper, a self-adaptive quantum radial basis function (QRBFN) network is proposed for classification applications. The hidden layer of the QRBFN model contains quantum function neurons, which are multilevel activation functions. Each quantum function neuron is composed of the sum of sigmoid functions shifted by quantum intervals. A self-adaptive learning algorithm is proposed. The proposed the SCA method is a fast, one-pass algorithm for a dynamic estimation of the number of clusters in an input data space. The backpropagation algorithm is used to tune the adjustable parameters. Simulation results were conducted to show the performance and applicability of the proposed model.

15.00 *Turing Machine Simulation Using Hard-limiter Neurons [#1186]*

Narendra S. Chaudhari and Nirmal Dagdee, Nanyang Technological University, Singapore; Shri G.S. Inst. of Tech. and Sci., Indore (M.P.), India

We introduce a method for construction of a Turing machine using binary, hard- limiter neurons with integer weights and thresholds. We identify the problem of potentially infinite fan-in needed for read units. We give two approaches to tackle this problem. The first approach organizes the neural read units in the form of a pipeline. The second approach organizes the read units in tree- structure. We identify trade-off in time performance and design complexity for these two approaches.

Neurodynamics

Thursday, 29 July, 14.00–15.40, Room: I, Chair: Desire Bolle

14.00 *Self-control Dynamics for Sparsely Coded Networks with Synaptic Noise [#1097]*

Desire Bolle and Rob Heylen, University of Leuven, Belgium

For the retrieval dynamics of sparsely coded attractor associative memory models with synaptic noise the inclusion of a macroscopic time-dependent threshold is studied. It is shown that if the threshold is chosen appropriately as a function of the cross-talk noise and of the activity of the memorized patterns, adapting itself automatically in the course of the time evolution, an autonomous functioning of the model is guaranteed. This self-control mechanism considerably improves the quality of the fixed-point retrieval dynamics, in particular the storage capacity, the basins of attraction and the mutual information content.

14.20 *Response Space Construction for Neural Error Correction [#1056]*

Michael Stiber and Mark Pottorf, University of Washington, Bothell, United States

A physiological neuron model that incorporates the recognized prototype of an inhibitory synapse was analyzed in terms of the effects of isolated inhibitory post-synaptic potentials on its ongoing behavior. The nonstationary, transient activity resulting from these perturbations cannot be analyzed in terms of motion on some attractor (because of long-duration aftereffects) nor linearized (as the perturbations are large). Instead, results suggest that changes in the value of either of the system's slow state variables may be used to construct a global response space, within which all attractors and nonstationary behaviors exist.

14.40 *Modified Freeman Model: A Stability Analysis and Application to Pattern Recognition [#1523]*

Mustafa Ozturk, Dongming Xu and Jose Principe, University of Florida, United States

The biologically realistic Freeman model of the olfactory cortex has been used to solve some engineering problems. However, due to the nature of the nonlinear function in the model, only numerical computer simulations can help explore the behavior of the system for different sets of control parameters. In this paper, we modify the nonlinear function with a piecewise linear model and show that this simplified model exhibits the same qualitative behavior as the original one. Moreover, for this modified model, we employ the analytical tools of nonlinear dynamics to understand the system response for different parameter values. Finally, similar to the original system, we show that the modified system can be used as an auto- associative memory.

15.00 *Cholinergic Effects on Spectral Properties of Spike Trains in Rat Cortical Neurons [#1070]*

Takashi Tateno, Yasuhiko Jimbo and Hugh Robinson, Univeristy of Cambridge, United Kingdom; University of Tokyo, Japan

We investigated cholinergic modulation effects on synchronized burst activity of neurons in rat dissociated cortical cultures on electrode arrays, using a cholinergic agonist, Carbachol (CCh). Application of CCh resulted in a loss of regularity, a less precise synchronization, and a fragmentation of the burst structure. We found that temporal properties of spike trains were well- characterized by a simple Poisson cluster-process model, which provided a precise insight into the temporal structure of spike trains and allowed quantitative fitting of the spectral changes induced by CCh. These results should help to elucidate the complex actions of cholinergic modulation on cortical cells in intact neural networks.

15.20 *Modeling Nonlinear Neural Dynamics with Volterra-Poisson Kernels (special session Se) [#1647]*

Spiros Courellis, Ghassan Gholmieh, Vasilis Marmarelis and Theodore W. Berger, University of Southern California, US

A nonparametric quantitative model is introduced that captures the nonlinear dynamic properties of neural systems using input/output data. It is based on the Volterra modeling approach adapted for point-process inputs and outputs. Using input/output data, a model is presented for the CA1 region of the hippocampus. The model reliably represents the nonlinear dynamic mapping performed by CA1 with high accuracy. Compared to traditional descriptors of nonlinear neural dynamics, the presented model provides a generalized, comprehensive view.

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AUTHORS' INDEX

Page numbers of papers where a person is the first author are shown in bold. The italic page numbers point to sessions of which the person is a chair.

IJCNN 2005

International Joint Conference on Neural Networks

July 31 - August 4, 2005
Montréal, Québec, Canada

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IJCNN 2005 is organized by the International Neural Network Society and the IEEE Computational Intelligence Society, and is supported by funding from the Florida Institute of Technology, the University of Texas-Arlington, the ACIL of the University of Missouri-Rolla and the Ford Motor Company.

This annual meeting has a rich history dating back to 1987 and is the largest international neural network conference in the world. The conference invites submissions addressing theoretical and practical topics in neural networks including:

- **Perception and motor function**: vision and image processing, auditory and speech processing, pattern recognition,…
- **Cognitive function**: learning and memory; conditioning, reward and behavior, mental disorders, attention and consciousness, language, emotion and motivation,…
- **Computational neuroscience**: models of neurons, systems neurobiology, spiking neurons,…
- **Informatics**: neuro- and bio- informatics; brain models,…
- **Hardware**: neuromorphic hardware; embedded NN, reconfigurable systems,…
- **Neurodynamics**: recurrent nets, chaotic systems,…
- **Adaptation and decision making**: reinforcement learning, approximate dynamic programming, advanced learning methods and optimization, self-organizing systems, probabilistic and information-theoretic methods, support vector machines, intelligent agents, fuzzy neural systems and evolutionary computation,…
- **Applications**: signal processing, control, diagnostics, robotics, telecom, biomedical, financial, security,…

The complete list of topics is available at http://faculty.uwb.edu/ijcnn05. Selected conference papers will be included in "Advances in Neural Network Research: IJCNN 2005", a Special Issue of the journal *Neural Networks*, tentatively planned for Summer 2005.

The IJCNN 2005 Program will also include a variety of special sessions, and a series of post-conference workshops devoted to recent and important developments in neural networks is planned for August 4 (evening) and August 5 (full day), 2005. Plenary lectures will feature **Pierre Baldi** (University of California-Irvine), **Mitsuo Kawato** (ATR Computational Neuroscience Labs, Japan), **Frank Lewis** (University of Texas-Arlington), **Michael Petrides** (McGill University, Canada) and **Carver Mead** (California Institute of Technology).

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Message from the General Chair

July 2004 will be the first time in the history of the series of the annual IEEE International Conferences on Fuzzy Systems ("FUZZ-IEEE-s") when this most important meeting of the world's fuzzy scientists is held in a Central European country.

Hungarian fuzzy researchers have ever since played an active role in the international Computational Intelligence community, in the IEEE NNC and later NNS (soon becoming CIS), in the IFSA, and many other organizations, its members appearing even in difficult periods regularly at the major conferences of the field, submitting papers frequently to FSS, IEEE TFS and other journals.

In 2004 Hungary eventually got the chance to host FUZZ-IEEE and at the same time also its sister conference IJCNN in Budapest. We organizers sincerely hope that these twin conferences are becoming a great success, indeed. Considering the always fluctuating interest in participation at the large conferences, influenced by geographic location, travel costs, international politics, wars and terrorism, we really did not start preparing the conference with the sure conviction that our initial, somewhat optimistic, estimates for the number of submissions and participants will become true. I can report now with pleasure and thanks to all interested and contributing authors that we had a total of 441 submissions of which 312 papers have been accepted! While conferences often boost with the high percentage of rejections we must state it clearly that in every case a thorough and strict review process was followed by a final weighing of the reviewer's reports and eventually all papers were rejected where the average result was neutral or worse, or where at least one of the reviewers recommended vague or definite rejection. All papers thus accepted were definitely recommended for acceptance by all reviewers. (With the exception of the organized sessions where the reviewing process was always coordinated by the organizing chairs and so in most cases only the average opinion was communicated to the Program Chairs.)

It is not surprising that with such a high average standard we were in an extremely difficult situation when we had to classify some of the papers into poster sessions. However, even by reducing presentation time and squeezing six or sometimes even seven papers into the time slots originally foreseen for five papers, only 201 could be classified as orals (including the keynotes and plenaries), while the remaining 111 were accepted as poster papers. In order to enhance the efficiency of poster sessions I proposed a somewhat unusual way for poster presentations: papers were divided into topical groups as "poster sessions" with session chairs, who were asked to present their respective sessions in a short comprehensive overview, which would be followed by similarly short presentations of the authors themselves, in the form of a "guided tour" within the whole session (physically clustered in a close neighborhood). The idea is that after this oral introduction interested participants would be able to focus on the papers being most interesting for them, indeed. At the time of writing this message I can just hope that this technical innovation will be judged as useful and successful both by authors and attendance at the time of the conference!

Returning to the topic of the program in general, first of all it should be mentioned that I decided to open up towards a field where I see great possibilities of future interactions and mutually beneficial collaborations, namely Ubiquitous Computing. A keynote talk will be given by Dr. Ken Fishkin from Intel and I have great expectations that

many interesting conversations and discussions between Ken and fuzzy (and maybe also neural networks) scientists will develop during and after the conference – starting possibly a number of new research directions, generating maybe an entirely new application area of Computational Intelligence.

At the end of the message I would like to thank all who helped with this conference. They are so numerous that I cannot mention their names, they are chairs and committee members, they are with the conference office or are session organizers, etc. I just want to thank here especially to the Minister of Informatics and Communication, Kálmán Kovács who kindly agreed to the Ministry becoming a sponsor and contribute to the costs of the meeting.

I wish you all a very successful scientific event and in addition some enjoyable days in fascinating Budapest, with lots of good Hungarian food and wine and a bunch of pleasant memories to take home.

László T. Kóczy
General Chair

Message from the Ministry of Informatics and Communication

Information and communication technologies are the driving force of all kinds of development. Having recognized this the Hungarian Government has established a separate Ministry dealing with the issues of information society and telecommunications. A complex strategy (Hungarian Information Society Strategy) was adopted in 2003 setting the key objectives and priorities of our concerted efforts in building information society.

Our approach and commitment are duly reflected by the number of significant international conferences held in Hungary in the past few months such as the European Ministerial Conference on Information Society in February, Intelligent Transport Systems in Europe in May and the IANIS Annual Conference in June.

Hosting the annual FUZZ-IEEE conference, the most important meeting of the world's fuzzy scientists, is an other meaningful event to be added to this list.

Hungary's central position in the heart of Europe and our membership in the European Union enable us to be involved in important co-operations and to serve as a connecting link between larger regions. However, our activities are not limited to Europe. In the United States we created the Hungarian Technology Center, which helps small and medium sized ICT companies to get foothold in the American market. At the same time we are working with the MIT Media Laboratory aiming at establishing a similar institution and research center in Hungary that could serve the development of the entire region. In Asia we are developing strong co-operation with several countries of the region. As a part of it in October 2004 the Hungary-Asia IT Forum will take place in Budapest, where 8 Asian countries will present their "best practices" in the fields of information and communication technologies.

We consider that hosting FUZZ-IEEE 2004 in Budapest this year will further contribute to our goal to become a knowledge center in the heart of Europe. The Ministry of Informatics and Communications of Hungary is proud to support this important event. I wish you a successful conference and a pleasant stay in Budapest.

Kálmán Kovács
Minister of Informatics and Communications

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FUZZ-IEEE 2004 Program

15.21 *On the Lattice Structure of Preclusive Rough Sets*
Gianpiero Cattaneo and Davide Ciucci
15.38 *Painting Algorithms for Fuzzy Classification*
Daniel Gomez, Javier Montero, Javier Yanez and Carmelo Poidomani
15.55 *On Measuring Association Between Preference Systems*
Przemyslaw Grzegorzewski
16.12 *Subsethood Measure for Intuitionistic Fuzzy Sets*
Przemyslaw Grzegorzewski and Edyta Mrowka

Clustering and Image Processing 1, Chair: H. Ishibuchi, Room: E.....153

14.30 *Scalable Clustering: A Distributed Approach*
Prodip Hore and Lawrence Hall
14.47 *Validating Clusters using the Hopkins Statistic*
Amit Banerjee and Rajesh Dave
15.04 *Fuzzy Canonical Correlation and Cluster Analysis for Brain Mapping on Long Term Memory Consolidated by Mnemonics*
Hidetomo Ichihashi, Katsuhiro Honda and Araki Shoichi
15.21 *Heuristic Extraction of Fuzzy Classification Rules Using Data Mining Techniques: An Empirical Study on Benchmark Data Sets*
Hisao Ishibuchi and Takashi Yamamoto
15.38 *On the Min-transitive Approximation of Symmetric Fuzzy Relations*
Peter Dawyndt, Hans De Meyer and Bernard De Baets
15.55 *A Fuzzy Approach to White Blood Cells Segmentation in Color Bone Marrow Images*
Eduard Montseny, Pilar Sobrevilla and Santiago Romani
16.12 *A New Hybrid c-Means Clustering Model*
Nikhil Pal, Kuhu Pal, Jim Keller and Jim Bezdek

Monday, 26 July, 17.00–19.00

Applications (Invited Track). 3. Information Technology, Chair: D. Filev, Room: F.....154

17.00 *Fuzzy and Probabilistic Models of Association Information in Sensor Networks*
Leon Reznik and Vladik Kreinovich
17.20 *Fuzzy Logic Enabled Software Agents for Supervisory Control*
Janos Grantner, George Fodor and Ramakrishna Gottipati
17.40 *A Fuzzy Discrete Event System for HIV/AIDS Treatment Planning*
Hao Ying, Feng Lin, Xiaodong Luan, Rodger MacArthur and Jonathan Cohn
18.00 *Trust Evaluation within a Type-2 Fuzzy Logic Framework*
Devinder Kaur and Dominic Wilson
18.20 *A Hybrid System for Multi-Agent Exploration*
Cindy Leung and Adel Al-Jumaily
18.40 *Coastal Environmental Management by Fuzzy System Modeling*
Gilberto Pereira, Alexandre G. Evsukoff, Ricardo Coutinho and Nelson F. F. Ebecken

Models in Learning from Data (Invited Track) 2. Rule-based systems, Chair: R. Kruse, Room: H.....155

17.00 *Detecting Ambiguities in Regression Problems Using TSK Models*
Arup Nandi and Frank Klawonn
17.20 *Contextual Generic Association Rules Visualization using Hierarchical Fuzzy Meta-rules*
Sadok Ben Yahia and Engelbert Mephu Nguifo
17.40 *Genetic Tuning on Fuzzy Systems Based on the Linguistic 2-Tuples Representation*
Rafael Alcala and Francisco Herrera
18.00 *Mining Fuzzy Rules for Time Series Classification*
Wai-Ho Au and Keith Chan
18.20 *Choosing the best predicates for data-driven fuzzy modeling*
Mario Drobics
18.40 *Fuzzy Pattern Matching with Adaptive Bin Width Histograms to Maximize Classification Performances*
Moamar Sayed Mouchaweh, Patrice Billaudel and Bernard Riera

Imprecision Modeling with Non-Standard Logics (Invited). Fuzzy Algebra, Chair: V. N. Huynh, Room: D.....156

17.00 *A Context-Based Interpretation of Linguistic Variables*
Van Nam Huynh and Yoshiteru Nakamori

17.20 *A Note on Fuzzy Granular Reasoning*
Tetsuya Murai, Yasuo Kudo, Van Nam Huynh, Akira Tanaka and Mineichi Kudo

17.40 *Incoherent Objects and Fuzzy Sets*
Germano Resconi

18.00 *Non-Monotonic Reasoning in Prioritized Knowledge Bases Based on Granular Reasoning*
Yasuo Kudo and Tetsuya Murai

18.20 *Novel Analysis and Design of Fuzzy Inference Systems Based on Lattice Theory*
Vassilis Kaburlasos and Athanasios Kehagias

18.40 *Interpretability Improvement of Input Space Partitioning by Merging Fuzzy Sets Based on an Entropy Measure*
Shang-Ming Zhou and John Q. Gan

Interaction and Intelligence 1. (Invited), Chair: N. Kubota, Room: E 156

17.00 *Visual Perception for A Partner Robot Based on Computational Intelligence*
Naoyuki Kubota

17.20 *Behavior Learning of A Partner Robot with A Spiking Neural Network*
Hironobu Sasaki and Naoyuki Kubota

17.40 *Sensor Selection based on Fuzzy Inference for Sensor Fusion*
Futoshi Kobayashi, Daisuke Masumoto and Fumio Kojima

18.00 *Networked Intelligence by using Ontology*
Eri Sato, Toru Yamagchi and Fumio Harashima

18.20 *Methods to manipulate the output of dissociated living neuronal network in vitro by the electrical input*
Suguru Kudoh and Takahisa Taguchi

18.40 *Localization of brain activity during perception of circle movement by use of equivalent current dipole analysis*
Takahiro Yamanoi, Hisashi Toyoshima, Toshimasa Yamazaki and Shin-ichi Ohnishi

Tuesday, 27 July, 9.00–9.50

Plenary Talk: Structured Learning for Partner Robots, Chair: Imre J. Rudas, Speaker: Naoyuki Kubota, Room: C.....157

9.00 *Structured Learning for Partner Robots*
Naoyuki Kubota

Tuesday, 27 July, 10.10–12.10

Applications (Invited Track). 4. Finances, Vision, Biomedical, Chair: P. Bonissone, Room: H 157

10.10 *Fuzzy Modeling within the Statistical Process Control Framework*
Dimitar Filev and Janice Tardiff

10.27 *Evolution of Intelligent Agent in Auction Market*
Jong Yih Kuo and Jonathan Lee

10.44 *Image fusion using fuzzy logic and applications*
Harpreet Singh, Jyoti Raj, Gulsheen Kaur and Thomas Meitzler

11.01 *Environmental Applications of Fuzzy Logic - Special Workshop "Fuzzy System Applications"*
Yannis Phillis, Vassilis Kouikoglou, Luc Andriantiatsaholiniaina and Xiaomin Zhu

11.18 *A Fuzzy Confidence Value for DNA Bases*
Rency Varghese, Mohamad Musavi and Habtom Ressom

11.35 *A User-Oriented Fuzzy System for Components Packaging and Systems Integration*
Stuart H. Rubin and Wei Dai

11.52 *Application of fuzzy logic principles to the classification of 2D-PAGE maps belonging to human pancreatic cancers treated with Trichostatin-A*
Emilio Marengo, Elisa Robotti, Daniela Cecconi, Aldo Scarpa and Pier Giorgio Righetti

Tuesday, 27 July, 14.00–16.00

14.40 *Fuzzy Methods for Automated Intelligent Data Analysis*
Detlef Nauck, Martin Spott and Ben Azvine
15.00 *Extracting Knowledge and Computable Models from Data - Needs, Expectations, and Experience*
Thomas Natschlaeger, Felix Kossak and Mario Drobics
15.20 *Premise Parameter Estimation and Adaptation in Fuzzy Systems with Open-Loop Clustering Methods*
Edwin Lughofer and Erich Peter Klement
15.40 *A Fuzzy Automaton for Control Applications*
Muhammad Torabi Dashti

Fuzzy Mathematics (Invited), Chair: P. Gader, Room: D 162

14.00 *Minimization of Regret Decision Making with Dempster-Shafer Uncertainty*
Ronald Yager
14.20 *Choquet integral with respect to a regular non-additive measure*
Yasuo Narukawa and Toshiaki Murofushi
14.40 *Continuous Choquet Integrals with Respect to Random Sets with Applications to Landmine Detection*
Paul Gader, Wen-Hsiung Lee and Andres Mendez-Vasquez
15.00 *Renyi entropy with respect to Choquet capacities*
Paul Gader, Wen-Hsiung Lee and Xuping Zhang
15.20 *Additions of Completely Correlated Fuzzy Numbers*
Christer Carlsson, Robert Fuller and Peter Majlender
15.40 *A Generalized Vertex Method for Computing with Fuzzy Intervals*
Didier Dubois, Helene Fargier and Jerome Fortin

Fuzzy Information Retrieval, Chair: R. Kruse, Room: I 162

14.00 *From Boolean to Fuzzy Algebraic Queries in a Possibilistic Database Framework*
Patrick Bosc and Olivier Pivert
14.20 *A Truth Space Diagram Temporal Linguistic Rule Extraction Procedure Using Multiple Objective Evolutionary Algorithm*
Pedro DeLima and Gary Yen
14.40 *Index Structures for Flexible Querying in Fuzzy Spatial Databases*
Aziz Sozer and Adnan Yazici
15.00 *A Complete Set of Fuzzy Relational Algebraic Operators in Fuzzy Relational Databases*
Xiaohui Tang and Guoqing Chen
15.20 *Fuzzy Logic and Multiobjective Evolutionary Algorithms as Soft Computing Tools for Persistent Query Learning in Tect Retrieval Environments*
Oscar Cordon, Felix Moya and Carmen Zarco
15.40 *Non-additive Grey Relational Model: Case Study on Evaluation of Flexible Pavement*
Jia-Ruey Chang, Ching-Tsung Hung, Gwo-Hshiung Tzeng and Jyh-Dong Lin

Tuesday, 27 July, 16.30–17.30

Panel Session: Soft Computing as a Tool, Chair: Chair: E. H. Mamdani & P. Bonissone, Room: C 163

Tuesday, 27 July, 17.30–19.00

Plenary Poster Session: Fuzzy Logic, Chair: R. Mesiar, Room: P.....163

T170 *Roughness of Fuzzy Sets Based on Two New Operators*
Hongli Liang, Huaguang Zhang and Derong Liu
T171 *Discrete Fuzzy Control Loops Based on a Motor Neuro-Fuzzy Model. Pushing Too Far a Continuous Logic?*
Dan Mihai
T172 *Identification of Fuzzy Model Using Evolutionary Programming and Least Squares Estimate*
Bin Ye, Chuangxin Guo and Yijia Cao
T173 *Applications of Fuzzy Decision-Making in Pipeline Leak Localization*
Jian Feng, Huaguang Zhang and Derong Liu

T225 *A MIMO Fuzzy-Control System for High-Speed Machining Processes. Results of a Case of Study*
Jose Emilio Jimenez, Rodolfo Haber and Jose Ramon Alique
T226 *Perception-based Expert System with Application to Clinical Decision Making*
Adam Gaweda, Alfred Jacobs, Michael Brier and George Aronoff

Wednesday, 28 July, 9.00–9.50

Plenary Talk: Progressive Sampling Schemes for Approximate Clustering in Very Large Data Sets.,
Chair: E. P. Klement, Authors: James Bezdek and Richard Hathaway, Room: C **170**

Wednesday, 28 July, 10.10–12.10

System Architectures and Hardware, Chair: R. Marks, Room: E **170**

10.10 *On the use of Fourier methods in URC fuzzy system design*
Jeffrey Weinschenk, Robert Marks and William Combs
10.30 *Robust Neuro-fuzzy Controller Design via Sliding-mode Approach*
Hsu Chun-Fei, Lee Tsu-Tian, Lin Chih-Min and Chen Li-Yang
10.50 *Learning Complex Combinations of Operations in a Hybrid Architecture*
L. Andrew Coward, Tamás D. Gedeon and Uditha Ratnayake
11.10 *Algorithms of Multilevel Synthesis of Fuzzy Functions*
Andrzej Wielgus
11.30 *A High Performance IDS Processing Unit for a New Fuzzy-based Modeling*
Masayuki Murakami, Nakaji Honda and Junji Nishino
11.50 *A CMOS Implementation of Current-Mode Min-Max Circuits and A Sample Fuzzy Application*
Behzad Mesgarzadeh

Applications of Type 2 Fuzzy Logic 1 (Invited), Chair: H. Hagras, Room: F **170**

10.10 *Centroid Uncertainty Bounds for Interval Type-2 Fuzzy Sets: Forward and Inverse Problems*
Jerry Mendel and Hongwei Wu
10.30 *A Type-2 Fuzzy Logic Controller for the Liquid-level Process*
Dongrui Wu and Woei Wan Tan
10.50 *A New and Efficient Method for the Type-2 Meet Operation*
Simon Coupland and Robert John
11.10 *A Type-2 Fuzzy Logic Controller For Autonomous Mobile Robots*
Hani Hagras
11.30 *Effect of Type-2 Fuzzy Membership Function Shape on Modelling Variation in Human Decision Making*
Turhan Ozen and Jonathan Garibaldi
11.50 *Pro-Two: A Hardware Based Platform For Real Time Type-2 Fuzzy Inference*
Miguel Melgarejo, Antonio Garcia and Carlos Pena-Reyes

Fuzzy Optimization and Design, Chair: L. Magdalena, Room: H **171**

10.10 *Chance-Constrained Programming for Quadratic Minimum Spanning Tree Problem with Fuzzy Costs*
Jinwu Gao and Mei Lu
10.27 *KBCT: A Knowledge Extraction and Representation Tool for Fuzzy Logic Based Systems*
Jose M. Alonso, Luis Magdalena and Serge Guillaume
10.44 *Optimizing Sampling Time in Single Photon Counting Experiments*
László Nadai, László T. Kóczy and Péter Várlaki
11.01 *Using Fuzzy Distance to Evaluate the Consensus of Group Decision-Making - An Entropy-based Approach*
Chi-Chun Lo and Ping Wang
11.18 *Evaluation Function Guided Search for Fuzzy Set Covering*
Ian Cloete and Jacobus van Zyl
11.35 *A Proposal of Visualization Method for Obtaining Interpretable Fuzzy Rules*
Kosuke Yamamoto, Takeshi Furuhashi and Tomohiro Yoshikawa
11.52 *Identification of Fuzzy T-S ARMAX Models*
Bore-Kuen Lee and Bor-Sen Chen

Wednesday, 28 July, 14.00–16.00

15.08 *Fuzzy Translation Tools for Linguistic Terms*
Andy Verkeyn and Dick Botteldooren
15.25 *The Rapid Elicitation of Knowledge About Images Using Fuzzy Information Granules*
Jonathan Rossiter
15.42 *Discovering Gene-Gene Relations from Fuzzy Sequential Sentence Patterns in Biomedical Literature*
Jung-Hsien Chiang, Zong-Xian Yin and Cheng-Yu Chen

Real World Applications, Chair: P. Kulczycki, Room: D 175

14.00 *Image Analysis via Fuzzy Reasoning Approach: Prototype Applications at NASA*
Jesus Dominguez and Steve Klinko
14.20 *A Software for Electric-Power Fuzzy Critical Analysis*
Mariana Dumitrescu, Toader Munteanu and Dan Floricau
14.40 *Kernel Estimators for Analysis of Systems with Fuzzy Uncertainty*
Piotr Kulczycki
15.00 *Improving Visual Servoing Using Fuzzy Filters*
Paulo Sequeira Goncalves, Luis Mendonca, Joao Sousa and Joao Caldas Pinto
15.20 *Experiments with a Hierarchical Text Categorizer*
Domonkos Tikk, György Biró and Jae Dong Yang
15.40 *Fuzzy Linear Assignment Problem: An Approach to Vehicle Fleet Deployment*
Minh Ngoc Ngo, Kiam Tian Seow and Kok Wai Wong

Wednesday, 28 July, 17.30–19.00

Plenary Poster Session: Fuzzy Control, Chair: K. Tanaka & D. Liu, Room: P 176

W170 *A Generalized Fuzzy Hyperbolic Modeling and Control Scheme*
Zhang Mingjun, Zhang Huaguang and Liu Derong
W171 *Adaptive Fuzzy Output Feedback Control for Nonlinear MIMO Systems*
Shaocheng Tong and Yan Shi
W172 *Rule Chain and Dominant Rule Control Algorithm for Unknown Nonlinear Systems*
Hailiang Zhao
W173 *Feedback Control via Popov for Fuzzy Systems with Input Saturations*
Ji-Chang Lo and Min-Long Lin
W174 *Approximation Capability Analysis of Hierarchical Takagi-Sugeno Fuzzy Systems*
Xiao-Jun Zeng and John Keane
W175 *Analysis of Autoregressive Fuzzy Systems*
Zdenek Vlcek
W176 *Approximations of Large Rule Fuzzy Logic Controller by Simplest Fuzzy Controller*
Rakesh Arya, R. Mitra and Vijay Kumar
W177 *Predictive Control Based on Fuzzy Model for Steam Generator*
Daniela Andone and Andrei Hossu
W178 *Robot hand tracking using adaptive fuzzy control*
Perez Carlos, Reinoso Oscar, Garcia Nicolas, Neco Ramon and Vicente Maria Asuncion
W179 *Robust Stable Feedback Linearization of Fuzzy Modeled Nonlinear Systems via LMI's*
Chang-Woo Park, Chan-Woo Moon, Jongbae Lee, Young-Ouk Kim and Ha-Gyeong Sung
W180 *The Discourse Self-adapting Fuzzy Controller for Temperature Control Processing in Disinfecting Cupboard*
Yongquan Yu, Ying Huang and Bi Zeng
W181 *Output Regulation for Discrete-time Nonlinear Time-Varying Delay Systems: An LMI Approach*
Tung-Sheng Chiang, Chian-Song Chiu and Peter Liu
W182 *Output Regulation Control via Virtual Model Reference Approach*
Peter Liu, Tung-Sheng Chiang and Chian-Song Chiu
W183 *Control of Discrete-Time Chaotic Systems Using One-Step-Ahead Adaptive Fuzzy Controller*
Feng Wan, Huilan Shang and Li-Xin Wang
W184 *How to tune fuzzy controllers*
Eduardo Gomez-Ramirez and Armando Chavez-Placencia
W185 *Design and Analysis of SISO Fuzzy Logic Controller for Power Electronic Converters*
Viswanathan Kanakasabai, Dipti Srinivasan and Ramesh Oruganti

Thursday, 29 July, 9.00–9.50

Thursday, 29 July, 10.10–12.10

11.18 *Fuzzy Relational Equations in Monoidal Logics*
Ladislav Kohout
11.35 *Computationally Efficient Incremental Transitive Closure of Sparse Fuzzy Binary Relations*
Manolis Wallace and Stefanos Kollias
11.52 *Indistinguishability Operators generated by fuzzy Numbers*
Joan Jacas and Jordi Recasens

Philosophy of Soft Computing (Invited), Chair: V. Niskanen, Room: D 183

10.10 *Ontological Grounding of Fuzzy Theory*
I. Burhan Turksen
10.27 *Scientific Outlook from Soft-Computing Standpoint*
Vesa Niskanen
10.44 *DNA Computing Approach to Optimal Decision Problems*
Junzo Watada, Satoshi Kojima, Satomi Ueda and Osamu Ono
11.01 *On Aristotelian Tradition and Fuzzy Revolution*
Jorma Mattila
11.18 *40 years ago: "Fuzzy Sets" is going to be published*
Rudolf Seising
11.35 *Spatial Knowledge Creation In A Circular World - Perspectives On Logical And Visual Communication In A Social Space*
Susanne Kratochwil and Josef Benedikt
11.52 *A Philosophical Study on Meaning and Fuzzy Sets*
Tero Joronen

Thursday, 29 July, 14.00–16.00

Fuzzy Control and Robotics 2, Chair: M. Sugeno, Room: E 184

14.00 *Stabilization of Nonlinear Systems based on Piecewise Lyapunov Functions*
Tadanari Taniguchi and Michio Sugeno
14.20 *Output Regulation Control via Fuzzy Operational Point Reference Approach*
Chian-Song Chiu, Tung-Sheng Chiang and Peter Liu
14.40 *Internet-Based Remote Stabilization for Nonlinear Systems*
Kazuo Tanaka, Hiroshi Ohtake and Hua Wang
15.00 *Fuzzy Reference Gain-Scheduling Approach as Intelligent Agents: FRGS Agent*
Jose Ernesto Araujo, Karl Heinz Kienitz, Sandra A. Sandri and Jose Demisio S. da Silva
15.20 *Fuzzy Control for Fuzzy Interval Systems. Part I: Solving First Order Fuzzy Equations*
Reda Boukezzoula, Laurent Foulloy and Sylvie Galichet
15.40 *Obtaining a Fuzzy Controller with High Interpretability in Mobile Robots Navigation*
Manuel Mucientes and Jorge Casillas

Fuzzy Modeling (Invited), Chair: L. T. Kóczy & J. Botzheim, Room: F 184

14.00 *Two Step Feature Selection: Approximate Functional Dependency Approach Using Membership Values*
Ozge Uncu and I. Burhan Turksen
14.20 *Construction of Fuzzy Signature from Data: An Example of SARS Pre-clinical Diagnosis System*
Kok Wai Wong, Tamás D. Gedeon and László T. Kóczy
14.40 *Regularized Numerical Optimization of Fuzzy Rule Bases*
Johannes Himmelbauer and Mario Drobics
15.00 *3D Model Estimation from Multiple Images*
András Rövid, Annamária R. Várkonyi-Kóczy and Péter Várlaki
15.20 *Estimating fuzzy membership functions parameters by the Levenberg-Marquardt algorithm*
János Botzheim, Cristiano Cabrita, László T. Kóczy and Antonio Ruano
15.40 *A New Cluster Validity Criterion for Fuzzy C-Regression Model and Its Application to T-S Fuzzy Model Identification*
Chung-Chun Kung and Chih-Chien Lin

Thursday, 29 July, 16.20–16.50

DETAILED PROGRAM & ABSTRACTS

Monday, 26 July, 9.20–10.10

Plenary Talk: Precisiated Natural Language (PNL) – Toward an Enlargement of the Role of Natural Languages in Scientific Theories

Monday, 26 July, 9.20–10.10, Room: A, Chair: Enrique Ruspini
Speaker: Lotfi A. Zadeh, University of California, United States

It is a deep-seated tradition in science to view the use of natural languages in scientific theories as a manifestation of mathematical immaturity. The rationale for this tradition is that natural languages are lacking in precision. However, what is not recognized to the extent that it should, is that adherence to this tradition carries a steep price. In particular, a direct consequence is that existing scientific theories do not have the capability to operate on perception-based information exemplified by "Most Finns are honest." Such information is usually described in a natural language and is intrinsically imprecise, reflecting a fundamental limitation on the cognitive ability of humans to resolve detail and store information.

Monday, 26 July, 12.10–13.00

Plenary Talk: Ubiquitous Computing Challenges in Recognizing and Predicting Human Activity

Monday, 26 July, 12.10–13.00, Room: A, Chair: László T. Kóczy
Speaker: Kenneth Fishkin, Intel Research Seattle, United States

Ubiquitous Computing offers a compelling vision, in which computers vanish into the environment, using sensors to infer their context, and then using dynamically available actuators to influence their environment. This vision has proven as difficult as it is compelling. In this paper, we first outline the vision, then highlight what we believe are the main hurdles preventing its realization, and then present a new paradigm to help overcome these hurdles within a particular subset of inferencing, inferring the activity of humans in their environment. Existing prototypes indicate that the paradigm is a fruitful one - the issues and challenges inherent in going beyond these first steps are described.

Monday, 26 July, 14.30–16.30

Applications (Invited). 1. Toward Intelligent Human Robot Interface 2. Control

Monday, 26 July, 14.30–16.30, Room: H, Chair: Z. Z. Bien & D. Filev

14.30 *A 'Personalized' Facial Expression Recognition with Fuzzy Similarity Measure and Novel Feature Selection Method [#1249]*
Dae-Jin Kim and Zeungnam Bien, Dept. of EECS, KAIST, Korea (South)

In this paper, we discuss about a design process of 'personalized' classifier with soft computing techniques. Based on a human's way of thinking, a construction methodology for personalized classifier is mentioned. Here, two fuzzy similarity measures and ensemble of classifiers are effectively used. A feature selection method for the fuzzy neural networks plays also a key role for construction of personalized classifier. As one of the possible applications, facial expression recognition problem is discussed. The numerical result shows that the proposed method can enhance the classification rate for 22 persons from 81.0 to 90.4.

14.50 *Facial Action Detection from Dual-View Static Face Images [#1054]*
Maja Pantic and Leon Rothkrantz, Delft University of Technology, Netherlands

In this paper we present an automatic system that we developed to recognize facial muscle activity (action units, AUs) from static images of combined frontal- and profile-view of the face. For the frontal view, the face region is subjected to multi-detector processing. A set of 19 frontal-face feature points is then extracted from the spatially sampled contours of the facial components. For the profile view, 10 feature points are extracted from the contour of the face-profile region. Based on these 29 points, 29 individual facial muscle action units (AUs) occurring alone or in combination in an input dual-view face image are recognized using a rule-based reasoning with uncertainty. A recognition rate of 86 percent is achieved.

15.10 *Facial Caricature Drawing Using Subjective Image of a Face Obtained by Words [#1370]*
Takehisa Onisawa and Yusuke Hirasawa, University of Tsukuba, Japan

This paper mentions the facial caricature drawing system that draws caricature reflecting user's impressions and image of model's face. The present system has user's own databases of parameter values of facial features expressing impressions and facial features since the meanings. Parameter values of caricature are calculated according to inputted linguistic expressions of user's impressions and image of model's face. The system draws facial caricature using calculated parameters values. The results of subject experiments to draw facial caricature using the present system show that the present system can draw facial caricatures not only reflecting subject's images of models' faces but also giving high recognition degree.

15.30 *Facial Expression Classification Based on MPEG-4 FAPs: The Use of Evidence and Prior Knowledge for Uncertainty Removal [#1347]*
Manolis Wallace, Amaryllis Raouzaiou, Nicolas Tsapatsoulis and Stefanos Kollias, National Technical University of Athens, Greece

As low resolution shots, rotations of the head with respect to the camera, face deformation due to speech and so on inflict a great deal of uncertainty in FAP measurements, uncertainty is also inherent in the process of expression analysis.

In this paper we tackle such uncertainty via the observation that user emotions do not typically alter rapidly very often. Thus, possibilistic evidence may be gathered from each frame about the user expression; evidence from the current and recent frames can be combined using evidence theory.

15.50 *On-line Identification of MIMO Evolving Takagi-Sugeno Fuzzy Models [#1025]*

Plamen Angelov, Costas Xydeas and Dimitar Filev, Lancaster University, United Kingdom; Ford Motor Company, United States

In this paper recently introduced evolving Takagi-Sugeno approach has been extended for the case of MIMO system model. Both parts of the identification algorithm, namely the unsupervised fuzzy rule-base antecedents learning by a recursive clustering, and the supervised parameters learning by Kalman- filtering-based procedure, are extended for the case of multidimensional output. The radius of influence of each fuzzy rule is considered in a vector form which adds to the flexibility of the approach. Simulation results using a benchmark Mackey-Glass chaotic time-series prediction illustrate the computational efficiency of the proposed method.

16.10 *Fuzzy Logic for Plant Monitoring and Diagnostics [#1027]*

Oscar Castillo and Patricia Melin, Tijuana Institute of Technology, Mexico

We describe in this paper a new approach for plant monitoring and diagnostics using type-2 fuzzy logic and fractal theory. The concept of the fractal dimension is used to measure the complexity of the time series of relevant variables for the process. A set of type-2 fuzzy rules is used to represent the knowledge for monitoring the process. In the type-2 fuzzy rules, the fractal dimension is used as a linguistic variable to help in recognizing specific patterns in the measured data. (Paper for Worhshop Fuzzy Systems Applications)

Learning from Data (Invited Track) 1. Inductive Learning

Monday, 26 July, 14.30–16.30, Room: I, Chair: U. Bodenhofer

14.30 *Towards Learning in Parallel Universes [#1156]*

Michael Berthold and David Patterson, University of Konstanz, Germany; Tripos, Inc., United States

Most learning algorithms operate in a clearly defined feature space and assume that all relevant structure can be found in this one, single space. For many local learning methods, especially the ones working on distance metrics (e.g. clustering algorithms), this poses a serious limitation. We disucss an algorithm that directly finds a set of cluster centers based on an analysis of the distribution of patterns in the local neighborhood of each potential cluster center. This type of cluster construction makes it feasable to find clusters in several feature spaces in parallel, effectively finding the optimal feature space for each cluster independently.

14.50 *Getting adaptability or expressivity in inductive logic programming by using fuzzy predicates [#1356]*

Mathieu Serrurier and Prade Henri, Universite Paul Sabatier, France

Introducing fuzzy predicates in inductive logic programming may serve two different purposes : getting more expressivity by learning fuzzy rules, or allowing for more adaptability when learning classical rules. On the one hand, we can thus learn gradual and certainty rules, which have an increased expressive power and have no simple crisp counterpart. On the other hand, fuzzy predicates in rules can be used for dicretization when the database contains numerical attributes. In this case the fuzzy counterparts of crisp rules allow us to check the meaningfulness and the accuracy of the crisp rules. In this paper we discuss the interest and the application domain of each kind of rules with fuzzy predicates.

15.10 *Participatory Learning: A Paradigm for More Human Like Learning [#1044]*

Ronald Yager, Iona College, United States

We discuss the participatory learning paradigm and emphasize the all inclusive role of the currently beliefs in every aspect of the learning process. We describe how the acceptance mechanism determines which observations will be used for learning based upon their compatibility with the current beliefs. We point out how this lead to more efficient learning. A prototypical example of a participatory learning system is introduced. We introduce the concept of a reviewer that monitors the performance of the system and gives it some independence from the current beliefs. THIS IS BEING SUBMITTED FOR THE TRACK ON FUZZY METHODS AND MODELS IN LEARNING FROM DATA

15.30 *Information Measures in Fuzzy Decision Trees [#1269]*

Xiaomeng Wang and Christian Borgelt, Otto-von-Guericke Universitaet Magdeburg, Germany

Decision trees are a popular form of classification models. It is well known that classical trees lack the ability of modelling vagueness. By connecting fuzzy systems and classical decision trees, we try to achieve classifiers that can model vagueness and are comprehensible. We discuss the core problem of how to compute the information measure used in the induction of fuzzy trees and propose some improvements. In addition, we consider fuzzy rule bases derived from fuzzy decision trees and present some heuristic strategies to prune them. We report the results of experiments in which we compare our approach to other well-known classification methods.

15.50 *Imprecise Nested Granular Complexes [#1061]*

Lawrence Mazlack, University of Cincinnati, United States

Causal reasoning occupies a central position in human reasoning. Causality is granular in many ways. Knowledge of some causal effects is imprecise. Perhaps, complete knowledge of all possible factors might lead to crisp causal descriptions. However, it is unlikely that all possible factors can be known. Commonsense understanding accepts imprecision, uncertainty and imperfect knowledge and is more successful reasoning with a few large-grain sized events than many fine-grained events. Perhaps, a satisficing solution would be to develop large-grained solutions and only go to an implicitly nested finer-grain when the impreciseness of the large-grain is unsatisfactory. Fuzzy Markov models might be used.

16.10 *Ranking by Pairwise Comparison: A Note on Risk Minimization [#1184]*

Eyke Huellermeier and Johannes Fuernkranz, Marburg University, Germany; Darmstadt Technical University, Germany

We consider the problem of learning ranking functions in a supervised manner. A ranking function is a mapping from instances to rankings over a finite label set. Our learning method is a two-step procedure. First, a valued preference structure is induced from given preference data, using a natural extension of so-called pairwise classification. A ranking is then derived from that preference structure by means of a simple scoring function. It is shown that a prediction thus obtained is a risk minimizer if the distance between rankings is measured by the Spearman rank correlation. We conclude the paper by outlining a potential application of the method in (qualitative) fuzzy classification.

Innovative Trends in Mathematical Models of Imprecision (Invited)

Monday, 26 July, 14.30–16.30, Room: D, Chair: M. D. Cock

14.30 *Fuzzy Rough Sets: Beyond the Obvious [#1209]*
Martine De Cock, Chris Cornelis and Etienne E. Kerre, Ghent University, Belgium

Rough set theory was introduced in 1982. Soon it was combined with fuzzy set theory, giving rise to a hybrid model, involving fuzzy sets and fuzzy relations, which appears to be a natural, elegant generalization. In this paper we reveal that in the fuzzification process an important step seems to be overlooked. The most fascinating part is that this forgotten step arises from the true essence of fuzzy set theory: namely, that an element can belong to a given degree to more than one fuzzy set at the same time.

14.47 *An Algebraic Characterisation of Fuzzy Rough Sets [#1232]*
Anna Maria Radzikowska and Etienne E. Kerre, System Research Institute, Poland; Ghent University, Belgium

In this paper we present an algebraic approach to fuzzy generalisation of rough sets. We take an arbitrary residuated lattice L as a basic algebraic structure. L-fuzzy rough sets are defined using the product operator and its residuum provided by the residuated lattice L. Depending on classes of binary fuzzy relation, we define several classes of L-fuzzy rough sets and show properties of the respective classes of these structures.

15.04 *An Approach to Roughness of Fuzzy Sets [#1078]*
Van Nam Huynh and Yoshiteru Nakamori, Japan Advanced Institute of Science and Technolo, Japan

In rough-set-based data analysis, the roughness of a set is used to express the degree of inexactness of the set arose due to incompleteness of available knowledge. Recently, an attempt of integration between the theories of fuzzy sets and rough sets has resulted in providing a roughness measure for fuzzy sets (Banerjee and Pal, 1996). In this paper we introduce a parameter-free roughness measure for fuzzy sets based on the notion of the mass assignment of a fuzzy set. Several interesting properties of this new measure are proved. Furthermore, we also discuss some possible extensions of the so-called approximation quality, which may be used to describe the rough approximation quality of a fuzzy classification.

15.21 *On the Lattice Structure of Preclusive Rough Sets [#1197]*
Gianpiero Cattaneo and Davide Ciucci, Universita' degli studi di Milano Bicocca, Italy

Once defined a rough approximation map on the abstract notion of minimal BZ lattice, the collection of all rough approximations is took into account and its structure is analyzed with respect to lattice properties. Further, some non--standard complementations are introduced on it. Finally, the results obtained in the abstract environment are applied to the concrete case of preclusive rough sets on a preclusive space.

15.38 *Painting Algorithms for Fuzzy Classification [#1210]*
Daniel Gomez, Javier Montero, Javier Yanez and Carmelo Poidomani, Complutense University, Spain; Catania University, Italy

Land cover analysis by means of remotely sensing images quite often suggest the existence of fuzzy classes, where no clear borders or particular shapes appear. In this paper we present an image classification aid algorithm which shows as its main output a processed image where each pixel is being colored according to the degree of similitude to their respective surrounding pixels. Such a processed image is therefore suggesting possible classes, to be implemented in more sophisticated image classification process. A key underlying argument for this approach is the relevance of painting techniques in order to help decision makers to understand complex information relative to fuzzy image classification.

15.55 *On Measuring Association Between Preference Systems [#1407]*
Przemyslaw Grzegorzewski, Polish Academy of Sciences, Poland

The problem of measuring association between preference systems in situations with missing information or noncomparable outputs is discussed. New correlation coefficient, which generalize Kendall's rank correlation coefficients used traditionally in statistics, is suggested. The construction utilizes intuitionistic fuzzy sets.

16.12 *Subsethood Measure for Intuitionistic Fuzzy Sets [#1413]*
Przemyslaw Grzegorzewski and Edyta Mrowka, Polish Academy of Sciences, Poland

The problem of measuring degree of inclusion between intuitionistic fuzzy sets is discussed. A simple subsethood measure based on the Hamming distance between intuitionistic fuzzy sets is suggested...

Clustering and Image Processing 1

Monday, 26 July, 14.30–16.30, Room: E, Chair: H. Ishibuchi

14.30 *Scalable Clustering: A Distributed Approach [#1084]*
Prodip Hore and Lawrence Hall, University of South Florida, United States

The ever-increasing size of data sets and poor scalability of clustering algorithms has drawn attention to distributed clustering for partitioning large data sets. In this paper we propose an algorithm to cluster large-scale data sets without clustering all the data at a time. Data is randomly divided into almost equal size disjoint subsets. We then cluster each subset using the hard- k means or fuzzy k-means algorithm. The centroids of subsets form an ensemble. The centroids are combined to form a global set. Experimental results show that most of the time the pattern of clusters generated by our algorithm has small difference from the pattern of clusters generated by clustering all the data at a time.

14.47 *Validating Clusters using the Hopkins Statistic [#1086]*
Amit Banerjee and Rajesh Dave, New Jersey Institute of Technology, Newark, NJ, United States

A novel scheme for cluster validity using a test for random position hypothesis is proposed. The random position hypothesis is tested against an alternative clustered hypothesis on every cluster produced by a partitioning algorithm. A test statistic such as the well-known Hopkins statistic could be used as a basis to accept or reject the random position hypothesis, which is also the null hypothesis in this case. The Hopkins statistic is known to be a fair estimator of randomness in a data set. The concept is borrowed from the clustering tendency domain and its applicability to validating clusters is shown here using two artificially constructed test data sets.

15.04 *Fuzzy Canonical Correlation and Cluster Analysis for Brain Mapping on Long Term Memory Consolidated by Mnemonics [#1091]*

Hidetomo Ichihashi, Katsuhiro Honda and Araki Shoichi, Osaka Prefecture University, Japan; Matsushita Electric Industrial Co., Ltd., Japan

Fuzzy Canonical Correlation Analysis (FCCA) is developed, which can detect wave form of each voxel and minimize the effect of false activity such as inner speech during control epochs. This makes it possible to design an elastic experimental and control block. A brain mapping in recalling long term memories consolidated by mnemonics called the Method of Loci was carried out using fMRI experiments. The fMRI signals were analyzed using SPM99 and the FCCA together with fuzzy c-means (FCM) clustering. The clustering results reveal the functional specialization of Broca's area and visual area.

15.21 *Heuristic Extraction of Fuzzy Classification Rules Using Data Mining Techniques: An Empirical Study on Benchmark Data Sets [#1095]*

Hisao Ishibuchi and Takashi Yamamoto, Osaka Prefecture University, Japan

The aim of this paper is to examine the classification performance of compact fuzzy rule-based systems with high comprehensibility. Those fuzzy systems are designed in a heuristic manner using rule selection criteria. A small number of simple fuzzy rules are extracted from numerical data based on each rule selection criterion. We examine the classification performance of extracted fuzzy rules through computational experiments on a number of benchmark data sets in the UCI ML Repository. While fuzzy rules are extracted using a simple heuristic method with no optimization or tuning procedures, our results on some data sets are comparable to reported results by the C4.5 algorithm in the literature.

15.38 *On the Min-transitive Approximation of Symmetric Fuzzy Relations [#1157]*

Peter Dawyndt, Hans De Meyer and Bernard De Baets, Ghent University, Belgium

Two new algorithms are proposed for generating a min-transitive approximation of a given reflexive and symmetric fuzzy relation which, in general, deviates less from the given fuzzy relation than its min-transitive closure, and which is guaranteed to be still reflexive and symmetric. Since the new algorithms are weight-driven, they can be used to generate layer by layer the partition tree associated to the corresponding min-transitive approximation. We report on numerical tests that have been carried out on synthetic data to compare the approximations generated by the new algorithms to the min-transitive closure and the min-transitive approximation delivered by the UPGMA clustering algorithm.

15.55 *A Fuzzy Approach to White Blood Cells Segmentation in Color Bone Marrow Images [#1227]*

Eduard Montseny, Pilar Sobrevilla and Santiago Romani, Technical University of Catalonia, Spain; Rovira i Virgili University, Spain

Locating, identifying, and counting the different classes of White Blood Cells manually are tedious and consuming-time tasks that could be simplified by means an automatic analysis, in which segmentation is a crucial step. In this paper we present an approach to automatic cell segmentation within color bone marrow microscopic images, which is robust with regard to variable illuminant level conditions, and takes into account color components' stability degrees. For each image pixel we get the similarity degree between its color and the system colors, what makes algorithm design much easier because allows to emulate experts' image segmentation skills.

16.12 *A New Hybrid c-Means Clustering Model [#1379]*

Nikhil Pal, Kuhu Pal, Jim Keller and Jim Bezdek, Indian Statistical Institute, India; Institute of Engineering and Management, India; University of Missouri, CO, United States; University of West Florida, United States

Earlier we proposed the fuzzy-possibilistic c-means (FPCM) model and algorithm that generated both membership and typicality values when clustering unlabeled data. FPCM imposes a constraint on the sum of typicalities over a cluster that leads to unrealistic typicality values for large data sets. Here we propose a new model called possibilistic-fuzzy c-means (PFCM). PFCM produces memberships and possibilities simultaneously, along with the cluster centers. PFCM addresses the noise sensitivity defect of FCM, overcomes the coincident clusters problem of possibilistic c-means (PCM) and eliminates the row sum constraints of FPCM. Our numerical examples show that PFCM compares favorably to all of the previous models.

Monday, 26 July, 17.00–19.00

Applications (Invited Track). 3. Information Technology

Monday, 26 July, 17.00–19.00, Room: F, Chair: D. Filev

17.00 *Fuzzy and Probabilistic Models of Association Information in Sensor Networks [#1297]*

Leon Reznik and Vladik Kreinovich, Rochester Institute Of Technology, United States; University of Texas at El Paso, United States

The paper considers the problem of improving accuracy and reliability of measurement information acquired by sensor networks. It offers the way of integrating sensor measurement results with association information available or a priori derived at aggregating nodes. The models applied for describing both sensor results and association information are reviewed with consideration given to both neuro-fuzzy and probabilistic models and methods. The information sources, typically available in sensor systems, are classified according to the model (fuzzy or probabilistic), which seems more feasible to be applied. The integration problem is formulized as an optimization problem.

17.20 *Fuzzy Logic Enabled Software Agents for Supervisory Control [#1235]*

Janos Grantner, George Fodor and Ramakrishna Gottipati, Western Michigan University, United States; ABB Automation Technology Products AB, Sweden

Programs for contemporary industrial control systems are designed using Object Oriented methods and software agents. A trend is that agents are becoming more autonomous, more complex and are having more responsibilities. There is a need for a high-level information representation such that a predictable behavior can be achieved in a uniform way for all agents. A fuzzy automaton-based approach offers clear benefits for developing agents of reconfigurable architecture. This paper reports on a research project that is currently underway to develop a Generic Encapsulated Fuzzy Automaton Software Agent for Object Oriented Control Systems.

17.40 *A Fuzzy Discrete Event System for HIV/AIDS Treatment Planning [#1151]*

Hao Ying, Feng Lin, Xiaodong Luan, Rodger MacArthur and Jonathan Cohn, Wayne State University, United States

Treatment planning for most diseases is currently partial art and partial science. One promising approach is the novel fuzzy discrete event systems whose theoretical framework was recently developed by us. In the present paper, we apply it to treatment planning for HIV/AIDS patients who have never received antiretroviral therapy. We show how to design such a system. We have also statistically evaluated the preliminary results produced by the system in comparison with two AIDS specialists on our team. The results indicate strong agreement between the physicians and the fuzzy discrete event system. This is the first and only application of fuzzy discrete event systems in the literature.

18.00 *Trust Evaluation within a Type-2 Fuzzy Logic Framework [#1237]*
Devinder Kaur and Dominic Wilson, University of Toledo, United States

A model for reasoning about trust and risk is developed as a result of investigating the representation and processing of beliefs within a type-2 fuzzy logic framework. This model is shown to be more realistic than the Dempster-Shaffer theory and Subjective Logic because of its lack of restriction to binary propositions. The model also gives an indication of the quality of its implications by allowing best case and worst case analyses. This model is tested using the game theoretic Prisoners Dilemma problem as well as the hypothetical operation of an internet store. In both cases the model is shown to give a more realistic modeling environment and deliver more useful information than when using crisp values.

18.20 *A Hybrid System for Multi-Agent Exploration [#1265]*
Cindy Leung and Adel Al-Jumaily, University of Technology, Sydney, Australia

This paper describes a multi-agent system that performs exploration and target seeking. A bidding scheme is applied to obtain assistance and cooperation between the mobile robots. An occupancy grid-based map and laser sensors are used for mapping. Frontier based exploration is implemented to determine unexplored areas to search. Targets are identified by designated colours in the vision sensors. Wavefront propagation is used for path planning to both the frontiers and the targets. Fuzzy logic is applied to the laser scans to perform collision avoidance.

18.40 *Coastal Environmental Management by Fuzzy System Modeling [#1102]*
Gilberto Pereira, Alexandre G. Evsukoff, Ricardo Coutinho and Nelson F. F. Ebecken, COPPE/Federal University of Rio de Janeiro, Brazil; Almirante Paulo Moreira Study Institute, Brazil

Environmental data often need to be analyzed in order to obtain information necessary for environmental management decision. The main task today is to shift what is natural and antrophic variability and the assessment of trophic status to forecast the future ecosystem behavior. The case studied is the algal community growth in coastal upwelling area of Cabo Frio Island at Rio de Janeiro state, southeastern of Brazil as a bioindicator since this place is becoming a operational support base of a oil drilling companies. We used a machine learning approach to elicit regularities and dependences that include both numerical and logical conditions. Workshop Fuzzy System Applications.

Models in Learning from Data (Invited Track) 2. Rule-based systems

Monday, 26 July, 17.00–19.00, Room: H, Chair: R. Kruse

17.00 *Detecting Ambiguities in Regression Problems Using TSK Models [#1372]*
Arup Nandi and Frank Klawonn, University of Applied Sciences BS/WF, Germany

The aim of regression is to approximate a function from which measurements were taken. Although the underlying assumption is always that the data actually are (noisy) samples of a function, this might not be true in some cases. For instance, when we consider data from a technical process that is controlled by human operators, these operators might use different strategies to reach a particular goal. Trying to fit these data with a single function will not work, no matter which approximation technique we use. In this paper, we propose an algorithm based on competing TSK models to detect such ambiguities in data sets.

17.20 *Contextual Generic Association Rules Visualization using Hierarchical Fuzzy Meta-rules [#1222]*
Sadok Ben Yahia and Engelbert Mephu Nguifo, Faculte des Sciences de Tunis, Tunisia; Centre de recherches en Informatique de Lens, France

Traditional framework for mining association rules has pointed out the derivation of many redundant rules. In order to be reliable in a decision making process, such discovered rules have to be concise and easily understandable for users or as well as an input to visualization tools. In this paper, we present a graph-based visualization prototype for handling generic bases of association rules. An interesting feature of the prototype is that it provides a "contextual" exploration of such rule set. Such additional displayed knowledge, based on the construction of fuzzy meta-rules, enhances man-machine interaction by emulating a cooperative behavior.

17.40 *Genetic Tuning on Fuzzy Systems Based on the Linguistic 2-Tuples Representation [#1404]*
Rafael Alcala and Francisco Herrera, Dept. of Computer Science and A.I. U. of Granada, Spain

One of the research lines of Linguistic Fuzzy Modeling in the last years has leaded up to the objective of giving more accuracy to the Linguistic Fuzzy Modeling, without losing the associated interpretability to a high level. In this work, a new post-processing method of Fuzzy Rule-Based Systems is proposed by means of an evolutionary lateral tuning of the linguistic variables, with the main aim of obtaining Fuzzy Rule-Based Systems with a better accuracy and maintaining a good interpretability. To do so, this tuning considers a new rule representation scheme by using the linguistic 2-tuples representation model which allows the lateral variation of the involved labels. We analyze this approach considering a real-world problem.

18.00 *Mining Fuzzy Rules for Time Series Classification [#1279]*
Wai-Ho Au and Keith Chan, The Hong Kong Polytechnic University, Hong Kong

Time series classification is concerned about discovering classification models in a database of pre-classified time series and using them to classify unseen time series. To better handle the noises and fuzziness in time series data, we propose a new data mining technique to mine fuzzy rules in the data. The fuzzy rules discovered employ fuzzy sets to represent the revealed regularities and exceptions. The resilience of fuzzy sets to noises allows the proposed approach to better handle the noises embedded in the data. Furthermore, it uses the adjusted residual as an objective measure to evaluate the interestingness of association relationships hidden in the data.

18.20 *Choosing the best predicates for data-driven fuzzy modeling [#1188]*
Mario Drobics, Software Competence Center Hagenberg, Austria

Data-driven fuzzy modeling is concerned with the induction of computational models from data. When creating fuzzy models from data, the problem arises how to choose the underlying fuzzy sets. On the one hand, the fuzzy sets should have a semantic meaning to ease interpretation, but on the other hand, their shape has a large influence on the quality of the resulting fuzzy model. In this paper, we will present an algorithm to derive fuzzy partitions from data. We will then illustrate the influence of the number and shape of fuzzy sets on the quality and the complexity of the resulting models. We show that by using ordering-based predicates, the problem of choosing the optimal number of fuzzy sets can be overcome.

18.40 *Fuzzy Pattern Matching with Adaptive Bin Width Histograms to Maximize Classification Performances [#1073]*
Moamar Sayed Mouchaweh, Patrice Billaudel and Bernard Riera, Professor Assistant, France; Full Professor, France

Fuzzy Pattern Matching is a supervised classification method, which uses histograms to generate membership functions. The classification performances increase with the separability between classes. We propose to use histograms with adaptive bin width according to the dispersion of learning samples in each class. The goal is to increase the separability between classes and to reduce the classification time. The efficacy of this method is tested in using several real examples.

Imprecision Modeling with Non-Standard Logics (Invited). Fuzzy Algebra

Monday, 26 July, 17.00–19.00, Room: D, Chair: V. N. Huynh

17.00 *A Context-Based Interpretation of Linguistic Variables [#1109]*

Van Nam Huynh and Yoshiteru Nakamori, Japan Advanced Institute of Science and Technolo, Japan

In this paper we first introduce a context-based interpretation of fuzzy concepts within which the modal-logic-based formulation of fuzzy sets is related. Within the framework, we also establish an interpretation of the mass assignment of a fuzzy set. As a consequent, an alternative interpretation of linguistic variables is presented that is clearly related to voting model semantics of linguistic variables as developed by Lawry (2000, 2001). The relationship between the two interpretations is also established.

17.20 *A Note on Fuzzy Granular Reasoning [#1263]*

Tetsuya Murai, Yasuo Kudo, Van Nam Huynh, Akira Tanaka and Mineichi Kudo, Hokkaido University, Japan; Muroran Institute of Technology, Japan; Japan Advanced Institute of Science and Technolo, Japan

This paper aims to discuss how reasoning processes are represented in terms of granularization of possible worlds. Firstly, processes of classical inference are formulated from a point of view of reconstructing Kripke-style models. The essential point of the reconstruction is that some possible worlds are amalgamated to generate granules of worlds and vice versa. Next, the idea is applied for fuzzy reasoning processes by considering fuzzy sets as fuzzily granularized possible worlds. One of advantages in the approach is that linguistic truth values with linguistic hedges are naturally introduced.

17.40 *Incoherent Objects and Fuzzy Sets [#1168]*

Germano Resconi, Catholic University at Brescia, Italy

This paper introduces the concept of incoherent objects with the use of the modal logic structure. The definition of incoherent objects is inside the meta-theory of uncertainty that represents fuzzy set algebras by possible world semantics. We improve the traditional definition of worlds by the conceptual space and the uncertainty by the non locality inside the conceptual space. Every logic expression can be written in a traditional way or by the action of semantic agents that change the logic value of the logic variables in a subset of the worlds. Fuzzy sets and fuzzy invariants are introduced by the conflicting set of evaluation in different worlds. A new pseudo-axiomatic structure that represent any type of fuzzy reasoning is presented.

18.00 *Non-Monotonic Reasoning in Prioritized Knowledge Bases Based on Granular Reasoning [#1271]*

Yasuo Kudo and Tetsuya Murai, Muroran Institute of Technology, Japan; Hokkaido University, Japan

We propose a method of semantically non-monotonic reasoning in prioritized knowledge bases based on incomplete information systems and granular reasoning. Our non-monotonic reasoning is characterized as "reasoning with disregard of difference of detail." We provide granularized models and priority of each rule, and formulate the method of semantically non-monotonic reasoning based on the idea of ignored sets, rejected sets and possible patterns of atomic sentences we propose.

18.20 *Novel Analysis and Design of Fuzzy Inference Systems Based on Lattice Theory [#1013]*

Vassilis Kaburlasos and Athanasios Kehagias, Technological Educational Institution of Kavala, Greece; Aristotle University of Thessaloniki, Greece

This work presents a Fuzzy Inference System (FIS) as a look-up table for function approximation by interpolation involving Fuzzy Interval Numbers or FINs for short. It is shown that the cardinality of the set F of FINs equals N1, that is the cardinality of the totally ordered lattice R of real numbers. Hence a FIS can implement in principle all N2 (larger than N1) real functions, moreover a FIS is endowed with a capacity for local generalization. It follows a unification of Mamdani- with Sugeno-type FIS. Based on lattice theory novel interpretations are introduced and, in addition, a tunable metric distance dK between FINs is shown. Several of the proposed advantages are demonstrated experimentally.

18.40 *Interpretability Improvement of Input Space Partitioning by Merging Fuzzy Sets Based on an Entropy Measure [#1043]*

Shang-Ming Zhou and John Q. Gan, Depart. of Computer Science,University of Essex, United Kingdom

A fuzzy set merging algorithm (FSM) is proposed for the generation of distinguishable fuzzy sets. A relative compactness measure is defined to characterize the homogenous information that one pattern shares with its neighbors, and an information entropy is employed to evaluate the distinguishability of fuzzy sets. By maximizing this entropy measure the optimal number of merged fuzzy sets with good distinguishability can be obtained. Furthermore, a scheme is proposed to optimize the input space partitioning for a TS fuzzy model by using the FSM algorithm. As a result, a good trade-off between global approximation ability and interpretability in input space partitioning is achieved in the TS model

Interaction and Intelligence 1. (Invited)

Monday, 26 July, 17.00–19.00, Room: E, Chair: N. Kubota

17.00 *Visual Perception for A Partner Robot Based on Computational Intelligence [#1385]*

Naoyuki Kubota, Tokyo Metropolitan University, Japan

This paper proposes a method for visual perception for a partner robot interacting with a human. Imitation is a powerful tool for gestural interaction between children. Furthermore, others' action can be a hint for obtaining a new behavior that might not be the same as the original action. This paper proposes a visual perception method for a partner robot based on the interactive teaching mechanism of a human teacher. The proposed method is composed of a spiking neural network, a self-organizing map, a steady-state genetic algorithm, and softmax action selection strategy. Furthermore, we discuss the interactive learning of a human and a partner robot based on the proposed method through several experiment results.

17.20 *Behavior Learning of A Partner Robot with A Spiking Neural Network [#1395]*

Hironobu Sasaki and Naoyuki Kubota, Fukui University, Japan; fukui University, Japan

This paper proposes an on-line learning method for a partner robot. First, the concept of perceiving- acting cycle is applied for learning the relationship between perception and action of a partner robot interacting with its environment. Next, we propose a spiking neural network for learning collision avoiding behavior. The robot learn the forward relationship from sensory inputs to motor outputs as well as the predictive relationship from motor outputs to the sensory inputs. Experimental results show that the robot can learn embodied actions restricted by its physical body.

17.40 *Sensor Selection based on Fuzzy Inference for Sensor Fusion [#1170]*
Futoshi Kobayashi, Daisuke Masumoto and Fumio Kojima, Kobe University, Japan

Sensor fusion is received much attention because a robot has various and numerous sensors to recognize an environment. By sensor fusion, the robot can get immeasurable information and more accurate information. We have proposed a sensor fusion method with sensor selection based on the reliability of sensor value in order to select sensor values. This paper proposes a novel sensor selection method with fuzzy inference. In this method, selection rules for sensor values are constructed fuzzy rules. Here, selection rules are generated by the genetic algorithm. Then, the sensor values for sensor fusion process are selected according to selection rules. Finally, selected sensor values are fused in a neural network based sensor fusion module.

18.00 *Networked Intelligence by using Ontology [#1196]*
Eri Sato, Toru Yamagchi and Fumio Harashima, Tokyo Metropolitan Institute of Technology, Japan; Tokyo Denki University, Japan

Now day, the system can't build interaction between human. Therefore, We focus attention on ontology technology. Human can communicate with other that combined with a situation and body language. This is because human has the ontology. We propose the ontology as the system for human recognition purposes, and show the effective of the agent system that is constructed in order to become more intelligent by the ontology and that automatically recognizes the purpose of humans by the intuitive interface such as movements of hands or faces. In addition, ontology not only supports communication of human and robot but also employed for a smoother communication between robots.

18.20 *Methods to manipulate the output of dissociated living neuronal network in vitro by the electrical input [#1226]*
Suguru Kudoh and Takahisa Taguchi, HLT,National Institute of Adv(AIST)/ JST, PRESTO, Japan; HLT,National Institute of Adv (AIST), Japan

In dissociated neurons, we induced a long lasting synaptic potentiation, and found out that functional connections between neurons in the living neuronal network was changed dynamically by a transient increase of electrical activities of the whole neural network. Using electrical inputs in the network, we were able to operate the spatio-temporal patterns stored in this neuronal network. We tried to make an association of a particular activity pattern with another pattern by simultaneous recall of stored pattern. After high frequency stimulation, One of the divided subsets of patterns frequently merged to another one suggested that particular cue stimulation linked to two stored pattern simultaneously.

18.40 *Localization of brain activity during perception of circle movement by use of equivalent current dipole analysis [#1248]*
Takahiro Yamanoi, Hisashi Toyoshima, Toshimasa Yamazaki and Shin-ichi Ohnishi, Faculty of Engineering, Hokkai-Gakuen University, Japan; Information Science Research Center Co. Ltd, Japan; RIKEN SNP Research Center, Japan

A moving white circle on a CRT was presented to subjects. Moving patterns were downward, upward, rightward and leftward. A random movement of the circle was presented to subjects in comparison of other movements. These five movements were presented at random to the subjects. Meantime, electroencephalo- grams were recorded. The data was summed in each movement and the equivalent current dipole localization (ECDL) was done to estimate the source. From the results, the dipoles was estimated on the MT at latency from 80ms to 120ms, and after on the intraparietal sulcus, on the precentral gyrus and on the frontal eye field.

Tuesday, 27 July, 9.00–9.50

Plenary Talk: Structured Learning for Partner Robots

Tuesday, 27 July, 9.00–9.50, Room: C, Chair:Imre J. Rudas
Speaker: Naoyuki Kubota, Tokyo Metropolitan University, Japan

This paper introduces a learning method, structured learning, for partner robots interacting with a human. Soft computing techniques such as fuzzy, neural, and evolutionary computing are applied for learning the interrelation between the robot and a human. We show several experimental results of two types of partner robots. ,

Tuesday, 27 July, 10.10–12.10

Applications (Invited Track). 4. Finances, Vision, Biomedical

Tuesday, 27 July, 10.10–12.10, Room: H, Chair: P. Bonissone

10.10 *Fuzzy Modeling within the Statistical Process Control Framework [#1338]*
Dimitar Filev and Janice Tardiff, Ford Motor Company, United States

This paper links the well-known technique of Statistical Process Control monitoring to the concept of rule-based fuzzy modeling. A family of rules with fuzzy predicates describes the set of steady state input-output relationships when the process variations are due to process noise (common causes). The ability of the SPC method to on-line diagnose a change in the distribution of the process variables is used to identify a new operating point of the systems, and consequently the initiation of a new potential rule. The model is applied as a decision support tool for process optimization. A case study on automotive paint process optimization that is based on this concept is presented.

10.27 *Evolution of Intelligent Agent in Auction Market [#1350]*
Jong Yih Kuo and Jonathan Lee, Fu Jen Catholic University, Taiwan; National Central University, Taiwan

This paper presents a fuzzy mental model to address evolution of intelligent agents in virtual market. Agent fitness and fuzzy multi-criteria decision-making are proposed as evolution mechanisms, and fuzzy soft goals are introduced to facilitate the evolution process. Genetic programming operators are employed to restructure agents in the proposed multi-agent evolution cycle. We conduct a series of experiments to determine the most successful strategies and to see how and when these strategies evolve based on the context and the bidding stance of the agent's opponent.

10.44 *Image fusion using fuzzy logic and applications [#1317]*

Harpreet Singh, Jyoti Raj, Gulsheen Kaur and Thomas Meitzler, Wayne State University, Detroit, MI 48202, United States; TACOM, Survivability Technology Area,Warren, MI, United States

Image fusion deals with integrating data obtained from different sources of information for intelligent systems. Image Fusion provides output as a single image from a set of input images.Image Fusion finds application in automotive, medical and other areas. Some techniques are currently available for image fusion. Some new approaches have been suggested in this work in particular, Fuzzy and Neuro-Fuzzy. Algorithms are also proposed for the above said techniques for image fusion process. The work is also supplemented by algorithms, which help us analyze the output qualitatively on attributes like Entropy, Statistical moments etc.

11.01 *Environmental Applications of Fuzzy Logic - Special Workshop "Fuzzy System Applications" [#1361]*

Yannis Phillis, Vassilis Kouikoglou, Luc Andriantiatsaholiniaina and Xiaomin Zhu, Technical University of Crete, Greece

In this work we outline two methods to define and assess sustainability and recyclability. Both concepts are of enormous environmental importance. Yet no definitions or mathematical methods to measure them exist. In fact, different people have different ideas about these concepts. This is due to their complexity, vagueness, and nonlinearity. Fuzzy logic is a natural methodology to answer such questions as: What is sustainability (recyclability)? How sustainable (recyclable) is an economy (material)? Which are the critical com- ponents? Can the system be optimized?

11.18 *A Fuzzy Confidence Value for DNA Bases [#1367]*

Rency Varghese, Mohamad Musavi and Habtom Ressom, University of Maine, United States; Georgetown University, United States

A novel approach is presented for determining confidence values for bases called in DNA sequencing. The approach employs fuzzy logic, which forwards flexibility, adaptability and intuition through the use of linguistic variables and fuzzy membership. The proposed fuzzy logic-based method determines the confidence values based on the height, the peakness, and the spacing of the first most likely candidate (the base called) and the peakness and height for the second likely candidate. The technique has been tested on over 3000 ABI 3700 DNA files and the result has shown improved performance over the existing Phred's and ABI's quality value.

11.35 *A User-Oriented Fuzzy System for Components Packaging and Systems Integration [#1419]*

Stuart H. Rubin and Wei Dai, SPAWAR Systems Center, United States; Victoria University, Australia

This paper investigates the issues of components packaging and systems integrations through users oriented application services delivery. We investigate the use of a fuzzy component that is capable of extracting contextual semantics from the goals specified by users to assist systems integration needs. The process of the integrated solutions impacts both internal (i.e., software components) and external (i.e. systems) worlds. The integration control process is mediated through a fuzzy-based transformation mechanism to assist in decision making from users perspectives.

11.52 *Application of fuzzy logic principles to the classification of 2D-PAGE maps belonging to human pancreatic cancers treated with Trichostatin-A [#1420]*

Emilio Marengo, Elisa Robotti, Daniela Cecconi, Aldo Scarpa and Pier Giorgio Righetti, University of Eastern Piedmont, Italy; University of Verona, Italy

2D gel-electrophoresis is the most widespread technique applied in the field of proteomics. It produces complex samples (2D gel maps) which are very difficult to compare. In this paper a method is proposed based on fuzzy logic principles. The method can be summarised in four steps: 1) digitalisation of the image; 2) fuzzyfication of the digitalised image; 3) comparison of the samples and calculation of a similarity matrix; 4) application of Multidimensional Scaling technique to the similarity matrix, in order to verify the presence of clusters of samples. The investigated dataset consists of 18 samples belonging to two different cell lines (Paca 44 and T3M4) of control (untreated) and drug-treated pancreatic ductal carcinoma cells.

Learning from Data (Invited Track) 3. Learning from Clustering

Tuesday, 27 July, 10.10–12.10, Room: C, Chair: E. Hullermeier

10.10 *FUZZSAM -- Visualization of Fuzzy Clustering Results by Modified Sammon Mapping [#1312]*

János Abonyi and Robert Babuska, University of Veszprem, Hungary; Delft University of Technology, Netherlands

Since in practical data mining problems high-dimensional data are clustered, the resulting clusters are high-dimensional geometrical objects, which are difficult to analyze and interpret. Cluster validity measures try to solve this problem by providing a single numerical value. As a low dimensional graphical representation of the clusters could be much more informative than such single value, this paper proposes a new tool for the visualization of fuzzy clustering results. This new tool maps the cluster centers and the data such that the distances between the clusters and the data-points will be preserved. The examples demonstrate that the proposed algorithm is a useful tool in user-guided clustering.

10.30 *Fuzzy Ant Clustering by Centroid Positioning [#1067]*

Parag Kanade and Lawrence Hall, University of South Florida, United States

We present a swarm intelligence based algorithm for data clustering. The algorithm uses ant colony optimization principles to find good partitions of the data. In the first stage of the algorithm ants move the cluster centers in feature space. The cluster centers found by the ants are evaluated using a reformulated Fuzzy C Means criterion. In the second stage the best cluster centers found are used as the initial cluster centers for the Fuzzy C Means algorithm. Results on 6 data sets show that the partitions found by FCM using the ant initialization are better than those from randomly initialized FCM. Hard C Means was also evaluated and the partitions from the algorithm are better than from randomly initialized Hard C Means.

10.50 *A New Approach for Fuzzy Clustering of Web Documents [#1304]*

Menahem Friedman, Moti Schneider, Mark Last, Omer Zaafrany and Abraham Kandel, Nuclear Research Center - Negev, Israel; Netanya Academic College, Israel; Ben-Gurion University of the Negev, Israel; University of South Florida, United States

Most existing methods of document clustering are based on the classical vector-space model, which represents each document by a fixed-size vector of key terms or key phrases. In large and diverse document collections such as the World Wide Web, this approach suffers from a tremendous computational overload. We propose a new fuzzy-based approach to clustering documents that are represented by vectors of variable size. Each entry in a vector consists of two fields. The first field is the name of a key phrase in the document and the second denotes an importance weight associated with this key phrase. We will describe the proposed approach in detail and show how it is implemented in a real world application from the area of web monitoring.

11.10 *Fuzzy Clustering for Selecting Structure of Nonlinear Models with Mixed Discrete and Continuous Inputs [#1205]*

Daniela Girimonte, Robert Babuska and János Abonyi, Politecnico di Bari, DEE, Italy; Delft University of Technology, Netherlands; University of Veszprem, Hungary

A method for selecting regressors in nonlinear models with mixed discrete (categorical) and continuous inputs is proposed. Given a set of input-output data and

an initial superset of potential inputs, the relevant inputs are selected by a model-free search algorithm. Fuzzy clustering is used to quantize continuous data into subsets that can be handled in a similar way as discrete data. Two simulation examples and one real-world data set are included to illustrate the performance of the proposed method and compare it with the performance of regression trees. For small to medium size problems (up to 15 candidate inputs), the proposed method works effectively. For larger problems, the computational load becomes too high.

11.30 *Descriptive Concept Extraction with Exceptions by Hybrid Clustering [#1064]*

Marie-Jeanne Lesot and Bernadette Bouchon-Meunier, Laboratoire d'Informatique de Paris 6, France

Natural concept modelling aims at numerically representing semantic knowledge; generally, experts are asked to provide linguistic terms associated with numerical data descriptions. We propose to exploit non labelled databases to extract the concepts enabling a semantic description. Our method identifies the subgroups corresponding to the concepts and then represents them as fuzzy subsets. The identification step is based on a conjugate iterative use of the single linkage hierarchical clustering algorithm and the fuzzy c-means, that explicitely takes into account both separability and compactness; the description step builds membership functions as generalized gaussians. The experimental results agree with spontaneous descriptions.

11.50 *On Constructing Probabilistic Fuzzy Classifiers from Weighted Fuzzy Clustering [#1285]*

Uzay Kaymak and Jan van den Berg, Erasmus University Rotterdam, Netherlands

Probabilistic fuzzy classifiers are classifier systems that combine fuzzy set theory with probability theory. Recently, weighted extension of fuzzy clustering has been proposed to design probabilistic fuzzy classifiers for binary classification problems. This method uses a weighting scheme to modify the distances from which the membership values for the fuzzy clusters are determined. The clustering results are influenced by this weighting scheme. In this paper, we investigate the influence of different types of weighting schemes on the classification performance. It is observed empirically that a weighting scheme that depends linearly on the deviations from a priori average class probability gives the best clustering results.

Soft Computing in Cyber Security (Invited). Applications

Tuesday, 27 July, 10.10–12.10, Room: E, Chair: A. Ralescu & A. Inoue

10.10 *A Road Map of Knowledge Management for Network Security and Roles of Soft Computing [#1424]*

Atsushi Inoue and Anca Ralescu, Eastern Washington University, United States; University of Cincinnati, United States

This paper presents a road map of knowledge management for network security. To handle real-time manners and unpredictable distributions of network traffic, a sophisticated artificial intelligence needs to underlie a multi agent system architecture served as a middleware of knowledge management operations. To realize this, Soft Computing intrinsically plays the key roles in the most of primary knowledge management tasks.

10.35 *Support Vector Classifiers and Network Intrusion Detection [#1425]*

John Mill and Atsushi Inoue, Spokane Falls Community College, United States; Eastern Washington University, United States

Within network security, there is the task of intrusion detection. Intrusion detection is a classification task that attempts to discern if a given request for network service is an intrusion attempt or a safe request. Since the creation of the 1999 KDD Cup network intrusion data set[1], several machine learning approaches to this task have been found to be successful. In this work we propose using the successful Support Vector Machine learning approach to classify network requests. We use computational experiments to explore two factors that influence SVM performance in this task and demonstrate two novel approaches to this task.

11.00 *Potential Application of Training Based Computation to Intrusion Detection [#1423]*

Kosuke Imamura and Kris Smith, Eastern Washington University, United States

Without detection of a network intrusion, a system is not capable of properly defending itself. Therefore, the first step in preserving system integrity is to detect whether or not the system is under attack. We initiated a research project that utilizes training based computation for network intrusion detection. The goal of this project is to defend the system from unknown attacks. Packet analysis approaches are effective at detecting known attacks, but fail at unknown attack detection. In order to protect the system from unknown attacks, we need to develop a classifier system which is independent of the signatures found in network packets. One of the promising ways to perform this classification is to profile kernel level activities...

11.25 *A Hybrid System for Modeling Credit Ratings for US Airports [#1160]*

Salwa Ammar and Ronald Wright, Le Moyne College, United States

Developing credit ratings for public institutions requires procedures that enable analysts to consider a complex combination of quantitative and qualitative data in a manner that is verifiable, consistent, and reasonably transparent. The procedures must also provide rationale for the ratings and the ability to monitor ratings on a regular basis. Rating agencies have tried to achieve these objectives by using expert analysts and rating committees. However, they find themselves increasingly challenged about the quality of the work, particularly the ongoing monitoring of previously rated institutions. This paper describes a successful hybrid system that combines fuzzy logic and expert systems to model the rating process for public airports.

11.45 *Combination of fuzzy identification algorithms applied to a column flotation process [#1219]*

Susana Vieira, Joao M. C. Sousa and Fernando Durao, Technical University of Lisbon, IST-IDMEC, Portugal; Technical University of Lisbon, IST-CVRM, Portugal

The column flotation process is a very complex, nonlinear and multivariable system. Fuzzy modeling is a well-known modeling technique, which has been applied to complex and nonlinear processes. This paper proposes a fuzzy modeling identification technique, where the structure of the model is determined using a regularity criterion, and the rules are identified using fuzzy clustering optimized by a real-coded genetic algorithm. Real data is used for the design and validation of the column flotation fuzzy model. The results are compared to other well-known fuzzy modeling techniques. The validation results show that is possible to find a better model using the identification procedure proposed in this paper.

Interaction and Intelligence 2. (Invited)

Tuesday, 27 July, 10.10–12.10, Room: D, Chair: N. Kubota

10.10 *A Formulation of Receptive Field Type Input Layer for TAM Network Using Gabor Function [#1335]*
Isao Hayashi, Hiromasa Maeda and James R. Williamson, Kansai University, Japan; Information Science Research Center Corp., Japan; Lockheed Martin Corp., United States

A hypercomplex cell can detect contour orientation by slit type receptive field. The receptive field is represented by adjacent ON and OFF regions filled, respectively, with plus and minus signs. An approach for modeling receptive field is Gabor function. In this paper, we formulate receptive field type input layer for TAM network using Gabor filtering. The biological motivation for Gabor filtering to the TAM network lies in constructing like the receptive field in human visual cortex. We formulate here the receptive field type input layer in the TAM network, and show the usefulness of TAM network through some examples.

10.34 *Fuzzy Adaptive Search Method for Parallel Genetic Algorithm with Combined Sub-Populations [#1340]*
Yoichiro Maeda and Masahide Ishita, University of Fukui, Japan

We have already proposed Fuzzy Adaptive Search method for Parallel Genetic Algorithm (FASPGA) assorted Fuzzy Adaptive Search method for Genetic Algorithm (FASGA) which is able to tune the genetic parameters according to the search stage by fuzzy rule and Parallel Genetic Algorithm (PGA) which is able to obtain high-quality solutions in the evolution. In this paper, moreover, we propose FASPGA with the operation of dynamically combining sub-populations (C-FASPGA) which combines two elite islands in the final stage of the evolution to find a better solution as early as possible. Furthermore, we also report simulation results of learning Rastrigin function as compared with PGA and FASPGA.

10.58 *A Memory-based Neural Network Model for Efficient Adaptation to Dynamic Environments [#1342]*
Seiichi Ozawa and Kenji Tsumori, Kobe University, Japan

In dynamic environments, agents should be able to not only acquire new knowledge but also modify old knowledge. However, modifying all acquired knowledge is not always efficient, because the knowledge once acquired may be useful again when a similar environment reappears. Moreover, a part of the knowledge can be shared among different environments. To learn efficiently in such a situation, we propose a neural network model that consists of the following four modules: resource allocating network, long-term memory, association buffer, and environmental change detector. We apply this model to a simple dynamic environment in which several target functions to be approximated are varied in turn.

11.22 *Dynamical Optimal Learning for FNN and Its Applications [#1362]*
H. J. Tang, K. C. Tan and T. H. Lee, National University of Singapore, Singapore

This paper presents a new dynamical optimal learning (DOL) algorithm for three-layer linear neural networks and investigates its generalization ability. The optimal learning rates can be fully determined during the training process. The mean squared error is guaranteed to be stably decreased and the learning is less sensitive to initial parameter settings. The simulation results illustrate that the proposed DOL algorithm gives better generalization performance and faster convergence as compared to standard error back propagation algorithm.

11.46 *A proposal of CMAC with Foresight Knowledge Layer For Heterogeneous Multi-agent System [#1382]*
Yukinobu Hoshino, Akira Sakakura and Katsuari Kamei, Dept. of Computer Science Ritsumeikan University, Japan; Graduate School of Computer Science and Engineer, Japan

The purpose of our research is the acquisition of cooperative behaviors in a heterogeneous multi-agent system. In this paper, we used the fire panic problem and we have tried to be learned how agents escape from the fire. Also, we have observed agents behavior and checked a character of agent types. In the fire panic problem, a fire exists in a field, and progresses step by step this fire spreads. The objective of the agent is to reach a goal position without touching the fire. The agent has to run away from a fire and get a goal: Exit. In this paper, we observe how agents escape from the fire by cooperating with other agents. For this problem, we propose a unique CMAC- based Q-learning system for heterogeneous multi-agent systems.

Tuesday, 27 July, 14.00–16.00

Soft Computing in Fault Diagnosis and Prognosis (Invited)

Tuesday, 27 July, 14.00–16.00, Room: E, Chair: Hamid Berenji

14.00 *Enhanced Auto-Associative Neural Networks for Sensor Diagnostics (E-AANN) [#1431]*
Massieh Najafi, Charles Culp and Reza Langari, Texas A and M Universtiy, United States; Texas A and M Universtiy, United Kingdom

In this paper we address the problem of sensor fault diagnosis in complex systems. The motivation for this work is the common problem encountered in industrial setting, i.e. sensor shift, drift and outright failure. The approach proposed in this paper is based on Auto-Associative Neural Networks but has been extended to address some intrinsic deficiencies of these types of networks in practical setting. In particular, it is shown that the proposed approach provides the basic functionality needed for single sensor fault detection in a multi-sensor environment with limited additional computational burden. This work is presently under further development to address multi- sensor failures.

14.30 *Control Design for Diagnostic and Prognostic of Hardware Systems [#1432]*
Yang Wang, Francisco Benito, Guillermo Vera and Mo Jamshidi, University of New Mexico, United States

In this paper we present the modeling and control system's design of a laser pointing system. The aim of the paper is to provide means of detecting the relative errors of the system to correct them using actuating signals both directly and indirectly. The proposed control system will be used as part of a diagnostic and prognostic analysis for both systems. The paper includes the mathematical model of the two systems and Matlab simulations of the designed controller as well as its response to different stimulus. Diagnostic and prognostic approaches for actuator faults will be presented.

15.00 *Using Gated Experts in Fault Diagnosis and Prognosis [#1433]*
Hamid Berenji, Yan Wang, David Vengerov, Reza Langari and Mo Jamshidi, NASA Research Park, United States; University of New Mexico, United States; Texas A and M University, United States

Three individual experts have been developed based on Extended Auto Associative Neural Networks (E-AANN), Kohonen Self Organizing Maps (KSOM), and the Radial Basis Function based Clustering (RBFC) algorithms. An integrated method is proposed later to combine the set of individual experts managed by a Gated Experts algorithm, which assigns the experts based on their best performance regions. We have used a Matlab Simulink model of a chiller system and applied the individual experts and the integrated method to detect and recover sensor errors. It has been shown that the integrated method gets better performance in diagnostics and prognostics compared with each individual expert.

15.30 *ANFIS Application to Competition on Artificial Time Series (CATS) [#1417]*
Cameron Potter and Michael Negnevitsky, University of Tasmania, Australia

This paper presents an application of an Adaptive Neural Fuzzy Inference System (ANFIS) to forecasting an artificial time series. Forecasting is an excellent use for intelligent technologies, but too often forecasts are difficult to compare. This paper was written as attempt to set a benchmark system for future comparison. Although, the system presented in this paper did not respond well to the training data, this paper suggests possible solutions.

Learning from Data (Invited Track) 4. Industrial Applications

Tuesday, 27 July, 14.00–16.00, Room: G, Chair: U. Bodenhofer

14.00 *Adaptable Markov Models in Industrial Planning [#1286]*
Joerg Gebhardt, Frank Ruegheimer, Heinz Detmer and Rudolf Kruse, Intelligent Systems Consulting, Germany; University of Magdeburg, Germany; Volkswagen Group, Germany

A significant number of scientific and economic problems is characterised by a large number of interrelated variables. But with larger variable number, the domain under consideration may grow fastly, so that analyses and reasoning become increasingly difficult. Graphical models allow to represent the combined distributions compactly and are suitable for dealing with uncertain and incomplete information. In this paper we describe their application to a problem of industrial planning. We also demonstrate how the iterative planning process can be supported by allowing the users to adapt the model using revision and updating operators. Moreover we discuss the problem of inconsistent inputs.

14.20 *Achieving Transparency and Adaptivity in Fuzzy Control Framework: an application to Power Transformers Predictive Overload System [#1390]*
Vincenzo Loia, Lucio Ippolito, Pierluigi Siano and Gianni Acampora, University of Salerno, Italy

In this work we first present a general web-based architecture that supports a high integration of heterogeneous and increasingly complex control systems, and then we focus on a Takagi-Sugeno-Kang (TSK) fuzzy model able to reproduce the thermal behaviour of mineral-oil-filled power transformers for implementing a protective overload system. The TSK fuzzy model, working on the load current waveform and on the top oil temperature (TOT), gives an accurate global prediction of the hot-spot temperature (HST) pattern. In order to validate the usefulness of the approach suggested herein, some data cases, derived from various laboratory applications, are presented to measure the accuracy and robustness of the proposed fuzzy model.

14.40 *Fuzzy Methods for Automated Intelligent Data Analysis [#1218]*
Detlef Nauck, Martin Spott and Ben Azvine, BT Research and Venturing, United Kingdom

Although fuzzy data analysis has increased in popularity within the research community this technology is rarely found in industrial solutions. We believe this is mainly due to not enough easy to use software being available. In order to push fuzzy systems and related technology into industrial data analysis applications we need to provide appropriate software. We have developed an IDA platform that automates the data analysis process to a large extent. It uses fuzzy knowledge bases to match user requirements to features of analysis methods and to select, configure and execute IDA processes automatically. Although the platform can use any type of data analysis method we have focused on soft computing methods.

15.00 *Extracting Knowledge and Computable Models from Data - Needs, Expectations, and Experience [#1182]*
Thomas Natschlaeger, Felix Kossak and Mario Drobics, Software Competence Center Hagenberg, Austria

Intelligent analysis of process data helps to reveal as much information about the production process as possible. This information is most useful if it is available in the form of predictive models. Such models can be generated by means of (fuzzy logic based) machine learning methods. In this paper we describe industrial applications in the areas of process optimization and quality control where we have successfully established machine-learning methods as intelligent data analysis tools. We will report the characteristics of machine-learning tools which according to our experience support successful applications in an industrial environment. Furthermore we describe some methodical aspects resulting from this applications.

15.20 *Premise Parameter Estimation and Adaptation in Fuzzy Systems with Open-Loop Clustering Methods [#1183]*
Edwin Lughofer and Erich Peter Klement, Fuzzy Logic-Lab/ University Linz, Austria

In this paper first open-loop clustering methods are described, i.e. clustering methods which are able to adapt former generated clusters pointwise. Afterwards, a new approach for estimating and updating nonlinear parameters in Takagi-Sugeno fuzzy inference systems, i.e. premise parameters in the rules' antecedents, by applying open-loop clustering algorithms is stated together with the impact on the bias error and training time for up to 5-dimensional fuzzy models. Additionally, a detailed analysis of the method is given.

15.40 *A Fuzzy Automaton for Control Applications [#1191]*
Muhammad Torabi Dashti, Centrum voor Wiskunde en Informatica, Netherlands

A fuzzy automaton which handles real-valued data has been of interest to control society as a mean to tackle identification problem of dynamical systems. In this paper, we'll investigate a firm basis to apply fuzzy automata (FA) with fuzzy alphabet to real-valued control and modeling applications. In this way, a novel definition of transducer FA will be devised. The new definition yields a close connection between FA and rule-based fuzzy inference systems which provides an induction algorithm for FA. The concept will be discussed in detail through a case study on modeling a time-dynamic process.

Fuzzy Mathematics (Invited)

Tuesday, 27 July, 14.00–16.00, Room: D, Chair: P. Gader

14.00 *Minimization of Regret Decision Making with Dempster-Shafer Uncertainty [#1101]*

Ronald Yager, Iona College, United States

We are loncerned with the problem of uncertain decision making. The paradigm of decision making using minimization of maximal regret (MMR) is introduced. We discuss a generalization of the MMR method leading to a parameterized family of minimal regret methods. We apply the minimal regret method of decision making to situations in which our uncertainty profile is represented by a Dempster-Shafer belief structure THIS IS BEING SUBMITTED FOR THE SPECIAL SESSION ON CHOQUET INTEGRALS ORGANIZED BY PAUL GADER

14.20 *Choquet integral with respect to a regular non-additive measure [#1199]*

Yasuo Narukawa and Toshiaki Murofushi, Toho gakuen, Japan; Tokyo Institute of Technology, Japan

In this paper, non-additive measures on the class of Borel subsets in locally compact space are studied. Mainly two types of regularity, that is, i- regurarity and completion regularity, are considred. The various regularities are arranged and their correlation is clarified. The properties reflected by the Choquet integral with respect to a regular fuzzy measure are stated. The representation theorem of some functional and the approximation theorem of Choquet integral of integrable function are presented. keyword: Non-additive measure, fuzzy measure, Choquet integral, regularity, approximation.

14.40 *Continuous Choquet Integrals with Respect to Random Sets with Applications to Landmine Detection [#1281]*

Paul Gader, Wen-Hsiung Lee and Andres Mendez-Vasquez, University of Florida, United States; Unversity of Florida, United States

A hit-miss transform is defined using Choquet integrals with respect to random sets. In this context, random sets represent random shapes defined on the plane. Random sets are characterized by their capacity functionals. Capacity functionals are fuzzy measures. Thus, input images can be integrated with respect to random sets. The integration is interpreted as stochastic morphological dilation or erosion. Specifically, the integrals represent the average probability that sets either intersect or are contained in the random sets, the average being over the alpha cuts of the input image. Formulas are defined for random erosions and dilations of disks and annuli with Gaussian radii. Applications to landmine detection are given.

15.00 *Renyi entropy with respect to Choquet capacities [#1357]*

Paul Gader, Wen-Hsiung Lee and Xuping Zhang, University of Florida, United States; Unversity of Florida, United States

Entropy terms are analyzed for use in a heterogeneous network involving Ordered Weighted Averaging (OWA) operators and feed-forward neural networks, referred to as FOWA networks. The OWA operators are used to aggregate feature information and were previously used successfully in a landmine application. Weight vectors of OWA operators are special cases of Choquet capacities for which the Shannon entropy has been defined. One can also consider the quadratic Renyi entropy for OWA weight vectors. A term is added to the objective function of the FOWA network involving these entropy terms. An analysis of the derivatives used in gradient descent is conducted.

15.20 *Additions of Completely Correlated Fuzzy Numbers [#1075]*

Christer Carlsson, Robert Fuller and Peter Majlender, IAMSR, Abo Akademi University, Finland; Eotvos Lorand University, Hungary; TUCS/IAMSR, Abo Akademi University, Finland

In this paper we will consider additions of interactive fuzzy numbers. The interactivity relation between fuzzy numbers will be defined by their joint possibility distribution. We will show that Nguyen's theorem remains valid in this environment. We will give explicit formulas for the γ-level sets of the extended sum of two completely correlated fuzzy numbers. We will show that the interactive and the non-interactive sums have the same membership function for any pair of completely positively correlated fuzzy numbers. Finally, we will prove that the interactive sum of two completely negatively correlated fuzzy numbers A and B with $A(x) = B(-x)$ for all $x \in {\mathbb R}$, will be (crisp) zero.

15.40 *A Generalized Vertex Method for Computing with Fuzzy Intervals [#1143]*

Didier Dubois, Helene Fargier and Jerome Fortin, Irit, France

We introduce a new method for computing functions of fuzzy intervals under various assumptions on the concerned functions. We formally present the notion of left and right profiles of fuzzy intervals as a tool for fuzzy interval computation. Several results show that interval analysis methods can be directly adapted to fuzzy interval computation where end point of intervals are changed into left and right profiles. Our approach is illustrated by numerous simple examples all along the paper, and a special section is devoted to the application of these concepts on different known problems. Keywords: fuzzy arithmetics, approximate reasoning, fuzzy mathematics

Fuzzy Information Retrieval

Tuesday, 27 July, 14.00–16.00, Room: I, Chair: R. Kruse

14.00 *From Boolean to Fuzzy Algebraic Queries in a Possibilistic Database Framework [#1032]*

Patrick Bosc and Olivier Pivert, Irisa-Enssat, France

This paper is situated in the area of databases containing ill-known values represented by possibility distributions. Some previous works have shown that it was possible to define a possibilistic database model that is a strong representation system for a query language including four algebraic operators (selection, projection, fk-join and union). The strong representation system property guarantees that the query evaluation process does not have to make the interpretations of the database explicit. In this paper we study the extension of this query language to the case where queries may involve fuzzy terms and we investigate the impact of such an extension on the model.

14.20 *A Truth Space Diagram Temporal Linguistic Rule Extraction Procedure Using Multiple Objective Evolutionary Algorithm [#1083]*

Pedro DeLima and Gary Yen, Oklahoma State University, United States

Autonomous temporal linguistic rule extraction is an application of growing interest for its relevance to both decision support systems and fuzzy controllers. In the presented work, rules are evaluated using three qualitative metrics based on their representation on the truth space diagram. Each metric is then treated as a conflicting optimization goal and Multiple Objective Evolutionary Algorithm is used to obtain a set of optimal non-dominant rules. Novel techniques for data pre-processing and rule set post-processing are designed. Data collected from a simulated hot and cold water mixer is used to validate the proposed procedure.

14.40 *Index Structures for Flexible Querying in Fuzzy Spatial Databases [#1096]*
Aziz Sozer and Adnan Yazici, Middle East Technical Univ., Turkey; Middle East Technical University, Turkey

Database systems can be effective only if the data are properly handled at the physical level. Therefore, it is important to develop an effective spatial and aspatial indexing technique to facilitate flexible spatial and/or aspatial querying for spatial databases. In this study we adapt a number of spatial index structures, such as Multi-level grid file (MLGF), G-tree, R-tree, and R*-tree, for fuzzy spatial databases and compare the performances of these structures for various flexible queries.

15.00 *A Complete Set of Fuzzy Relational Algebraic Operators in Fuzzy Relational Databases [#1275]*
Xiaohui Tang and Guoqing Chen, Tsinghua University, China

Relational algebra is the theoretical basis of database design and queries. This paper extends our efforts on fuzzy relational algebraic operations under the so-called extended possibility-based data representation framework. With a more general setting of the division operator, a complete set of fuzzy algebraic operators (union, product, minus, selection, projection) is obtained, which can be proven and used to formulate other operators such as intersection, division and join. Like in the classical database model, this is important and desirable for designing fuzzy query languages.

15.20 *Fuzzy Logic and Multiobjective Evolutionary Algorithms as Soft Computing Tools for Persistent Query Learning in Tect Retrieval Environments [#1300]*
Oscar Cordon, Felix Moya and Carmen Zarco, University of Granada, Spain; Puleva S.A., Spain

In this work we get Persistent queries (a kind of queries used in IRSs to represent a user's long-term standing information need) with a more representative structure for text retrieval issues. To do so, we make use of soft computing tools: fuzzy logic is considered for representation and inference purposes, and multiobjective evolutionary algorithms are applied to build the persistent fuzzy query. Experimental results will show how both an expressive fuzzy logic-based query structure and a proper learning process to derive it are needed in order to get a good retrieval efficacy, when comparing our process to single-objective evolutionary methods to derive both classic Boolean and extended Boolean queries.

15.40 *Non-additive Grey Relational Model: Case Study on Evaluation of Flexible Pavement [#1386]*
Jia-Ruey Chang, Ching-Tsung Hung, Gwo-Hshiung Tzeng and Jyh-Dong Lin, Civil Eng., MingHsin Uni. of Sci. and Tech., Taiwan; Civil Eng., National Central University, Taiwan; Inst. of Tech. Manag., National Chiao Tung Uni., Taiwan

Most attributes in system have inter-dependent characteristics in some degree and cannot be evaluated by the conventional additive measure. To solve this problem, one non-additive measure method, fuzzy integral, is introduced in the paper to prepare the dependent attributes in advance and give them independence before the grey relational analysis is conducted. The intention is to improve the accuracy and performance of conventional analyses. A non-additive grey relational model is established. To reveal the feasibility of this model, a case study was conducted to study the effects of distress parameters on the flexible pavement in Taiwan. From the practical application, the rationality of this model can be shown.

Tuesday, 27 July, 16.30–17.30

Panel Session: Soft Computing as a Tool

Tuesday, 27 July, 16.30–17.30, Room: C, Chair: E. H. Mamdani & P. Bonissone

Tuesday, 27 July, 17.30–19.00

Plenary Poster Session: Fuzzy Logic

Tuesday, 27 July, 17.30–19.00, Room: P, Chair: R. Mesiar

T170 *Roughness of Fuzzy Sets Based on Two New Operators [#1007]*
Hongli Liang, Huaguang Zhang and Derong Liu, Northeastern University, China; University of Illinois at Chicago, United States

In this paper, two new operators are introduced for the rough set theory. Using them, two inequalities well-known in the rough set theory can now be modified to become equalities. With this change, no information will be lost in the new expressions. Hence, many properties in rough set theory can be improved and in particular, the union, the intersection, and the complement operations can be redefined based on the two equalities. Finally, roughness properties of fuzzy sets are analyzed using the new operations.

T171 *Discrete Fuzzy Control Loops Based on a Motor Neuro-Fuzzy Model. Pushing Too Far a Continuous Logic ? [#1008]*
Dan Mihai, University of Craiova, Romania

The paper deals with the abilities of a neuro-fuzzy model for a low inertia servomotor, obtained with ANFIS, for controlling the position in a servosystem. For the considered motor and whole the servosystem, the authors have a large amount of off-line and on-line experience so that the study is based on several comparisons between the performance of the system with the standard motor model and its neuro-fuzzy model in control strategies based on a standard Look- Up-Table fuzzy control and an adaptive fuzzy one. The results are useful for a good tuning of the knowledge base for different fuzzy control algorithms.

T172 *Identification of Fuzzy Model Using Evolutionary Programming and Least Squares Estimate [#1021]*
Bin Ye, Chuangxin Guo and Yijia Cao, Zhejiang University, China

A novel hybrid algorithm EPLSE is proposed to design fuzzy rule bases automatically, which is based on the combination of EP (Evolutionary Programming) and LSE (Least Squares Estimate). By utilizing the consequent parameters of the super 1st-order Sugeno model, the training error is decreased greatly. Compared with the original work, the proposed algorithm has remarkably improved the fuzzy model's precision and simplified its structure. In the simulation, EPLSE is employed to to predict a chaotic time series. Comparisons with some typical fuzzy modeling methods and artificial neural networks are presented and discussed. Other promising applications of the proposed EPLSE are also suggested.

T173 *Applications of Fuzzy Decision-Making in Pipeline Leak Localization [#1047]*

Jian Feng, Huaguang Zhang and Derong Liu, Northeastern University, China; Northeastern University, Shenyang, China; University of Illinois, United States

Monitoring of oil transporting pipeline is an important task. A leak detection of oil pipeline, therefore, plays a key role in the overall integrity monitoring for a pipeline system. This paper proposes a fuzzy decision-making approach to oil pipeline leak location. The two main methods, pressure gradient location and negative pressure wave location, are combined with fuzzy logical decision-making to form a novel fault diagnosis scheme. The combination scheme can improve the precision of location. An application example, 14km long oil pipeline leak detection and location, is illustrated, and the practical results demonstrate the effectiveness of the proposed approach.

T174 *Design of Optimal Fuzzy Observers based on TS Fuzzy Model [#1074]*

Mohanlal P.P. and Kaimal M.R., ISRO Inertial Systems Unit, Trivandrum, Kerala, India; Dept. of Comuter Science, University of Kerala, India

In this paper, optimal fuzzy observer is developed for discrete time nonlinear stochastic system based on Takagi-Sugeno (TS) fuzzy model. We design optimal fuzzy observer using the mathematical duality and by extending the nonlinear Bayesian estimation using Gaussian sum approach to the TS fuzzy model

T175 *Fuzzy modeling and Optimal Control of Nonlinear second order systems [#1076]*

Mohanlal P.P. and Kaimal M.R., ISRO Inertial Systems Unit, Trivandrum, Kerala, India; Dept. of Comuter Science, University of Kerala, India

This paper presents the Exact Fuzzy Modeling and optimal control of a class of second order nonlinear dynamic systems. Input saturation, output slew rate limit and nonlinear stiffness are considered. Conventionally, the TSK fuzzy modeling blends local linear models to represent a nonlinear system. Here, instead of local linear models, a set of 'Boundary Linear Models' (BLM) and associated membership-functions are so chosen that the fuzzy blending of these models result in an exact representation of the overall nonlinear system. Optimal fuzzy controller is designed based on this exact fuzzy model and results are compared with a conventional design.

T176 *Application of Hierarchical Fuzzy Methodology for Smart Structures Vibration Control [#1105]*

Jonqlan Lin, Ching Yun University, Thailand

Modern high performance design specifications have given rise to the widespread use of lightweight structures. These structures are prone to undesirable resonant vibrations that can reduce structural life and contribute to mechanical failure. Considerable research has been undertaken with the aim of damping these vibrations using a piezoelectric transducer. A new active damping for a smart panel was investigated. A methodology for designing hierarchical fuzzy controllers was studied with system performance being measured and expressed by some fuzzy variables. By a hierarchical fuzzy logic structure is derived for a multi-input FLC, leading to the implementation of faster controllers with reduced memory demand.

T177 *Scale and Move Transformation-Based Fuzzy Interpolative Reasoning: A Revisit [#1145]*

Zhiheng Huang and Qiang Shen, University of Edinburgh, United Kingdom

This paper generalizes the previously proposed interpolative reasoning method to cover interpolations involving complex polygon, Gaussian or other bell-shaped fuzzy membership functions. The method works by first constructing a new inference rule via manipulating two given adjacent rules, and then by using scale and move transformations to convert the intermediate inference results into the final derived conclusions. This generalized method has two advantages: 1) It can easily handle interpolation of multiple antecedent variables with simple computation; and 2) It guarantees the uniqueness as well as convexity and normality of the resulting interpolated fuzzy (CNF) sets.

T178 *Mamdanian Logic [#1166]*

Yalin Zheng, Changshui Zhang and Xing Yi, Department of Automation, Tsinghua University, China

In the framework of stratified fuzzy propositional logic F, the regular harmonious neighborhood structure determined by the Mamdani approximate function Hgt is the typical and best paradigm of approximate reasoning neighborhood algorithms. The advantage of Mamdani algorithm directly comes from the regular harmonious property of Hgt presented by us in this paper, which guarantees that when the input of the obtained new approximate knowledge is close enough to that of the standard knowledge, not only the approximate reasoning consequence of the new knowledge will be adequately close to that of the standard knowledge, but also the new knowledge itself is close enough to the standard knowledge.

T179 *A Direct Induction Algorithm of Temporal Fuzzy Models [#1181]*

Juan Moreno-Garcia, Luis Jimenez and Jose Jesus Castro-Schez, University of Castilla-La Mancha, Spain; Universidad de Castilla-La Mancha, Spain

Temporal Fuzzy Models (TFMs) are used to represent in a linguistic way the systems that change in time, i. e., dynamic systems (DSs). TFMs are compounded by Temporal Fuzzy Rules (TFRs) which are ordered, thus, each rule represents a temporal zone. Normally, we obtain the TFMs by using a fuzzy model induced by means of other induction algorithm, that is: firstly, a induction algorithm is used to obtain a fuzzy model, and secondly, an induction algorithm is used to transform the obtained fuzzy model into a TFM. The aim of this paper is to present a direct induction algorithm of TFMs, that is, a method to obtain a TFM that represents the study DS by means of the used of a time serie as input.

T180 *Ordinal Sums by Using Genetic Algorithms [#1206]*

Angelo Ciaramella, Witold Pedrycz and Roberto Tagliaferri, University of Salerno, Italy; University of Alberta, Canada

In this paper a novel approach based on Ordinal Sums and Genetic Algorithms is introduced. The main characteristic of an Ordinal Sum lies in the use of different t-norms (t-conorms) defined over disjoint subintervals of the unit interval. In this approach a genetic optimisation environment to construct Ordinal Sums and to optimise subintervals and to allocate individual local t-norms is introduced. Different parametric and non-parametric t-norms (t-conorms) are used. Several results to demonstrate the properties of the approach are proposed. The application of the genetically designed Ordinal Sums in case of Zimmermann-Zysno logic operator data is also shown.

T181 *A Normal Form which Preserve 1-Tautologies and 0-Contradictions in a Class of Residuum-based Propositional Fuzzy Logics [#1229]*

Benjamin Bedregal, Regivan Santiago and Anne Canuto, Federal University of Rio Grande do Norte, Brazil

The most normal forms for fuzzy logics are versions of conjunctive and disjunctive classical normal forms. Unfortunately, they do not preserve neither 1-tautologies nor 0-contradictions. This paper introduces a normal form that partially preserves 1-tautologies for any continuous t-norm --- i.e. if a formula is a 1-tautology then their normal form is also a 1-tautology but the reciprocal does not always hold. For the class of t-norms without zero divisors it preserves 0-contradictions, i.e. a formula is 0-contradiction if and only if their normal form is also 0-contradiction. The paper shows that this normal form could be used to implement an automatic theorem provers for a class of residuum-based of propositional fuzzy logics.

T182 *Qualitative classification and evaluation in possibilistic decision trees [#1255]*

Nahla Ben Amor, Salem Benferhat and Zied Elouedi, Institut Superieur de Gestion de Tunis, Tunisia; CRIL - CNRS, Universite d'Artois, France

This paper presents a method for classifying objects in an uncertain context using decision trees. Uncertainty is related to attributes' values of objects to classify and is handled in a qualititative possibilistic framework. Then, an evaluation method to judge the classification efficiency, in an uncertain context, is proposed.

T183 *Qualitative Modelling of an Economic System using Rule Based Fuzzy Cognitive Maps [#1267]*
Joao Paulo Carvalho and Jose Tome, Instituto Superior Tecnico/INESC-ID, Portugal

Rule Based Fuzzy Cognitive Maps (RB-FCM) were previously introduced as a tool to model and simulate real world qualitative system dynamics, like social, economic or politic systems, while avoiding the limitations of existing approaches - like Forrester's System Dynamics or Kosko's Fuzzy Cognitive Maps. Truly qualitative modelling of qualitative dynamic systems is a delicate issue in a sense that even when one uses a "qualitative modelling tool" like RB-FCM, one often end up adopting quantitative model approaches in disguise. In this paper we use RB-FCM to model and simulate a didactic qualitative model of a macro-economic system using a qualitative modelling approach.

T184 *Qualitative Fuzzy Sets: Homotopy and Perception [#1344]*
Tsau Lin, San Jose State University, United States

What should be the correct perception of a fuzzy set? We believe a fuzzy set should be able to tolerate "small amounts" of "physical" perturbations. There are three approaches: Roughly, Type II fuzzifies the grades, Lin fuzzifies the membership functions, and Thiele captures Kripke style semantics. However, it is not immediate these approaches could tolerate "physical" perturbation. In this paper, we propose a homotopy approach, that clearly relates the notion of qualitative fuzzy set with "physical" deformation.

T185 *Fuzzy Ordering of Fuzzy Numbers [#1380]*
Luigi Troiano and Gerardo Canfora, RCOST - University of Sannio, Italy

Fuzzy numbers cannot be easily ordered as ordinary real numbers. Several proposals have addressed this problem, each with some drawbacks and limitations. This paper renounces to the idea of finding a universal ordering method for fuzzy numbers and suggests to compute the degree by which an arbitrary permutation of fuzzy numbers is ordered. Thus, ordering becomes itself fuzzy. This is useful in the development of decision support systems as a higher degree of accurateness is achieved, with respect to existing methods. However, accuracy is counter-balanced by a higher computation time. The paper address this issue, by proposing an efficient numeric solution.

T186 *Situation-Dependent Fuzzy Rating Based on Analogical Reasoning [#1393]*
Atsushi Hatashi and Takehisa Onisawa, University of Tsukuba, Japan

Rating scale method is used for the subjective evaluation and rating scale method with fuzzy theory is called fuzzy rating. This paper proposes situation- dependent fuzzy rating based on analogical reasoning. Proposed method assumes that mapping as analogy exists between situations and fuzzy sets expressing categories in one situation is obtained by those expressing categories in another situation and analogical reasoning. The usefulness of the presented method is confirmed by the experiments comparing fuzzy sets obtained by fuzzy rating with those obtained by the presented method. Similarity and the width of a fuzzy set are used for the comparison. Experimental results show that the presented method is useful for fuzzy rating.

T187 *Comparison of Operations Used for Fuzzy Modeling [#1428]*
Bohdan Butkiewicz, Warsaw University of Technology, Poland

In the paper fuzzy if . . . then rules are used for modeling. The model is considered as multi-dimensional function, which must to approximate a real object. Special attention is devoted here to if part of the rules. Conclusion of each rule is assumed as fuzzy singleton, as in many practical cases. Author shows that Mamdani approach is not the best solution. There are some other operations then minimum used for ?and? which give smaller modeling error. In the paper some possible interpretations of connective ?and? are considered and compared from modeling error point of view.

Plenary Poster Session: Fuzzy-Neuro-Evolutionary Hybrids

Tuesday, 27 July, 17.30–19.00, Room: P, Chair: N. Kasabo

T188 *Evolutionary Search for Optimal Fuzzy C-Means Clustering [#1134]*
Eduardo Hruschka, Ricardo Campello and Leandro de Castro, Universidade Catolica de Santos - Unisantos, Brazil

This paper introduces an evolutionary approach to automatically determine the optimal number and location of prototypes for the well-known Fuzzy C-Means (FCM) clustering algorithm. This approach is based on a Clustering Genetic Algorithm (CGA) specially designed for clustering tasks. It uses context-sensitive genetic operators to globally explore the search space in such a way that the strong dependence of the FCM algorithm on adequate previous estimations of the number and initial positions of its cluster prototypes is avoided. In this case, FCM works as a local search engine to speed up convergence and improve accuracy of the overall evolutionary procedure. Two examples are presented.

T189 *Hybrid Learning Algorithm for Fuzzy Neuro Systems [#1140]*
Ching-Hung Lee and Yu-Ching Lin, Dept. of EE, Yuan Ze University, Taiwan

In this paper, we propose a hybrid learning algorithm for fuzzy neural network (FNN) systems, which combining the backpropagation and the genetic algorithms. Without any pretraining, the algorithm achieves high accuracy performance. Here, we make a breakthrough of the restriction of membership function to be some specific shape The membership functions of the FNN are constructed by a group of line segment and then are fine tuned by genetic algorithm (GA) for achieving the mapping accuracy. Simulation results show that the mapping capability of the FNN trained by the proposed method is much better. In addition, the application on the fuzzy rules reduction is presented to show the effectiveness of the approach.

T190 *A Self-Organizing Recurrent Fuzzy CMAC Model for Dynamic System Identification [#1142]*
Cheng-Jian Lin, Huei-Jen Chen and Chi-Yung Lee, Chaoyang University of Technology, Taiwan; Nankai College, Taiwan

This paper presents a self-organizing recurrent fuzzy cerebellar model articulation controller (RFCMAC) model for identifying a dynamic system. A nonconstant differentiable Gaussian basis function is used to model the hypercube structure and the fuzzy weight. An online learning algorithm is proposed for the automatic construction of the proposed model during the learning procedure. The advantages of the proposed RFCMAC model are summarized as follows: (1) it requires much lower memory requirement than other models; (2) it selects the memory structure parameters automatically; and (3) it has better identification performance than other recurrent networks.

T191 *Towards a Neuro Fuzzy Tennis Coach: Automated Extraction of the Region of Interest (ROI) [#1252]*
Boris Bacic, Auckland University of Technology, New Zealand

This article introduces a case study on building an automated tennis coach in the area of connectionist methods for data analysis and modelling of human sporting activities. The main part of the article proposes automatic extraction of the Region Of Interest (ROI) from multidimensional time series representing human motion. Using this method with off-line learning on a small test data set this research demonstrates that it is possible to build a small- scale prototype of an automated tennis coach that can provide simple feedback on players' technique. In the process this study shows that the automated ROI selection method presented in this article was able to detect 100 per cent of ROIs from the test data.

T192 *Adaptive Recurrent Fuzzy Neural Network Control for Linearized Multivariable Systems [#1284]*
Lin Chih-Min, Chen Chiu-Hsiung and Chin Wei-Laing, Yuan-Ze University, Taiwan; Department of Electrical Engineering, Yuan-Ze Un, Taiwan

This paper develops a design method of recurrent fuzzy neural network (RFNN) control system for multi-input multi-output (MIMO) dynamic systems. This control system consist a feedback controller and a RFNN controller. The adaptive laws of RFNN are derived basedon the Lyapunov stability function so that the stability of the system can beguaranteed. Finally, the proposed control system is applied to an F-16 flightcontrol system. Simulation results demonstrate that the developed controlsystem can achieve favorable robust control performances even with some failures of the flight control system.

T193 *Power System Load Frequency Control By Evolutionary Fuzzy PI Controller [#1123]*
Chia-Feng Juang and Chun-Feng Lu, Dept. of Electri. Eng., National ChungHsing Univ, Taiwan; Dept. of Electri. Eng., Chung Chou Inst. of Tech, Taiwan

Power system load frequency control by fuzzy PI controller is proposed in this paper. During control, a fuzzy system is used to adaptively decide the PI controller gain according the area control error and its change. To ease the design effort and improve the performance of the controller, the fuzzy system is deigned by the Hybrid of Genetic Algorithm and Particle Swarm Optimization (HGAPSO). Simulations on a two-area interconnected power system with different kinds of perturbation are performed. The performance of the proposed approach is verified from simulations and comparisons.

T194 *Optimal Design of the 2-Layer Fuzzy Controller Using the Schema Co-Evolutionary Algorithm [#1256]*
Kwang-Sub Byun and Kwee-Bo Sim, Chung-Ang University, Korea (South)

The robot with various inputs generates various outputs. A proper controller is needed to control such a complex robot. In this paper, we introduce a 2-Layer Fuzzy Controller. It can control robustly and has the small number of rules in many input variables. It can not only deal with various inputs but also generate various outputs. The main problem in the fuzzy system is how to design the fuzzy knowledge base. For this specific problem, we optimize the fuzzy controller using the Schema Co-Evolutionary Algorithm (SCEA) to find a global optimal solution.

T195 *Random and Evolution Algorithms of the Tasks Scheduling and of the Production Scheduling [#1296]*
Tadeusz Witkowski, Arkadiusz Antczak and Pawel Antczak, Warsaw University of Technology, Poland; Lodz University of Technology, Poland

The paper presents contemporary artificial intelligence tools - genetic algorithms (GA) and random algorithms designed for the optimalisation of the production scheduling problem for multi-assortment short-series production. The essential idea of SZEZA method has been presented. SZEZA method has the ability of part control of the sequence of tasks. The efficiency of SZEZA has been compared with the efficiency of GA AGHAR and with efficiency of other met heuristic methods. Problems related with the further development of mentioned algorithms for the purpose of a choice and defining their optimal decision factors and constraints have been described.

Plenary Poster Session: Fuzzy Optimization and Design

Tuesday, 27 July, 17.30–19.00, Room: P, Chair: A. E. Ruano

T196 *A PI Type Self-Tuning Fuzzy Controller with Receding Horizon Optimization [#1005]*
Xu Min and Li Shao Yuan, Institute of Automation, Shanghai Jiaotong Univ., China

This paper presented a PI type fuzzy controller considering the error and the change rate of error. Based on this structure, we work out a method to tune the parameters of the PI type fuzzy controller online. In order to improve further the performance of the fuzzy controller, the optimization control supervised the under level controller by minimizing a generalized predictive control criterion. A simple and sufficient bound condition of input and output variable is achieved under the Lyapunov theory through the brief analysis. Simulation results are made to demonstrate the fine performance of these novel fuzzy controller structures.

T197 *Fuzzy Renewal Process, Fuzzy Renewal Reward Process and Their Applications [#1019]*
Ruiqing Zhao, Wanshwng Tang and Huaili Yun, Tianjin University, China; Tianjin University, Christmas Island

This paper extends the work in Zhao and Liu on fuzzy renewal process and renewal reward process from continuous case to more general case. Fuzzy elementary renewal theorem and fuzzy renewal reward theorem are developed and shown how them can be applied to maintenance policies. Three kinds of maintenance policies--fuzzy age replacement policy, fuzzy block replacement policy and fuzzy inspection policy are discussed. At the end of the paper, a hybrid intelligent algorithm is employed to solve the models proposed in maintenance policies and to arrive at optimum policies. A numerical example is enumerated and the result indicate that the algorithm is effective.

T198 *Some Properties of Optimistic and Pessimistic Values of Fuzzy Variables [#1020]*
Jin Peng and Baoding Liu, Tsinghua University, China

Based on the possibility measure, necessity measure, and credibility measure of fuzzy event, the optimistic and pessimistic values of fuzzy variable have been introduced for handling optimization problems in fuzzy environments. In this paper, some new properties of optimistic and pessimistic values of fuzzy variables are investigated. As an illustration, the optimistic and pessimistic values of a trapezoidal fuzzy variable are formulated.

T199 *Expected Value Model for A Fuzzy Random Warehouse Layout Problem [#1038]*
Lixing Yang and Yanbin Sun, Tsinghua University, China; Daqing Petroleum Institute, China

In this paper, a warehouse layout problem under fuzzy random environment is considered, in which different types of materials need to be placed in a warehouse so that the total transportation cost is minimized. For convenience of handling, the materials in the same class need to be placed in the adjacent cells. As a result, we construct expected value model for the problem and then design a hybrid intelligent algorithm for this model. Finally, some numerical examples are presented to show the efficiency of the algorithm.

T200 *On Crisp Equivalents of Fuzzy Chance-Constrained Multilevel Programming [#1081]*
Jinwu Gao, Baoding Liu and Kaoping Song, Dept. of Math. Sci., Tsinghua Univ., Beijing, China; Daqing Petroleum Institute, China

As an extension of multilevel programming, fuzzy multilevel programming was proposed for dealing with decentralized decision-making problem with fuzzy parameters. And it is more difficult for us to solve fuzzy multilevel programming for the Stackelberg-Nash equilibrium. In this paper, based on the credibility theory, some fuzzy chance-constrained multilevel programming models are converted to their crisp equivalents that can be solved by the traditional solution processes, thus providing an effective way for solving fuzzy multilevel programming for the Stackelberg-Nash equilibrium.

T201 *The Parametric Definition of Membership Functions in XFL3 [#1186]*
Francisco Jose Moreno-Velo, Iluminada Baturone, Santiago Sanchez-Solano and Angel Barriga, Instituto de Microelectronica de Sevilla, Spain

This paper presents a study of the different kinds of membership function (MF) definitions, regarding free MFs and families of MFs, and describes the capabilities of XFL3 (the formal specification language defined by Xfuzzy 3) to manage them. This includes not only the possibility of using them in a system design, but also the capability for extending the available functions with new user-defined membership functions and families. An application example has been included in order to discuss on the suitable parametric definition of the functions.

T202 *Hierarchical Fuzzy Systems with FITM [#1193]*
Santiago Aja-Fernandez and Carlos Alberola-Lopez, Universidad de Valladolid, Spain

A matrix inference method for fuzzy systems (FITM) is used to deal with hierarchical fuzzy systems (HFSs). The contribution of this paper is twofold: on one hand, we show that a HFS (either serial or parallel) can be easily converted into a single fuzzy system, and implemented via FITM. On the other, we show that a serial HFS can be obtained out of a complicated multiple-input single-output fuzzy system. An example of such a conversion for a three-input system is included.

T203 *A New TSK Fuzzy Modeling Approach [#1251]*
Kyoungjung Kim, You-Keun Kim, Euntai Kim and Mignon Park, Yonsei University, Korea (South)

In this paper, a new robust TSK fuzzy modeling algorithm is proposed. The proposed algorithm is the modified version of noise clustering algorithm. Various robust approaches to deal with the data containing noise or outliers in real applications were proposed, but most algorithms process clustering of data first and then conduct fuzzy regression. We propose the algorithm that parameters of the premise part and the consequent part are obtained simultaneously. The proposed algorithm shows good performance against noise or outliers. Without adaptation of parameters, the proposed algorithm shows the superior performance over other approaches.

T204 *Dynamic Decision Making with an Objective Function based on Fuzzy Preferences [#1264]*
Yuji Yoshida, Masami Yasuda, Jun-ichi Nakagami, Masami Kurano and Satoru Kumamoto, University of Kitakyushu, Japan; Chiba University, Japan

This paper presents a mathematical model for dynamic decision making with an objective function induced from fuzzy preferences. The fuzzy preference is related to decision making in artificial intelligence, and this paper models human behavior based on his aggregated fuzzy preferences. To deal with fuzzy preferences in dynamic decision making brings us difficulty which is different from static one since the value criterion of fuzzy preferences in dynamic behavior transforms together with time and it is formulated gradually. A reasonable criterion based on fuzzy preferences is formulated for the dynamic decision making, and an optimality equation for this model is derived by dynamic programming.

T205 *L_infinity-gain Fuzzy Control for Nonlinear Dynamic Systems with Persistent Bounded Disturbances [#1017]*
Chung-Shi Tseng and Bor-Sen Chen, Ming Hsin University of Science and Technology, Taiwan; National Tsing-Hua University, Taiwan

To date, nonlinear L_infinity-gain control problems have not been solved by the conventional control methods for nonlinear dynamic systems with persistent bounded disturbances. This study introduces a fuzzy control design to deal with the nonlinear L_infinity-gain control problem. First, the Takagi and Sugeno (T-S) fuzzy model is employed to approximate the nonlinear dynamic system. Next, based on the fuzzy model, the upper bound of L_infinity-gain of the closed-loop system can be obtained under some linear matrix inequality constraints. In this situation, the nonlinear L_infinity-gain control problem can be easily solved by LMI-based optimization method.

Plenary Poster Session: System Architectures and Hardware

Tuesday, 27 July, 17.30–19.00, Room: P, Chair: Vassilis Kaburlasos

T206 *grSOM: A Granular Extension of the Self-Organizing Map for Structure Identification Applications [#1011]*
Vassilis Kaburlasos and Stylianos Papadakis, Technological Educational Institution of Kavala, Greece

An extension of the Self-Organizing Map (SOM) is presented, namely granular SOM or grSOM for short, applicable beyond RN to FN, where F denotes the set of fuzzy interval numbers (FINs). Rigorous analysis establishes that F is a metric mathematical lattice. A FIN is interpreted as a linguistic granule, which corresponds to a local probability distribution function. The grSOM can be used for structure identification in linguistic system modeling applications. Experimental results using the greedy grSOM algorithm compare favorably with the results by alternative algorithms from the literature in two benchmark classification problems; in addition, descriptive decision-making knowledge (fuzzy rules) is induced from the data.

T207 *Temperature Control By Hardware Implemented Recurrent Fuzzy Controller [#1029]*
Chia-Feng Juang, Jung-Shing Chen and Hao-Jung Huang, Dept. of Electri. Eng., National ChungHsing Univ, Taiwan; Dept. of Electri. Eng., National Chunghsing Univ, Taiwan; Dept. of Electri. Eng., Chung Chou Inst. of Tech, Taiwan

Hardware implementation of a TSK-type Recurrent Fuzzy Network (TRFN-H) for water bath temperature control is proposed in this paper. The TRFN-H is constructed from recurrent fuzzy if-then rules and are built on-line through concurrent structure and parameter learning. To design TRFN-H for temperature control, the direct inverse control configuration is adopted, and owing to the structure of TRFN-H, no a priori knowledge of the plant order is required, which eases the design process. After the network is designed, it is realized on a FPGA chip. Good performance of TRFN-H chip is verified from comparisons with PC-based PID and fuzzy controller for different sets of experiments on water-bath temperature control.

T208 *Control of a Bioprocess using Orthonormal Basis Function Fuzzy Models [#1133]*
Ricardo Campello, Luiz Meleiro and Wagner Amaral, Universidade Catolica de Santos - Unisantos, Brazil; Universidade Federal do Parana - UFPR, Brazil; Universidade Estadual de Campinas - Unicamp, Brazil

Fuzzy models within the framework of orthonormal basis functions (OBF Fuzzy Models) were introduced in previous works and have shown to be a very promising approach to the areas of non-linear system identification and control since they exhibit several advantages over those dynamic model architectures usually adopted in the literature. In the present paper these models are reviewed and used as a basis for a predictive control scheme which is applied to the control of a process for ethyl alcohol (ethanol) production.

Plenary Poster Session: Real World Applications

Tuesday, 27 July, 17.30–19.00, Room: P, Chair: A. Yazici

T209 *Development of Adaptive Fuzzy Control for Electrical Servo Drive Via Total Sliding-Mode Technique [#1012]*
Rong-Jong Wai, Shun-Lin Yu and Kuo-Ho Su, Yuan Ze University, Taiwan; Chung-Shan Institute of Science and Technology, Taiwan; Tatung University, Taiwan

An adaptive fuzzy sliding-mode control (AFSMC) system for the high-precision position control of electrical servo drive is developed in this study. The proposed AFSMC system is designed via the approximation ability of fuzzy system to mimic the good behaviors of a total sliding-mode control system, which is designed without the reaching phase of conventional sliding-mode control to reduce the effect of uncertainties during the transient process. In the AFSMC system, prior knowledge of the system information is not required. All the adaptive tuning algorithms are developed in the sense of Lyapunov stability theorem, so that system-tracking stability can be guaranteed.

T210 *Possibilistic reasoning of user's intention from operation [#1035]*
Koichi Yamada, Masahiko Yagi and Villany Kimala, Nagaoka University of Technology, Japan

Human interface design for household appliances is becoming far more difficult than the one in the past, because they have so many functions and the control panels are so compact. The authors have proposed a novel human interface paradigm named Push Like Talking. PLT has buttons each of which has a word expressing a concept important to operate the appliance, and the user pushes the buttons with a word not to choose a function, but to talk to the appliance. PLT reasons the intention of the user from the words on the buttons. The paper proposes a possibilistic model representing the relations between the intentions and the words, and discusses a way to reason the intention from the words.

T211 *Project Scheduling Problem with Fuzzy Activity Duration Times [#1037]*
Hua Ke and Baoding Liu, Tsinghua University, China

This paper considers a type of project scheduling problem with objective of minimizing the total cost, in which project activities have fuzzy duration times and loan is taken into account in the total cost. According to some optimization goal, a fuzzy chance-constrained programming is built to model the project scheduling problem. Moreover, the technique of fuzzy simulation and genetic algorithm are integrated to design a hybrid intelligent algorithm to solve the fuzzy model. Finally, a simple numerical example is given to illustrate the effectiveness of the algorithm.

T212 *A New Information Fusion Method Based on Interval-Valued Fuzzy Numbers for Handling Multi-Criteria Fuzzy Decision-Making Problems [#1051]*
Shi-Jay Chen and Shyi-Ming Chen, Ph.D. Student, Taiwan; Professor, Taiwan

In this paper, we present a new information fusion method for fusing decision-maker's linguistic opinions to deal with multi-criteria fuzzy decision-making problems. The proposed information fusion algorithm uses interval-valued fuzzy numbers to represent the decision-makers' linguistic opinions. It uses linguistic quantifiers based on the FN-IOWA operator to flexibly determine the weights of linguistic opinions of each decision-maker for aggregating these linguistic opinions in different linguistic constraints. The proposed method can handle multi-criteria fuzzy decision-making problems in a more intelligent and more flexible manner.

T213 *A New Approach to Construct Membership Functions and Generate Fuzzy Rules from Training Instances [#1052]*
Shyi-Ming Chen and Fu-Ming Tsai, Professor, Taiwan; Computer Scientist, Taiwan

In recent years, many researchers focused on the research topic of constructing fuzzy classification systems to deal with the Iris data classification problem. One of the methods to construct fuzzy classification systems is to construct membership functions at first, and then to generate fuzzy rules. In this paper, we present a new method to construct membership functions and generate fuzzy rules from training instances. The proposed method can get a higher average classification accuracy rate and generates fewer fuzzy rules than the existing methods.

T214 *A Neuro-Fuzzy Classification Approach to the Assessment of Student Performance [#1068]*
Arif Alhammadi and Robert Milne, Etisalat College of Engineering, United Arab Emirates

This paper reports on the design and development of a Neuro-Fuzzy classification technique for predicting the student performance in a college of engineering. The main function of the Neuro-Fuzzy classifier is to investigate the rules that describe the students performance and classify them into three different groups based on their expected performance. This work would support the student admittance procedure by evaluating and predicting student performance before acceptance to the college as well as assessing the suitability of the entry exams. The experiment demonstrated that some of the entry exams gave a good indication of the student level while other exams did not predict the correct student level

T215 *Weighted Fuzzy Ontology for Chinese e-News Summarization [#1125]*
Chang-Shing Lee, Shu-Mei Guo and Zhi-Wei Jian, Chang Jung University, Taiwan; National Cheng Kung University, Taiwan

A Weighted Fuzzy Ontology (WFO) derived from a Chinese e-News corpus and a predefined domain ontology for Chinese e-News summarization is proposed in this paper. We utilize a Parallel Fuzzy Inference Mechanism (PFIM) to compute the weight of each concept for the WFO. Then, a WFO-based Intelligent Summarization Agent (WFOISA) will be used to generate the weighted event ontology and the summary sentences. An experimental website at Chang Jung University is constructed to test the performance of the proposed approach. The results show that the intelligent summarization agent with WFO can effectively perform the Chinese e-News summarization.

T216 *Parameter Estimation of Non-Linear Systems With Hammerstein Models Using Neuro-Fuzzy and Polynomial Approximation Approaches [#1130]*
Jose Vieira and Alexandre Mota, Escola Superior de Tecnologia Castelo Branco, Portugal; Universidade de Aveiro, Portugal

This paper presents two different approaches for parameter estimation of non- linear systems with Hammerstein models. The Neuro-Fuzzy Hammerstein Model approach uses a Takagi- Sugeno fuzzy model to approximate the non-linear static part. The Polynomial Approximation Hammerstein Model approach uses a polynomial of order n to approximate the non-linear static part. For the linear dynamic part both algorithms use the least squares parameter estimation. The methods were implemented off-line, in two steps: first, estimation of the non- linear static parameters and second estimation of the linear dynamic parameters. Finally, a gas water heater non-linear system was modelled as an illustrative example of these two approaches.

T217 *Assisting negotiations and supporting decisions in small e-bussines [#1147]*
Jose Jesus Castro-Schez, Juan Moreno-Garcia, Ramon Manjavacas and Carlos Gonzalez, University of Castilla-La Mancha, Spain

A lot of current small businesses involve very simple interaction models that are being formalized for carrying out electronic commerce via open networks, like the Internet, or closed, private networks. E-commerce implies carry on negotiation between suppliers and customers, and make a decision. In this paper, we develop a technique for multi-issue negotiations in competitive environments in which many sellers negotiate with one agent buyer that will have to make a decision. The technique leads the negotiation carrying out comparison-based analysis of multi-options provided for sellers and gains relevant information about each option. Moreover, an algorithm is developed to support buyer's decision based on that acquired information.

T218 *Virtual Screening using Local Neuro-Fuzzy Rules [#1213]*

Juergen Paetz and Gisbert Schneider, J.W. Goethe-Universitaet Frankfurt am Main, Germany

As an application of a neuro-fuzzy approach we present results of drug target molecules classification. Inactive molecules are separated from active ones for different ligand data sets. Our technique can be seen as a retrospective virtual screening method. As a basis the molecule data is encoded in descriptor vectors. We compare two descriptors, one encoding two-dimensional topological features and one encoding three-dimensional distances of atom types. ROC area for classification and enrichment factors of active molecules in local rules are compared. Although one could assume that 3D descriptors contain the more performant features than the 2D ones, we show that the used 2D descriptor has superior performance for the considered datasets.

T219 *Evaluation of biochemical sources pertinence in classification of cell's physiological states by evidence theory [#1223]*

Sebastien Regis, Jacky Desachy and Andrei Doncescu, LAAS CNRS / University of French West Indies, France; University of French West Indies, France; Laboratory of Analysis and Archtecture of sytems, France

For analysis and modelling of the biotechnological process we must look deeper to the biological systems. The goal of all modelling is either the biocontrol or finding the physiological states. We want to detect the physiological states using a small number of measured signals. We present in this paper the analyze of biochemical parameters using the evidence theory. The evidence theory is also used to characterize the pertinence of the parameters. This pertinence is based on the notion of conflict. We show that our measure of conflict based on a distance provides more coherent results as the classical methods.

T220 *Approximate Analysis of Fuzzy Node Fuzzy Graph and its Application [#1243]*

Hiroaki Uesu, Hajime Yamashita and Kimiaki Shinkai, Waseda University, Japan

By applying the fuzzy graph theory, we could analyze the inexact information efficiently and investigate the fuzzy relation by fuzzy graph. We extend the fuzzy graph theory, and propose a fuzzy node fuzzy graph. And we transform it to a crisp node fuzzy graph by using T-norm family. In this paper, we would explain a fuzzy node fuzzy graph, and propose new T- norm family "quasi logical product". By using this new T-norm, we could reasonably transform the fuzzy node fuzzy graph to the crisp node fuzzy graph. Moreover, we would illustrate its effectiveness through the sociometry analysis.

T221 *A Fuzzy Logic Based Expert System as a Network Forensics [#1266]*

Kim JungSun, Kim DongGeun and Noh BongNam, Computer Science, Chonnam National University, Korea (South); Interdisciplinary Program of IS, CNU, Korea (South); Division of Electronics Computer, CNU, Korea (South)

The field of digital forensic science emerged as a response to the growth of computer crimes. Network forensics is digital forensic in networked environments. But, the amount of network traffic is huge and might crash the traffic capture system if left unattended. Not all the information captured or recorded will be useful for analysis or evidence. Therefore, we need an effective and automated analyzing system for network forensics. In this paper, we proposed a fuzzy logic based expert system for network forensics that can analyze computer crimes in networked environments and make digital evidences automatically. This system can provide an analyzed information for forensic experts and reduce the time and cost of forensic analysis.

T222 *An Active Fuzzy Object-Oriented Database Approach [#1293]*

Burcin Bostan-Korpeoglu and Adnan Yazici, Middle East Technical University, Turkey

Knowledge intensive applications require an intelligent environment which can perform deductions due to user queries or events that occur inside or outside of the environment. In this study, we propose a fuzzy active object-oriented database for modelling knowledge intensive applications. Our approach integrates fuzzy, active and deductive rules with database objects, so that the system gains intelligent behaviour, which provides objects to perceive dynamic occurences and answer user queries. In this way, objects can produce new knowledge and keep themselves in a consistent, stable, and upto-date state.

T223 *A Fuzzy Method for Power System Model Reduction [#1306]*

Shu-Chen Wang and Pei-Hwa Huang, National Taiwan Ocean University, Taiwan

This paper studies the order reduction of power system dynamic models by fuzzy clustering. Based on the fuzzy c-means algorithm, a method is proposed for clustering the poles and the zeros of the original power system model into new clusters from which a reduced-order model can be obtained. Results from applying the method to a sample power system are demonstrated to show the validity of the proposed method.

T224 *A Study of Group Size and Communication in an Evolving Fuzzy-Controlled Population [#1314]*

Sam McKennoch, Sean Hoyt and Linda Bushnell, University of Washington, United States

This research effort is an investigation into communication activity in a distributed set of software agents. Agents exist in a predator-prey environment. Movements of prey agents are evolved upon a Mamdani type fuzzy inference system. Probabilistic predation and starvation forces, along with simulated communication activity act upon agents, causing them to cluster. Examined here is the correlation between mean cluster size after the population has sufficiently evolved, versus the average agent communication activity. Communication activity creates a loyalty to remain in a cluster for security rather than to change cluster membership. A mean r2 correlation of 0.87 was observed with this system, thus lending credence to our hypothesis.

T225 *A MIMO Fuzzy-Control System for High-Speed Machining Processes. Results of a Case of Study [#1373]*

Jose Emilio Jimenez, Rodolfo Haber and Jose Ramon Alique, Instituto de Automatica Industrial del CSIC, Spain

This paper presents a new approach to the control of cutting force in a high- speed machining process. A fuzzy-control system has been designed and implemented in an open computerised numerical control. The controller uses cutting force, which is measured from a dynamometric platform and processed by means of an integrated application, to modify the feed rate and the spindle speed in real time. The integration process, design steps and results of applying a fuzzy-control system are shown through the example of real high- speed machining operations. The results display a good transient response in the cutting-force pattern. The generalisation of the proposed algorithm could be one answer to the demands industrial manufacturing makes today.

T226 *Perception-based Expert System with Application to Clinical Decision Making [#1396]*

Adam Gaweda, Alfred Jacobs, Michael Brier and George Aronoff, University of Louisville, United States

The vast majority of medical decision support systems operate on crisp numerical information. This paper describes an approach based on the paradigm of Computing with Perceptions that accounts for imprecise character of clinical data. The proposed reasoning system handles imprecise input information in a computationally inexpensive way. An application example for decision support in the management of chronic anemia demonstrates the feasibility of the proposed approach.

Wednesday, 28 July, 9.00–9.50

Plenary Talk: Progressive Sampling Schemes for Approximate Clustering in Very Large Data Sets.

Wednesday, 28 July, 9.00–9.50, Room: C, Chair: E. P. Klement, Speaker: James Bezdek, Univ. of W Florida, United States; Georgia State Univ., United States

Wednesday, 28 July, 10.10–12.10

System Architectures and Hardware

Wednesday, 28 July, 10.10–12.10, Room: E, Chair: R. Marks

10.10 *On the use of Fourier methods in URC fuzzy system design [#1238]*

Jeffrey Weinschenk, Robert Marks and William Combs, University of Washington, United States; Baylor University, United States; The Boeing Company, United States

Previously, we demonstrated that rule explosion is avoidable in fuzzy inference engines by mapping an intersection rule configuration (IRC) to a union rule configuration (URC). Although conversion between IRC and URC systems is simple for a additively separable IRC rule tables, the conversion process is more difficult when the IRC rule table is additively inseparable. In a previous paper, we demonstrate a layered URC architecture can implement these types of systems, but did not provide a method for computing the weights. In this follow-on paper, we provide a Fourier-based algorithm for the above. We also prove that this technique is optimal in the sense that the mean-square approximation error is minimized for a fixed amount of resources.

10.30 *Robust Neuro-fuzzy Controller Design via Sliding-mode Approach [#1152]*

Hsu Chun-Fei, Lee Tsu-Tian, Lin Chih-Min and Chen Li-Yang, National Chiao-Tung University, Taiwan; Yuan-Ze University, Taiwan

The goal of this paper is to develop a model-free control method which is referred to as robust neuro-fuzzy sliding-mode control system. The proposed RNFSMC system is comprised of a fuzzy controller and a robust controller. The fuzzy controller is utilized to approximate an ideal controller by the developed tuning algorithms, and the robust controller is designed to achieve robust tracking performance index. To investigate the effectiveness of the proposed RNFSMC system, it is applied to control a Chua's chaotic circuit system. Simulation results demonstrate that the effect of the fuzzy approximation error on the tracking error can be attenuated efficiently by the proposed method without any knowledge of the controlled systems.

10.50 *Learning Complex Combinations of Operations in a Hybrid Architecture [#1368]*

L. Andrew Coward, Tamás D. Gedeon and Uditha Ratnayake, Australian National University, Australia; The Open University of Sri Lanka, Sri Lanka

The reasons why machine learning appears limited to relatively simple control problems are analyzed. A primary issue is that any condition detected by a learning system acquires multiple behavioural meanings. As learning continues, the need to preserve these meanings severely constrains the architectural form of the system. A hybrid architecture called the recommendation architecture in which the preservation of such meanings is explicitly managed is compared with a wide range of alternative learning approaches. It is concluded that systems with this recommendation architecture have the capability to learn to solve complex control problems.

11.10 *Algorithms of Multilevel Synthesis of Fuzzy Functions [#1274]*

Andrzej Wielgus, Warsaw University of Technology, Poland

This paper presents a new method of multilevel synthesis of fuzzy functions obtained from the behavioural description of a fuzzy system being implemented. New methodology relies on representing fuzzy functions by logic expressions in the form of polynomials, which can be transformed according to the rules of polynomial algebra. The transformations are based on extraction of common subexpressions, which is supported by a new algorithm of fuzzy division. As a result of synthesis, the minimised multilevel structure of fuzzy cells is obtained.

11.30 *A High Performance IDS Processing Unit for a New Fuzzy-based Modeling [#1364]*

Masayuki Murakami, Nakaji Honda and Junji Nishino, University of Electro-Communications, Japan

This paper presents a hardware unit for modeling systems using the Active Learning Method (ALM). The ALM, a new methodology of soft computing, has processing units called IDS's, which are tasked with extracting useful information from a system subject to modeling. In realizing the ALM in hardware, it is desirable in terms of processing nature, performance, and scalability to utilize dedicated hardware for IDS. A developed high performance IDS processing unit enables ALM-based modeling systems to increase realtime capabilities. In this paper, the hardware implementation of IDS and performance test results are reported, and a consideration of the redundancy of IDS processing units is described.

11.50 *A CMOS Implementation of Current-Mode Min-Max Circuits and A Sample Fuzzy Application [#1149]*

Behzad Mesgarzadeh, Linkoping University, Sweden

A new design of CMOS Min-Max circuits in current-mode is presented. These kinds of circuits have a growing number of fuzzy applications in fuzzy logic controllers. As a sample fuzzy application, Membership Function Generator (MFG) based on Min circuit, is presented. The proposed circuits have wide input and output dynamic range. A 3.3 V power supply has been applied and simulation results are presented in 0.35 um CMOS process.

Applications of Type 2 Fuzzy Logic 1 (Invited)

Wednesday, 28 July, 10.10–12.10, Room: F, Chair: Hani Hagras

10.10 *Centroid Uncertainty Bounds for Interval Type-2 Fuzzy Sets: Forward and Inverse Problems [#1212]*

Jerry Mendel and Hongwei Wu, University of Southern California, United States; Dept. EE, University of Southern California, China

Interval type-2 fuzzy sets (T2 FS) play a central role in fuzzy sets as models for words [6] and in engineering applications of T2 FSs [5]. These fuzzy sets are characterized by their footprints of uncertainty (FOU), which in turn are characterized by their boundaries--upper and lower member-ship functions (MF). The centroid of an interval T2 FS [3], which is an interval T1 FS, provides a measure of the uncertainty in the interval T2 FS. The main purpose of this paper is to demonstrate that our intuition is correct and to quantify the centroid of an interval T2 FS with respect to these geometric properties of its FOU. It is then possible to formulate and solve inverse problems, i.e. going from data to parametric T2 FS models.

10.30 *A Type-2 Fuzzy Logic Controller for the Liquid-level Process [#1138]*
Dongrui Wu and Woei Wan Tan, National University of Singapore, Singapore

This paper focuses on evolving type-2 fuzzy logic controllers (FLCs) genetically and examining whether they are better able to handle modelling uncertainties. The study is conducted by utilizing a type-2 FLC, evolved by a genetic algorithm (GA), to control a liquid-level process. A two stage strategy is employed to design the type-2 FLC. First, the parameters of a type-1 FLC are optimized using GA. Next, the footprint of uncertainty is evolved by blurring the fuzzy input set. Experimental results show that the type-2 FLC copes well with the complexity of the plant, and can handle the modelling uncertainty better than its type-1 counterpart.

10.50 *A New and Efficient Method for the Type-2 Meet Operation [#1119]*
Simon Coupland and Robert John, De Montfort University, United Kingdom

Type-2 fuzzy logic systems require considerable processing resources to arrive at a conclusion. This paper shows how this can be significantly reduced, focusing specifically on the meet operation. We show how to eliminate large amounts of redundancy from the operation and then present a geometric method that is even more efficient. Results from initial experiments into performance increases are given. These results show that our method can give a significant increase in performance for certain types of secondary memberships.

11.10 *A Type-2 Fuzzy Logic Controller For Autonomous Mobile Robots [#1057]*
Hani Hagras, University of Essex, United Kingdom

The traditional type-1 Fuzzy Logic Controller (FLC) using precise type-1 fuzzy sets cannot fully handle uncertainties facing mobile robots in unstructured environments. A type-2 Fuzzy Logic Controller using type-2 fuzzy sets can handle such uncertainties to produce a better performance. In this paper we present the type-2 FLC and its novel application for the real time control of mobile robots. We used the type-2 FLC to implement different robotic behaviours in indoor and outdoor unstructured and challenging environments. The type-2 FLCs dealt with the uncertainties facing mobile robots in unstructured environments and resulted in a very good performance that outperformed the type-1 FLCs whilst using smaller rule bases.

11.30 *Effect of Type-2 Fuzzy Membership Function Shape on Modelling Variation in Human Decision Making [#1315]*
Turhan Ozen and Jonathan Garibaldi, University of Nottingham, United Kingdom

This paper explains how the shape of type-2 fuzzy membership functions (mfs) can be used to model the variation in human decision making. An interval type- 2 fuzzy logic system is developed for umbilical acid-base assessment. The influence of the shape of the mfs on the variation in decision making of the FLS is studied. Three different methods are used to create the type-2 mfs. The centre points of the original type-1 mfs are shifted, the widths are shifted, and a uniform band is introduced around the original type-1 mfs. It is shown that there is a direct relationship between the variation in decision making and the uncertainty introduced to the mfs.

11.50 *Pro-Two: A Hardware Based Platform For Real Time Type-2 Fuzzy Inference [#1231]*
Miguel Melgarejo, Antonio Garcia and Carlos Pena-Reyes, Universidad Distrital FJC, Colombia; Universidad de los Andes, Colombia; Swiss Federal Institute of Technology, Switzerland

This paper describes Pro-Two, a hardware-based platform for implementing interval Type-2 fuzzy systems. First, the paper describes a computational model for Interval Type-2 Fuzzy Systems that considers parallel inference processing and inner-outer bound sets-based type reduction. Taking into account this model, we present our architecture for hardware implementation and parallel execution of fuzzy inferences. Such architecture is used to specify Pro-Two, which is implemented over FPGA technology. We validate Pro-two by implementing on it a Type-2 fuzzy adaptive filter. The results obtained corroborate the superior performance of Type-2 over Type-1 fuzzy logic for this application and its increased tolerance to low arithmetic resolution.

Fuzzy Optimization and Design

Wednesday, 28 July, 10.10–12.10, Room: H, Chair: L. Magdalena

10.10 *Chance-Constrained Programming for Quadratic Minimum Spanning Tree Problem with Fuzzy Costs [#1071]*
Jinwu Gao and Mei Lu, Dept. of Math. Sci., Tsinghua Univ., Beijing, China

This paper investigates a minimum spanning tree (MST) problem with fuzzy costs and quadratic cost structure, which we call the fuzzy quadratic minimum spanning tree problem (FQMST). After formulating the FQMST problem as a chance-constrained programming model based on a credibility measure, the deterministic equivalent is proposed when the fuzzy direct costs and fuzzy interactive costs are characterized by trapezoidal fuzzy numbers. Then, a genetic algorithm is designed for solving FQMST problems. Finally, a numerical example is provided for illustrating the effectiveness of the genetic algorithm.

10.27 *KBCT: A Knowledge Extraction and Representation Tool for Fuzzy Logic Based Systems [#1192]*
Jose M. Alonso, Luis Magdalena and Serge Guillaume, Universidad Politecnica de Madrid, Spain; Cemagref Montpellier, France

The paper presents a user-friendly portable tool for knowledge extraction of fuzzy systems. KBCT is an open source software that could be executed under Linux or Windows, and its goal is the generation or refinement of fuzzy knowledge bases with a particular interest of obtaining interpretable partitions and rules. KBCT lets the user define variables and rules, but also provides induction capabilities. Both types of knowledge, expert and induced, are integrated under the expert control. The user can check consistency and quality of rule base at any moment, and automatically simplify the rule base in order to reduce its size. The main objective is ensuring interpretability, simplicity and consistency along the whole process.

10.44 *Optimizing Sampling Time in Single Photon Counting Experiments [#1195]*
László Nadai, László T. Kóczy and Péter Várlaki, Computer and Automation Research Institute, Hungary; Budapest University of Technology and Economics, Hungary

The point fractal concept is applied in the paper for analyzing the time-scale variability of point processes recorded in photon counting experiments. The fractal dimension is estimated by a new fuzzy logic based algorithm to eliminate both systematic and stochastic errors. It is shown that there exists a scale-invariant region, and clustering will decrease by the increase of threshold (the inverse sensitivity of the detector). Under threshold variation it is confirmed that the maxima of homogenous scale-invariant intervals are just the same. Moreover, taking the probability scale law on different levels, a relationship holds between the saturation scale (return period) and the threshold (design variable).

11.01 *Using Fuzzy Distance to Evaluate the Consensus of Group Decision-Making - An Entropy-based Approach [#1224]*
Chi-Chun Lo and Ping Wang, National Chiao Tung University, Taiwan

How to weight expert's opinion is an important issue for determining the consensus of a group decision-making. In this paper, we proposed a method, called the Linguistic Weighted Entropy Method (LWEM), to assign weight to the opinion of an expert. Based on LWEM and the optimal aggregation method (OAM), we introduce the entropy-based aggregation method (EAM) in which fuzzy distance is used to evaluate consensus. A example is presented to verify the effectiveness and efficiency of EAM. By examining computational results, we notice that EAM is more flexible than OAM due to the fact that the weight of expert's opinions is considered. In fact, it can be shown that OAM is a special case of EAM.

11.18 *Evaluation Function Guided Search for Fuzzy Set Covering [#1303]*

Ian Cloete and Jacobus van Zyl, International University in Germany, Germany

Fuzzy set covering was introduced as an extended counterpart of crisp machine learning methods using a separate-and-conquer approach to concept learning. This approach follows a general-to-specific search through a space of partially ordered conjunctive descriptions. The search path followed depends to a large extent on the evaluation function used. This paper investigates the effect of the evaluation function on the quality of induced rules and the number of conjunctions examined.

11.35 *A Proposal of Visualization Method for Obtaining Interpretable Fuzzy Rules [#1360]*

Kosuke Yamamoto, Takeshi Furuhashi and Tomohiro Yoshikawa, Faculty of Engineering, Mie University, Japan

Visualization that makes input-output relationships interpretable is effective in extracting useful knowledge from unknown data. This paper presents visualization method that considers the visibility of fuzzy models. This method identifys clusters that have different statistical features, and projects the data to the "fusion axes", which are linear combinations of the multiple input variables, considering the distribution of each cluster in the projected space. This paper applies the proposed method to artificial data and also to collected data from the mobile robot, and shows that the proposed method can extract useful knowldge from the obtained visible and interpretable models.

11.52 *Identification of Fuzzy T-S ARMAX Models [#1050]*

Bore-Kuen Lee and Bor-Sen Chen, Chung Hua University, Taiwan; National Tsing Hua University, Taiwan

Identification of a T-S fuzzy ARMAX model is addressed in this paper. From the fuzzy ARMAX model, a fuzzy one-step ahead prediction model is developed. A recursive least square algorithm is then proposed to identify the parameters in the consequent part of a T-S fuzzy ARMAX system. Properties of the parameter estimates are rigorously derived. This work is an extension of the results of identification of stochastic linear systems in [8].

Fuzzy-Neuro-Evolutionary Hybrids

Wednesday, 28 July, 10.10–12.10, Room: D, Chair: N. Kasabov

10.10 *Image attachement using fuzzy-genetic algorithms [#1137]*

Barna Resko, Jean-Francois Bourges, Péter Korondi, Hideki Hashimoto and Zoltán Petres, Computer and Automation Research Institute, Hungary; Laval University, Canada; Budapest University of Technology and Economics, Hungary; University of Tokyo, Japan

This paper gives contribution to the construction of an image mosaic by pasting together a sequence of photographs taken by a regular digital camera from the same position but in different directions. A translation vector with a minimal difference between the common picture parts has to be found. The difference is defined using the fuzzyfied contours of each images. The search of the optimal translation is considered as a minimization process. This paper proposes a method that uses genetic algorithms to find the minimum point corresponding to the optimal translation. Using the fuzzy based comparison of the two images yields a fast fitness function.

10.30 *Neuro-Fuzzy Systems Derived From Quasi-triangular Norms [#1194]*

Leszek Rutkowski and Krzysztof Cpalka, Techn.Univ.of Czestochowa and WSHE Univ.of Lodz, Poland

Most neuro-fuzzy systems proposed in the past decade employ "engineering implications" defined by a t-norm, e.g. the minimum or the product. In this paper we apply a new class of operators called quasi-triangular norms for the construction of neuro-fuzzy systems. These operators depend on a certain parameter v and change their functional forms between a t-norm and a t-conorm. Consequently, the structure of neuro-fuzzy systems presented in the paper is determined in the process of learning. Learning procedures are derived and simulation examples are presented.

10.50 *Learning and Optimization of Fuzzy Rule Base by Means of Self-Adaptive Genetic Algorithm [#1204]*

Pablo Castro and Heloisa Camargo, Universidade Federal de Sao Carlos, Brazil

This work presents an approach for automatic fuzzy rule base generation and optimization by means of Self-Adaptive Genetic Algorithm, that changes dynamically the crossover and mutation rates ensuring population diversity and avoiding premature convergence. The application domain is multidimensional fuzzy pattern classification, where the class also is fuzzy. The membership functions were defined by the fuzzy clustering algorithm FC-Means. The performance of our method is evaluated on some well-known data sets. Compact fuzzy rule bases were generated with high classification ability. The dynamic change of crossover and mutation parameters showed that great improvement can be achieved to results.

11.10 *Reduction of Fuzzy Systems Through Open Product Analysis of Genetic Algorithm-Generated Fuzzy Rule Sets [#1329]*

Sanza Kazadi, Taehoon Shin, Diana Jue, Dharshan Chandramohan and David Choi, Jisan Research Institute, United States; University of Southern California, United States

We explore the reduction of a fuzzy classifier designed to perform a binary classification of tracked or wheeled vehicles based on acoustic data. A genetic algorithm is used to explore the design space of the classifier, with variations performed on the number of antecedents included in the final fuzzy system. We discover that systems with reductions in the number of antecedents of between 50 and 95% perform well on this classification. A novel method of extracting important system components, known as open product analysis, is applied, yielding systems that perform well with small numbers of antecedents. The fuzzy classifier we reduced performs well using only 10 to 15% of the antecedents that were originally used for classification.

11.30 *Design of a Hybrid Neuro-Fuzzy Decision-Support System with a Heterogeneous Structure [#1418]*

Michael Negnevitsky, University of Tasmania, Australia

This paper describes the design of a hybrid neuro-fuzzy system for diagnosing myocardial perfusion from cardiac images. The model described in this project has a heterogeneous structure - the neural network and fuzzy system work as independent components. When a new case is presented to the diagnostic system, the trained neural network determines inputs to the fuzzy system. Then the fuzzy system using predefined fuzzy sets and fuzzy rules, maps the given inputs to an output, and thereby obtains the risk of a heart attack.

11.50 *Motivational Processes and Fuzzy Logic of the Brain. Part 1: Experiment. (The ability to feel rests on the fact of mortality) [#1112]*

Lev Tsitolovsky and Uziel Sandler, Bar-Ilan University, Israel; Jerusalem College of Technology, Israel

In the first part of this paper we present a comprehensive review of the literature and results of the original experiments which supply trustworthy evidence that a real neuron makes a prediction of consequences of input signals and generates an output signal in conformity with this prediction. Based on the experimental data we point out that the phenomenon of motivation appears already on the neuronal level as the phenomenon of avoidance of neuron damage. We argue also that avoidance of injury and aspiration to live is one of the main parts of physiological regulation of the neuron learning and the motivational processes.

Wednesday, 28 July, 14.00–16.00

TP Model Transformation in Non-Linear Control (Invited)

Wednesday, 28 July, 14.00–16.00, Room: E, Chair: Péter Baranyi

14.00 *On Application of Grid Point Sampling and SVD Consolidation Approach [#1399]*

Yeung Yam, Lee Wai Man and Péter Baranyi, The Chinese University of Hong Kong, Hong Kong; Technical University of Budapest, Hungary

A recent computational approach for nonlinear plant modeling and control system design calls for generating the plant's linear approximations over a set of grid points in the domains of interest, and then conduct SVD consolidation to obtain a TS fuzzy model representation. Going a step further, grid point controllers may also be generated and then joined with the plant parameters for SVD reduction, possibly resulting in new fuzzy structure over that of the original plant. The present work aims to explore two outstanding issues regarding the approach. The first concerns its ability to extract inherent fuzzy structure, and the second the condition under which grid point controller design would maintain the fuzzy structure of the plant.

14.20 *Global Asymptotic Stabilization of the Aeroelastic Wing Section: a TP Model Transformation Based Approach [#1401]*

Péter Baranyi and Pal Michelberger, Budapest University of Technology and Economics, Hungary; Computer and Automation Research Institute, Hungary

A comprehensive analysis of aeroelastic systems has shown that these systems exhibit a broad class of pathological response regimes when certain types of non-linearities are included. In this paper, we propose a design method of a state-dependent non-linear controller for aeroelastic systems that includes polynomial structural non-linearities. The proposed method is based on recent numerical techniques such as the Tensor Product (TP) model transformation and the Linear Matrix Inequality (LMI) control design methods within the Parallel Distributed Compensation (PDC) frameworks. As an example, a controller is derived that ensures the global asymptotic stability of the prototypical aeroelastic wing section via one control surface.

14.40 *On the Approximation Properties of TP Model Forms [#1371]*

Domonkos Tikk, Péter Baranyi and Ron Patton, Budapest University of Technology and Economics, Hungary; University of Hull, United Kingdom

The tensor product (TP) based models have been applied widely in approximation theory and approximation techniques. The aim of this paper is to investigate the approximation capabilities of dynamic TP model. It is shown that the set of functions that can be approximated arbitrarily well by TP forms with bounded number of components lies no-where dense in the set of continuous functions. This drawback necessitates the application of trade-off techniques between accuracy and complexity of TP form. Such requirements are very difficult to consider in the analytical framework, but TP model transformation offers an easy way to deal with them.

15.00 *Reduction of the dynamic state-space in Fuzzy Q-learning [#1363]*

Szilveszter Kovács and Péter Baranyi, University of Miskolc, Hungary; Technical University of Budapest, Hungary

Reinforcement Learning (RL) methods are gaining more and more popularity recently in the autonomous robotics community. One of the possible difficulties of the reinforcement learning applications in complex situations is the huge size of the action-value-function representation. The case of continuous environment reinforcement learning could be even complicated, in case of applying dense partitions to describe the continuous universes, to achieve precise approximation of the basically unknown action-value-function. As a simple solution of these problems, in this paper the adoption of Higher Order SVD based fuzzy rule base complexity reduction techniques and its fast adaptation method is suggested.

15.20 *Reference Signal Control of the TORA System: a TP Model Transformation Approach [#1159]*

Zoltán Petres, Barna Resko and Péter Baranyi, Computer and Automation Research Institute, Hungary

This paper presents a case study of the TP (Tensor Product) model transformation in the control of a nonlinear benchmark problem.We design a non-linear controller of TORA system via TP model transformation and LMI based controller design technique that is also capable of the reference signal following control. The main contribution of the paper is to show that both numerical methods the TP model transformation and the LMI can readily be executed by computer independently on the given problem and without analytical derivations. Numerical simulation is used in the paper to provided empirical validation of the control results.

15.40 *Takagi-Sugeno Fuzzy Gain scheduling with Sampling-Time Uncertainties [#1129]*

Bourhane Kadmiry and Dimiter Driankov, Linkoeping University, Sweden; Oerebro University, Sweden

This paper addresses the robust fuzzy control problem for discrete-time nonlinear systems in the presence of sampling time uncertainties. The case of the discrete T--S fuzzy system with sampling-time uncertainty is considered and a robust controller design method is proposed. The sufficient conditions and the design procedure are formulated in the form of linear matrix inequalities (LMI). The effectiveness of the proposed controller design methodology is demonstrated of a visual-servoing control problem.

Applications of Type 2 Fuzzy Logic 2 (Invited)

Wednesday, 28 July, 14.00–16.00, Room: H, Chair: R. John

14.00 *Adaptive Noise Cancellation Using Type-2 Fuzzy Logic and Neural Networks [#1026]*

Oscar Castillo and Patricia Melin, Tijuana Institute of Technology, Mexico

We describe in this paper the use of type-2 fuzzy logic for achieving adaptive noise cancellation. The objective of adaptive noise cancellation is to filter out an interference component by identifying a model between a measurable noise source and the corresponding un-measurable interference. In this paper, we propose the use of type-2 fuzzy logic to find this model. The use of type-2 fuzzy logic is justified due to the high level of uncertainty of the process, which makes difficult to find appropriate parameter values for the membership functions.

14.20 *Antecedent Connector Word Models for Interval Type-2 Fuzzy Logic Systems [#1028]*

Hongwei Wu and Jerry Mendel, Dept. EE, University of Southern California, United States

We investigate ten compensatory operators and S-OWA operators in the framework of Mamdani interval type-2 fuzzy logic systems (FLS) so that the uncertainties originating from descriptive words, connector words and data can be simultaneously modeled. Our investigations show that for a non- singleton interval type-2 FLS Phi_p^MCA can be implemented and optimized. We also apply Phi_p^MCA to chaotic time-series prediction where the observations are corrupted by non-stationary noise. The results show that by incorporating Phi_p^MCA it may take less

time to train an interval type-2 FLS to achieve a certain performance, and the resulting system is more robust to noise.

14.40 *A Type-2 Fuzzy Embedded Agent For Ubiquitious Computing Enviornments [#1082]*
Faiyaz Doctor, Hani Hagras and Victor Callaghan, University of Essex, United Kingdom

We describe a novel system for learning and adapting type-2 fuzzy controllers for intelligent agents embedded in Ubiquitous Computing Environments (UCEs). Our type-2 agents operate non intrusively in an online life long learning manner to learn the user behaviour to control the UCE on the user's behalf. We have performed experiments in which the type-2 agent has learnt and adapted online to the user's behaviour during a stay of five days in the intelligent Dormitory (iDorm) which is a real UCE test bed. We will show how our type-2 agent deals with uncertainty and imprecision in UCEs to give a very good performance that outperform the type-1 fuzzy agents while using a smaller number of rules.

15.00 *Entropy Assessment For Type-2 Fuzziness [#1228]*
Ibrahim Ozkan and I. Burhan Turksen, University of Toronto, Canada

One of the sources of uncertainty, which perhaps is identified as parameter uncertainty, is the level of fuzziness in fuzzy system modeling. Given the optimum number of clusters and the cluster centers, one can explore Type-2 membership values that capture the uncertainty of memberships. In this paper, we explore variations of Type-2 membership values with the entropy measure for an artificially created 12 data sets. Crisp to fuzzy data sets are constructed so that each data set has a different standard deviation within each cluster. In turn, each cluster has the same standard deviation for a given artificial data set. Results are assessed by means of a particular Entropy measure.

15.20 *An interval type-2 fuzzy spherical shells algorithm [#1369]*
Cheul Hwang and Frank Chung-Hoon Rhee, Hanyang University, South Korea

This paper presents an interval type-2 fuzzy C-spherical shells (FCSS) algorithm that is an extension of the type-1 FCSS algorithm proposed. In our proposed method, the membership values for each pattern vector are extended as interval type-2 fuzzy memberships by assigning uncertainty to the type-1 memberships. By doing so, the cluster boundary obtained by the interval type-2 FCSS can be found to be more desirable than that of type-1 FCSS in the presence of noise. Experimental results are given to show the effectiveness of our method.

15.40 *Interval Type-2 Fuzzy Hidden Markov Models [#1416]*
Jia Zeng and Zhi-Qiang Liu, City University of Hong Kong, Hong Kong

This paper presents an extension of Hidden Markov Models (HMMs) using interval type-2 fuzzy sets (FSs) and fuzzy logic systems (FLSs): interval type-2 FHMMs. The advantage of this extension is that it can handle both randomness and fuzziness. Membership function (MF) of the type-2 FS is threedimensional. It is the third-dimension that provides additional degrees of freedom to handle both uncertainties. We apply our interval type-2 FHMMas acoustic model for phoneme recognition on TIMIT speech database. Experimental results show that the type-2 FHMM has a comparable performance as that of the HMM but is more robust to speech variation, while it retains almost the same computational complexity as that of the HMM.

Computing with Words

Wednesday, 28 July, 14.00–16.00, Room: I, Chair: Jerry Mendel

14.00 *A concept of similarity for intuitionistic fuzzy sets and its use in group decision making [#1215]*
Eulalia Szmidt and Janusz Kacprzyk, Systems Research Institute, Pol. Acad. Sci., Poland; Systems Research Institute, Polish Acad. of Sci., Poland

We apply a new measure of similarity to analyse the extent of agreement in a group of experts. The proposed measure takes into account not only a pure distance between intuitionistic fuzzy preferences but also examines if the compared preferences are more similar or more dissimilar to each other. The agreement of the entire group is assessed via an aggregation of individual testimonies expressed by intuitionistic fuzzy preference relations.

14.17 *Linguistically Quantified Propositions for Consensus Reaching Support [#1283]*
Janusz Kacprzyk and Slawomir Zadrozny, Systems Research Institute, Polish Acad. of Sci., Poland

Consensus reaching is as an important decision making process. Its effective support requires a practical, operational definition of the very concept of consensus. In our previous works we proposed a definition that is both precise and human consistent. Such an definition provides for a continuous assessment of the consensus degree which makes it an excellent discussion guidance indicator. In the present paper, we extend the set of relevant indicators so as to make the support of consensus reaching more effective and efficient. We are inspired by the very closely related concept of a linguistic summary of data and use it for the evaluation of an option's standing, an individual's position and a more elaborate consensus degree.

14.34 *Granular Data Model: Semantic Data Mining and Computing with Words [#1330]*
Tsau Lin, San Jose State University, United States

Using computing with words as a representation theory of Lin-Zadeh's notion of granular computing, the bitmap indexes of relational tables is formalized and extended. We call it a granular data model (GDM). If all granulations are partitions, a GDM is reduced to a classical relation in relational data model. Based on GDM, semantically rich rules can be mined. The underlying theme of this paper is computing with words; Data mining on GDM is one form of computing with words.

14.51 *MembershipMap: A Data Transformation Approach for Knowledge Discovery in Databases [#1355]*
Hichem Frigui, University of Memphis, United States

We propose a data transformation approach that facilitates many data mining, interpretation, and analysis tasks. Our approach, called MembershipMap, strives to extract the underlying structure or sub-concepts of each raw attribute automatically, and uses the orthogonal union of these sub-concepts to define a new, semantically richer, space. A combination of labeling schemes that are based on different measures of uncertainty will be presented. In particular, we introduce the CrispMap, the FuzzyMap and the PossibilisticMap. The proposed transformation is illustrated with several data sets, and we show that it can be used as a flexible pre-processing tool to support such tasks as: sampling, data cleaning, and outlier detection.

15.08 *Fuzzy Translation Tools for Linguistic Terms [#1400]*
Andy Verkeyn and Dick Botteldooren, Ghent University, Belgium

In this paper an automatic translation tool for linguistic terms is built. The terms are represented by fuzzy sets and the translations are based on the similarity degree between those fuzzy sets. The tool is tested on 21 adverbs in 9 languages. The fuzzy sets are constructed with a probability based approach, based on data from an International study on the choice of appropriate terms to label a noise annoyance scale. The results are in agreement with common sense translations. The translation tool requires a number of operators that must be chosen. A detailed sensitivity analysis is performed to investigate the impact of these choices. This shows that the procedure is quite stable for many operator choices.

15.25 *The Rapid Elicitation of Knowledge About Images Using Fuzzy Information Granules [#1403]*
Jonathan Rossiter, RIKEN, Inst. of Physical and Chemical Research, Japan

In this paper we present a new method for tagging image regions using uncertain information granules. This tagging forms an efficient route for the elicitation of

knowledge from domain experts with respect to images. We then use this uncertain granular information to train a fuzzy machine learner and then to classify unseen images. This method is particularly suited to applications where expert input into the classification process is essential but where the expert's time is in extremely short supply. Results are presented within the example domain of detecting lung disease from Computed Tomography scans.

15.42 *Discovering Gene-Gene Relations from Fuzzy Sequential Sentence Patterns in Biomedical Literature [#1167]*

Jung-Hsien Chiang, Zong-Xian Yin and Cheng-Yu Chen, CS Dept, National Cheng Kung University, Taiwan

We have developed a gene-gene (G-G) relation browser that combines fuzzy sequential pattern mining and information-extraction model to extract from biomedical literature knowledge on gene-gene interactions. Our approach aims to detect associated G-G relations that are often discussed in documents. Integration of the related relations will lead to an individual G-G network. Graphic presentation will be used to demonstrate the relationships between gene products.

Real World Applications

Wednesday, 28 July, 14.00–16.00, Room: D, Chair: P. Kulczycki

14.00 *Image Analysis via Fuzzy Reasoning Approach: Prototype Applications at NASA [#1041]*

Jesus Dominguez and Steve Klinko, ASRC Aerospace Corporation, United States

A set of imaging techniques based on Fuzzy Reasoning (FR) approach was built for NASA at Kennedy Space Center (KSC) to perform complex real-time visual- related safety prototype tasks, such as detection and tracking of moving Foreign Objects Debris (FOD) during the NASA Space Shuttle liftoff and visual anomaly detection on slidewires used in the emergency egress system for Space Shuttle at the launch pad. The system has also proved its prospective in enhancing X-ray images used to screen hard-covered items leading to a better visualization. The system capability was used as well during the imaging analysis of the Space Shuttle Columbia accident.

14.20 *A Software for Electric-Power Fuzzy Critical Analysis [#1351]*

Mariana Dumitrescu, Toader Munteanu and Dan Floricau, Electrical Engineering Department"Dunarea de Jos, Romania; Electrotechnical Faculty, Politehnica Bucuresti, Romania

For critical analysis of the Protected Electric Power Element-Protection System we built a complex software tool named "Fuzzy Event Tree Analysis". We exemplified the critical analysis for the electric power protection system of radial and curled electrical line. The paper proposes and exemplifies how to use the fuzzy logic in the critical analysis of the faults including abnormal workings, for the most important elements in Power Systems. Fuzzy Event Tree method is used in performing the electric power protection system independent analysis.

14.40 *Kernel Estimators for Analysis of Systems with Fuzzy Uncertainty [#1354]*

Piotr Kulczycki, Systems Research Institute, Polish Academy of Sc, Poland

The recently observed increase of uses of kernel estimators are related to a dynamic development of application possibilities of omnipresent computer technology. This paper presents the exemplary applications of kernel estimators methodology with respect to several practical tasks of broadly understood systems research, in the presence of fuzzy uncertainty: estimation of the demand for teletransmission services, medical diagnosing, parameter estimation for the needs of optimal control, and identification of untypical elements (outliers) in archeology.

15.00 *Improving Visual Servoing Using Fuzzy Filters [#1365]*

Paulo Sequeira Goncalves, Luis Mendonca, Joao Sousa and Joao Caldas Pinto, Escola Superior de Tecnologia de castelo Branco, Portugal; Technical University of Lisbon, Portugal

A new approach to improve visual servoing based on fuzzy filters is proposed in this paper. In visual servoing the speed of convergence depends on a constant gain, that directly influences the velocity of the robot manipulator joints. This velocity can achieve undesired behavior due to the intrinsically discrete visual servoing and when regulator control is used. In this paper the image features error is filtered by means of fuzzy filters, to improve the behavior of the robot joint velocities. Simulation results are presented for a 6 DOF eye-in-hand system, that demonstrates the efficiency of the proposed approach. Experimental results are also presented when a 2 DOF robot manipulator performs kinematic visual servoing.

15.20 *Experiments with a Hierarchical Text Categorizer [#1375]*

Domonkos Tikk, György Biró and Jae Dong Yang, Budapest University of Technology and Economics, Hungary; Textminer Ltd., Hungary; Chonbuk National University, Korea (South)

HITEC is a hierarchical text categorizer tool that is based on UFEX (Universal Feature EXtractor) algorithm. This paper presents experiments on the effectiveness of HITEC on several natural languages (English, German) and with various kinds of text corpora. The obtained results shows that HITEC outperforms its known competitors on the investigated corpora, and its performance is independent from the processed languages. The time and storage requirement of HITEC is considerable, therefore it can be run on an average PC.

15.40 *Fuzzy Linear Assignment Problem: An Approach to Vehicle Fleet Deployment [#1381]*

Minh Ngoc Ngo, Kiam Tian Seow and Kok Wai Wong, Nanyang Technological University, Singapore

This paper proposes and examines a new approach using fuzzy logic to vehicle fleet deployment. Fleet deployment is viewed as a fuzzy linear assignment problem. It assigns each travel request to an available service vehicle through solving a linear assignment matrix of defuzzied cost entries that "fuzzily aggregates" multiple criteria in simple rules incorporating human dispatching expertise. The approach is examined via extensive simulations anchored in a representative scenario of taxi deployment, and compared to the conventional case of using only distances as cost entries. Discussion in the context of related work examines the performance and practicality of the proposed approach.

Wednesday, 28 July, 17.30–19.00

Plenary Poster Session: Fuzzy Control

Wednesday, 28 July, 17.30–19.00, Room: P, Chair: K. Tanaka & D. Liu

W170 *A Generalized Fuzzy Hyperbolic Modeling and Control Scheme [#1034]*

Zhang Mingjun, Zhang Huaguang and Liu Derong, Northeastern University, Shenyang, P.R.China, China; Northeastern University, Shenyang, China; University of Illinois, United States

In this paper, a new generalized fuzzy hyperbolic model (GFHM) is proposed, which is proved to be a universal approximator. GFHM can be used as identifier for nonlinear dynamic systems and the back-propagation training algorithm is given. The feature of GFHM is that as the number of input variables or (and) fuzzy subsets increases, the number of the unknown parameters of GFHM will increase linearly. Finally, the adaptive fuzzy control scheme is presented, which can guarantee that the closed-loop system is globally asymptotically stable. The simulation results show the applicability of the modeling scheme and the effectiveness of the proposed adaptive control scheme.

W171 *Adaptive Fuzzy Output Feedback Control for Nonlinear MIMO Systems [#1042]*

Shaocheng Tong and Yan Shi, Liaoning Institute of Technology, China; Kyushu Tokai University, Japan

The adaptive fuzzy Control scheme based on observer is proposed for a class of MIMO nonlinear systems whose states are unavailable. By applying "dominant input" concept and combining adaptive control, control with fuzzy logic systems, the output feedback control law and parameter adaptive law are derived. The whole control scheme can guarantee the stability of the closed- loop, and achieve tracking performance.

W172 *Rule Chain and Dominant Rule Control Algorithm for Unknown Nonlinear Systems [#1048]*

Hailiang Zhao, Southwest Jiaotong University, China

This paper is focused on the control method based upon rule chains for unknown nonlinear systems. Fuzzy point is employed to simplify the expression of MIMO fuzzy rules. The rule's input and output dominant regions are proposed. The dominant rule control algorithm is constructed by means of the extension rules. The rule chain and the Epsilon-level control stability are presented. Furthermore, for the rule-base control systems, a sufficient and necessary condition about the stability is obtained and a method to analyze the stability is presented. An upper bound about the settling time and the maximum steady- error for the systems are estimated. Finally, an application result is employed to show the effectivity of the method.

W173 *Feedback Control via Popov for Fuzzy Systems with Input Saturations [#1049]*

Ji-Chang Lo and Min-Long Lin, National Central Univeristy, Taiwan; National Central University, Taiwan

We investigate a state feedback synthesis problem involving saturating inputs via Popov criterion. The problem formulated in fuzzy model is tackled via Popov criterion borrowed from system theory. We first show the fuzzy versions of Popov and then provide synthesis results based on Popov. With the design technique, the closed-loop fuzzy system is asymptotically stabilizable via sector-bounded saturating inputs. We present results in a unified fashion applicable to both continuous- and discrete-time problems. Finally the validity and applicability of the approach are demonstrated by an example.

W174 *Approximation Capability Analysis of Hierarchical Takagi-Sugeno Fuzzy Systems [#1062]*

Xiao-Jun Zeng and John Keane, Umist, United Kingdom

This paper discusses the approximation capacities of hierarchical Takagi-Sugeno fuzzy systems. By first introducing the concept of the natural hierarchical structure, it is proved that continuous functions with the natural hierarchical structure can be naturally and effectively approximated by hierarchical fuzzy systems to overcome the curse of dimensionality in both the number of rules and the number of parameters. Then, based on the Kolmogorov's theorem, it is shown that any continuous function can be represented as a superposition of functions with natural hierarchical structure and can then be approximated by hierarchical Takagi-Sugeno fuzzy systems to achieve the universal approximation property.

W175 *Analysis of Autoregressive Fuzzy Systems [#1080]*

Zdenek Vlcek, Czech Technical University in Prague, Faculty of, Czech Republic

The combination of fuzzy logic and neural networks are one of the techniques that are recently being used for modelling nonlinear system. Most of real-word systems have dynamic features, i.e. the actual output depends on the previous values. The so-called autoregressive dynamic fuzzy system with rules in the general forms have to be used. The specific problem appears when dealing with this autoregressive dynamic fuzzy systems. Their properties are very different and lead to serious problems in practice. This paper demonstrates the difficulties of the usage of a fuzzy system as an autoregressive dynamic system. Completely new criteria and algorithms for the analysis of the autoregressive dynamic fuzzy systems are proposed.

W176 *Approximations of Large Rule Fuzzy Logic Controller by Simplest Fuzzy Controller [#1139]*

Rakesh Arya, R. Mitra and Vijay Kumar, Indian Institute of Technology Roorkee, India

This paper deals with approximations of large rule fuzzy logic controller by simplest fuzzy controller (4 rules) via comparison of membership grade of output in the fuzzy sets of the two controllers. The inequalities between two controllers are compensated by proposed compensating factors. The proposed methodology enormously reduces the computational time. Various systems from available literature are utilized to demonstrate the proposed methodology. It has been found that the proposed approximations and conventional methods give approximately same results.

W177 *Predictive Control Based on Fuzzy Model for Steam Generator [#1146]*

Daniela Andone and Andrei Hossu, University "Politehnica" of Bucharest, Romania

Poor control of the steam generator water level in the secondary circuit of a nuclear power plant can lead to frequent reactor shutdowns. Such shutdowns are caused by violation of safety limits on the water level and are common at low operating power where the plant exhibits strong non-minimum phase characteristics. This paper presents a framework for addressing this problem based on a new method of predictive control based on fuzzy model. It has been shown that in the case of nonlinear processes, the approach using fuzzy predictive control gives very promising results. The proposed approach is potentially interesting in the case of heat-exchangers and furnaces.

W178 *Robot hand tracking using adaptive fuzzy control [#1158]*

Perez Carlos, Reinoso Oscar, Garcia Nicolas, Neco Ramon and Vicente Maria Asuncion, Miguel Hernandez University, Spain

This paper presents a new and robust algorithm to track a robot gripper during its movement in a teleoperation task. Based on acquired image and knowing the gripper model, the pose is obtained. This information is used to move a pan- tilt camera and keep the gripper centered in the image using an adaptive fuzzy logic controller. This control law is used combined with a position prediction technique to improve the system behavior (Extended Kalman Filter - EKF). Vision based systems have a lot of empirically adjustable parameters for a good working. With the algorithm proposed in this paper, the adjustable parameters are minimized, so the system robustness is increased.

W179 *Robust Stable Feedback Linearization of Fuzzy Modeled Nonlinear Systems via LMI's [#1174]*
Chang-Woo Park, Chan-Woo Moon, Jongbae Lee, Young-Ouk Kim and Ha-Gyeong Sung, Korea Electronics Technology Institute, South Korea

This paper presents the robust stability analysis and design methodology of the fuzzy feedback linearization control systems. Uncertainty and disturbances with known bounds are assumed to be included in the Takagi-Sugeno (TS) fuzzy models representing the nonlinear plants. L2 robust stability of the closed system is analyzed by casting the systems into the diagonal norm bounded linear differential inclusions (DNLDI) formulation. Based on the linear matix inequality (LMI) optimization programming, a numerical method for finding the maximum stable ranges of the fuzzy feedback linarization control gains is also proposed. To verify the effectiveness of the proposed scheme, the robust stability analysis and control design examples are given.

W180 *The Discourse Self-adapting Fuzzy Controller for Temperature Control Processing in Disinfecting Cupboard [#1175]*
Yongquan Yu, Ying Huang and Bi Zeng, Guangdong University of Technology, China

This paper presents a changeable discourse range fuzzy controller, which can narrow down the discourse range and raise up the control precision. To change the range of discourse, the narrowing down factor is used automatically according to the output error of the system. This control method is implemented in electronic disinfecting cupboard one kind of home appliances, and the result shows that it is the useful method to control home appliance, which accurate model is difficult to obtain.

W181 *Output Regulation for Discrete-time Nonlinear Time-Varying Delay Systems: An LMI Approach [#1198]*
Tung-Sheng Chiang, Chian-Song Chiu and Peter Liu, Ching-Yun University, Taiwan; Chien-Kuo Institute of Technology, Taiwan; BENQ Corporation, Taiwan

In this article, the T-S fuzzy model approach is extended to the stability analysis, control and output regulation design for discrete-time nonlinear systems with time-varying delay. The T-S fuzzy model with varying-time delay are presented and the stability conditions are derived from Lyapunov approach. We also present a stabilization approach and output regulation for nonlinear time delay systems through fuzzy state feedback and fuzzy observer-based controller. Sufficient conditions for the existence of fuzzy state feedback and integral gain with fuzzy observer gain are derived. A numerical simulation example is given to verify the output tracking performance of the proposed methods.

W182 *Output Regulation Control via Virtual Model Reference Approach [#1203]*
Peter Liu, Tung-Sheng Chiang and Chian-Song Chiu, BENQ Corporation, Taiwan; Ching-Yun University, Taiwan; Chien-Kuo Institute of Technology, Taiwan

This study proposes a fuzzy control design methodology for regulating an output of biasing nonlinear systems. First, the general nonlinear systems with constant/varying bias terms are represented by the T-S fuzzy model, which has common bias terms in consequent part. Then a parallel distributed integral compensation is introduced to drive the system with the desired output. Meanwhile, the virtual model reference scheme is utilized in stability analysis. Furthermore, the H-inf regulation is carried out on continuous/discrete-time nonlinear systems in a unified manner. The proposed method is also realized by solving linear matrix inequality problems (LMIPs). Numerical simulation examples are given to verify the output regulation performance.

W183 *Control of Discrete-Time Chaotic Systems Using One-Step-Ahead Adaptive Fuzzy Controller [#1236]*
Feng Wan, Huilan Shang and Li-Xin Wang, Zhejiang University, China; Laurentian University, Canada; Hong Kong University of Science and Technology, Hong Kong

This paper discusses chaos control in discrete-time nonlinear systems using one-step-ahead adaptive fuzzy controller. The chaotic system in a general form is modeled by a Mamdani type fuzzy system with parameters tuned on-line using system input-output data by the least square algorithm with deadzone. Based on this fuzzy model, a one-step-ahead controller is designed to minimize the error between the desired and the real system outputs. Performance analysis and simulation results in control of the Sin and Lozi systems are given to show the effectiveness of the scheme.

W184 *How to tune fuzzy controllers [#1241]*
Eduardo Gomez-Ramirez and Armando Chavez-Placencia, La Salle University, Mexico

Fuzzy controllers tuning implies the handling of a great quantity of variables like: the shape, number and ranges of the membership functions, the percentage of overlap among them and the design of the rule base. The importance of the tuning problem implies to obtain fuzzy system that decrease the settling time of the processes in which it is applied, or in some cases, the settling time must be fixed to some specific value. In this work, a very simple algorithm is presented for the tuning of a fuzzy controller using only one variable to adjust the performance of the system. The results will be obtained considering the relationship that exists between the membership functions and the settling time.

W185 *Design and Analysis of SISO Fuzzy Logic Controller for Power Electronic Converters [#1268]*
Viswanathan Kanakasabai, Dipti Srinivasan and Ramesh Oruganti, National University of Singapore, Singapore

Power converters are non-linear systems that usually employ linear controllers designed to offer good small-signal performance at the nominal operating point. Yet, the converter's large-signal response is generally poor. Fuzzy logic controllers (FLCs) used in such cases improve the response, but their small- signal response is not as good as that of linear controller. In this paper, design of a SISO-FLC that offers good small and large-signal performance in a boost converter is presented. Besides reducing control complexity, the FLC offers better transient response in the converter than the linear controller. Simulation results are presented to show this. Using describing function method, the system stability margins are also analyzed.

W186 *Fine Control of Monotonic Systems using a Global Self-Learning Adaptive Fuzzy Controller [#1291]*
Hector Pomares, Ignacio Rojas, Luis Javier Herrera, Jesus Gonzalez and Alberto Prieto, University of Granada, Spain

The goal of this paper is to achieve real time control of a monotonic system which, in general, may be non-linear and whose differential equations are unknown. We assume that there is no model of the plant available so there cannot be any off-line pre-training of the main controller parameters. We propose a both adaptive and self-learning algorithm capable of starting from a ``void'' fuzzy controller and, in real time, optimizing the fuzzy controller's rules (both antecedents and consequents) in order to translate the state of the plant to the desired value in the shortest possible time.

W187 *Development of a Type-2 Fuzzy Proportional Controller [#1299]*
Woei Wan Tan and Junwei Lai, National University of Singapore, Singapore

This paper aims at developing a type-2 fuzzy logic system to control a process whose parameters are uncertain. A method for designing Type-2 triangular membership functions with the desired generalized centroid is first proposed. By using this type-2 fuzzy set to partition the output domain, a type-2 fuzzy proportional controller is obtained. It is shown that the type-2 fuzzy logic system is equivalent to a proportional controller that may assume a range of gains. Simulation results are presented to demonstrate that the performance of the proposed controller can be maintained even when the system parameters deviate from their nominal values.

W188 *Fuzzy Control for Fuzzy Interval Systems. Part II : Application to Inverse Model Based Control [#1305]*
Reda Boukezzoula, Laurent Foulloy and Sylvie Galichet, Listic - university of Savoie, France

This part aims at designing a fuzzy inverse controller for fuzzy linear interval systems. The controller is designed from the fuzzy interval ranges of the system parameters. Indeed, for a given degree of confidence on the fuzzy system parameters, the control objective can be viewed as maintaining the system output within a tolerance envelope, around the exact trajectory, specified by a degree of preference on the fuzzy trajectory. The validity of the proposed method is illustrated by simulation examples.

W189 *Fuzzy Controllers for Tire Slip Control in Anti-lock Braking Systems [#1311]*
Radu-Emil Precup, Stefan Preitl, Marius Balas and Valentina Balas, "Politehnica" University of Timisoara, Romania; "Aurel Vlaicu" University of Arad, Romania

A Takagi-Sugeno fuzzy controller and an interpolative fuzzy controller for tire slip control in Anti-lock Braking System are proposed. Both fuzzy controllers are developed using a benchmark consisting of a simplified nonlinear model describing the slip dynamics for a wheel, and perform the merge between 64 locl PI and PID controllers. By employing local linearized models of the controlled plant, the local controllers are developed in the frequency domain. Development methods for the two fuzzy controllers are also offered.Simulations results show the control system performance enhancement ensured by the fuzzy controllers in comparison with the conventional PI ones.

W190 *Stabilisation of Takagi-Sugeno models with maximum convergence rate [#1374]*
Chadli Mohammed, Maquin Didier and Ragot Jose, CRAN, INPL, CNRS, UMR 7039, France

This paper deals with the stabilization of Takagi-Sugeno (T-S) models using state feedback controllers. Relaxed sufficient exponential stability conditions are given for both continuous and discrete multiple models. The stability conditions of the closed loop multiple models are expressed in linear matrix inequalities (LMI) form. To optimize the degree of stability, a formulation in term of generalized eigenvalues problem (GEVP) is proposed.

W191 *Design of robust observer for uncertain Takagi-Sugeno models [#1377]*
Abdelkader Akhenak, Mohammed Chadli, Jose Ragot and Didier Maquin, CRAN, CNRS, UMR, 7039, France

This paper deals with the robust fuzzy observer design problem for a class of uncertain nonlinear system represented by Takagi-Sugeno model. An efficient LMI (Linear Matrix Inequality) formulation is proposed to solve the problem.

Plenary Poster Session: Fuzzy Database Mining and Forecasting

Wednesday, 28 July, 17.30–19.00, Room: P, Chair: Domonkos Tikk

W192 *A Fuzzy Multidimensional Model for Supporting Imprecision in OLAP [#1155]*
Miguel Delgado, Carlos Molina, Daniel Sanchez, Amparo Vila and Lazaro Rodriguez-Ariza, University of Granada, Spain

The use of OLAP technology in new knowledge fields and the merge of data from different sources have made appeared new requirements for models to support this technology. What we propose in this paper is a new multidimensional model that can manage imprecision both in the dimensions and the facts. This enables the multidimensional structure to model the imprecision of the data as a result of the integration of data from different sources or even information from experts. This is done by means of fuzzy logic.

W193 *FRID:Fuzzy-Rough Interactive Dichotomizers [#1179]*
Rajen Bhatt and Gopal M., Indian Institute of Technology Delhi, India

In this paper, we propose FRID (Fuzzy-Rough Interactive Dichotomizers); a methodology for the induction of decision trees using rough set based measures to capture cognitive uncertainties inherent to databases. These measures are: 1) Fuzzy-roughness and 2) Fuzzy-rough entropy. Developed FRID algorithms have been initially applied to various real-world benchmark datasets, and experimentally compared with the three fuzzy classification tree generation algorithms reported so far. Simulation results confirm that the use of proposed strategy leads to smaller decision trees and as a result better generalization performance.

W194 *Clustering and Refinement of Hierarchical Concept from Categorical Databases Based on Rough Sets [#1287]*
Been-Chian Chien and Su-Yu Liao, Dept. of Information Eng., I-Shou University, Taiwan

A concept hierarchy is a concise and general form of knowledge representation. Hierarchical concept description can organize relationships of data and express knowledge embedded in databases explicitly. In this paper, we propose a new scheme based on rough sets to cluster and refine the concept hierarchy automatically for a given data set with nominal attributes. The proposed scheme consists of two algorithms: the concept clustering algorithm and the concept refinement algorithm. The experimental results show that the concept hierarchy mined by the proposed scheme contains meaningful concept in comparison with the previous approaches. The analysis of the algorithms also shows that the scheme is efficient and scaleable for large databases.

W195 *Predictive Fuzzy Clustering Model for Natural Streamflow Forecasting [#1316]*
Marina Magalhaes, Rosangela Ballini and Fernando Gomide, State University of Campinas, Brazil

Planning of hydroelectric systems is a complex and difficult task once it involves non-linear production features and depends on numerous variables. A key variable is the streamflow. Streamflow values must be accurately forecasted because they strongly influence energy production. This paper suggests a fuzzy prediction model based on fuzzy c-means clustering to explore past data structure, and two procedures to capture similarities between streamflow history and data used for prediction. Experiments with actual data suggest that the predictive clustering approach performs better than periodic autoregressive moving average models, the current streamflow forecasting methodology worldwide, and a fuzzy neural network, a non-linear model.

W196 *Natural Partitioning-based Forecasting Model for Fuzzy Time-Series [#1406]*
Sheng-Tun Li and Yeh-Peng Chen, National Cheng Kung University, Taiwan; National Kaohiung First University of S. and T., Taiwan

Since the forecasting framework of fuzzy time-series introduced, there have been a variety of models developed to improve forecasting accuracy or reduce computation overhead. However, the issue of partitioning intervals has rarely been investigated. This paper presents a novel approach to handling the issue by applying the natural partitioning technique, which can recursively partition the universe of discourse level by level in a natural way. Experimental results on the enrollment data of the University of Alabama demonstrate that the resulting forecasting model can forecast the data effectively and efficiently and outperforms the existing models. Furthermore, the propose model can be extended to handle high-order fuzzy time series.

Plenary Poster Session: Fuzzy Information Retrieval

Wednesday, 28 July, 17.30–19.00, Room: P, Chair: B. Bouchon-Meunier

W197 *Fuzzy Histograms and Fuzzy Chi-Squared Tests for Independence [#1060]*

Thomas Runkler, Siemens AG Corporate Technology, Germany

Histograms and chi-squared tests for independence are well defined for discrete data. In order to apply these methods to continuous data, some kind of discretization is necessary. A standard way of discretizing data is to use equally spaced (crisp) intervals. In this paper, this crisp discretization is modified to a fuzzy discretization. With this fuzzy discretization, definitions of fuzzy histograms and fuzzy chi-squared tests for independence are achieved. Six experiments indicate that these fuzzy data analysis methods outperform their crisp relatives in terms of smoothness, robustness against outliers, sensitivity for the position of data clusters, and sensitivity for the number of discretization bins.

W198 *Image Retrieval using Fuzzy Similarity: Measure Equivalence based on Invariance in Ranking [#1221]*

Jean-Francois Omhover, Marcin Detyniecki, Maria Rifqi and Bernadette Bouchon-Meunier, LIP6 - Pole IA, France

In this paper, we first introduce the fuzzy similarity measures in the context of a CBIR system. This leads to the observation of an invariance in the ranking for different similarity measures. We then propose an explanation to this phenomenon, and a larger theory about order invariance for fuzzy similarity measures. We introduce a definition for equivalence classes based on order conservation between these measures. We then study the consequences of this theory on the evaluation of document retrieval by fuzzy similarity.

W199 *On Aggregation Operators of Transitive Similarity and Dissimilarity Relations [#1307]*

Jorge Orozco and Lluis Belanche, Technical University of Catalonia (UPC), Spain

Similarity and dissimilarity are widely used concepts. One of the most studied matters is their combination or aggregation. However, transitivity property is often ignored when aggregating despite of it is a highly important property. This is studied by many authors but from different points of view. We collect here the most recent results in preserving transitivity when aggregating, intending to clarify the relationship between aggregation and transitivity and make it useful to design aggregation operators that keep transitivity property. Some examples of the utility of this results are also shown.

W200 *Fuzzy Aggregation Operators in Region-Based Image Retrieval [#1320]*

Zoran Stejic, Yasufumi Takama and Kaoru Hirota, Tokyo Institute of Technology, Japan; Tokyo Metropolitan Institute of Technology, Japan

We examine the effect of the fuzzy aggregation operators on the image retrieval performance, by comparing 67 operators, applied to the problem of computing the image similarity, given a collection of feature similarities of the image regions. While majority of the existing image similarity models express the image similarity as an aggregation of feature similarities, no study presents a comparison of the different operators. We compare the 67 operators by: (1) incorporating each operator into a hierarchical, region-based similarity model; and (2) evaluating the obtained model(s) on 64,339 images. Results show that the retrieval performance strongly depends on the operator(s) incorporated in the similarity model.

W201 *Eigen Fuzzy Sets and Image Information Retrieval [#1346]*

Salvatore Sessa, Ferdinando Di martino and Hajime Nobuhara, Universita' di napoli federico II, Italy; Universita' di Napoli Federico II, Italy; Tokyo Institute of Technology, Japan

An image, by normalizing its pixel values, can be interpreted as a fuzzy relation. We use the greatest (resp. smallest) eigen fuzzy set, with respect to the max-min (resp., min-max) composition, of this fuzzy relation for resolution of problems of image information retrieval. The experiments are executed on some images extracted from "View Sphere Database". A similarity measure is introduced for comparison between the sample image and the retrieved image.

W202 *Induction of Fuzzy Decision Rules Based upon Rough Sets Theory [#1405]*

Grzegorz Drwal and Marek Sikora, Silesian Technical University, Gliwice, Poland

This paper presents system which tries to combine the advantages of rough sets methods and fuzzy sets methods to get better classification. The fuzzy sets theory supports approximate reasoning and the rough sets theory is responsible for data analyzing and process of automatic fuzzy rules generation. The system was designed as typical knowledge based system consisting of four main parts: rule extractor, knowledge base, inference engine and user interface and occurs to be useful tool in various decision problems and fuzzy control.

W203 *Fuzzy Relational Knowledge Representation and Context in the Service of Semantic Information Retrieval [#1409]*

Manolis Wallace and Yannis Avrithis, National Technical University of Athens, Greece

In this paper we follow a fuzzy relational approach to knowledge representation. With the use of semantic fuzzy relations we define and extract the semantic context out of a set of semantic entities. Based on this, we then proceed to the case of information retrieval and explain how the three participating contexts, namely the context of the query, the context of the document and the context of the user, can be estimated and utilized towards the achievement of more intuitive information services.

Plenary Poster Session: Fuzzy Computing with Words

Wednesday, 28 July, 17.30–19.00, Room: P, Chair: Jerry Mendel

W204 *A Case Study to Illustrate the Use of Non-Convex Membership Functions for Linguistic Terms [#1273]*

Jonathan Garibaldi, Salang Musikasuwan, Turhan Ozen and Robert John, University of Nottingham, United Kingdom; De Montfort University, United Kingdom

Terms used in fuzzy systems are almost invariably normalised, convex and distinct. This paper extends previous work in which it was suggested that non- convex membership functions might be considered for use in the context of modelling human decision making. The merits of nonconvex fuzzy sets are discussed and a case study is presented to investigate inferencing in a practical implementation. It is shown that it is indeed possible to build a fuzzy expert system featuring usual Mamdani style fuzzy inference in which a time-related non-convex fuzzy set is used together with 'traditional' fuzzy sets. An examination is made of the resultant output surface generated by four different subclasses of non-convex mfs.

W205 *A Soft Method for Analyzing Properties of Web Documents [#1378]*

Dániel Szegő, Budapest University of Technology and Economics, Hungary

During the last few years several different techniques for analyzing and transforming Web documents have been developed including document checking tools,

document querying and transformation frameworks or search engines. These techniques are usually based on different theoretical approaches, hence some of them are lack of simple formal semantics or fuzzy extension. This paper investigates the possibility of realizing Web document processing in the context of fuzzy description logics providing simple but powerful method for analyzing fuzzy properties of Web documents.

Plenary Poster Session: Fuzzy Pattern Recognition and Image Processing

Wednesday, 28 July, 17.30–19.00, Room: P, Chair: V. Kodogiannis

W206 *Robust C-Shells Based Deterministic Annealing Clustering Algorithm [#1006]*

Xulei Yang, Qing Song, Aize Cao, Sheng Liu and Chengyi Guo, Nanyang Technological University, Singapore

A new clustering method, robust c-shells based deterministic annealing (RCSDA) algorithm is developed. This development recasts the concept of fuzzy c-shells algorithm into the probability framework and offers several improved features over existing clustering algorithms. First, it is a global or close-to-global minimization algorithm through deterministic annealing rather. Second, it is more effective in boundary detection with compact or hollow spherical shells. Finally, the basic idea of Dave's "noise clustering" is introduced into the algorithm which makes it robust against noise. The superiority of the proposed clustering method is supported by experimental results.

W207 *Comparison of two different dimension reduction methods in classification by arithmetic, geometric and harmonic similarity measure [#1094]*

Pasi Luukka and Aurel Meyer, Lappeenranta University of Technology, Finland

In this paper we have investigated effects of different dimension reduction methods to fuzzy similarity based classifier. We are going to show that dimension reduction plays especially important role with geometric and harmonic similarity based classification. Also we are going to show that arithmetic case is not so dependent on dimension reduction but very similar results can be achieved with full dimension instead of optimal dimension.

W208 *Computer-aided Diagnosis in Clinical Endoscopy using Neuro-Fuzzy Systems [#1187]*

Vassilis Kodogiannis, Univ. of Westminster, United Kingdom

In this paper, an innovative detection system to support medical diagnosis and detection of abnormal lesions by processing endoscopic images is presented. The images used in this study have been obtained using the new M2A Swallowable Capsule, a patented, video colour-imaging disposable capsule. The implementation of an advanced fuzzy inference neural network which combines fuzzy systems and artificial neural networks and the concept of fusion of multiple classifiers dedicated to specific feature parameters have been also adopted in this paper. The detection accuracy of the proposed system has reached to maximum, providing thus an indication that such intelligent schemes could be used as a supplementary diagnostic tool in endoscopy.

W209 *Fuzzy Enhancement Method Using Logarithmic Models [#1247]*

Vasile Pătraşcu, Politehnica University of Bucharest, Romania

Efficient enhancement methods can be obtained using affine transforms within logarithmic models. In this paper is defined a 3-parameter affine transforms, which allow a separated modification of luminosity and saturation. Better results can be obtained if fuzzy partitions are defined on the image support and then the pixels are separately processed in each window. Thus in each window there is defined an affine transform using luminosity mean, luminosity variance and saturation. The final image is obtained by replacing the affine transform parameters with fuzzy surfaces.

Plenary Poster Session: Robotics

Wednesday, 28 July, 17.30–19.00, Room: P, Chair: Dongbing Gu

W210 *Trajectory Tracking of Robot Using a Fuzzy Decentralized Sliding-Mode Tracking Control [#1087]*

Chih-Lyang Hwang and Hung-Yueh Lin, Dept. of Mechanical Engineering, Tatung Universi, Taiwan

A proportional control is first applied to improve the dynamics of robotic system. It is called "improved robotic system (IRS)", containing N subsystems. Each subsystem is approximated by the weighted combination of L linear pulse transfer function systems (LPTFSs). For every nominal LPTFS of the ith subsystem, a dead-beat to its sliding surface is designed. The H-infinity norm of the weighted sensitivity function between the mth sliding surface and the output disturbance is minimized. A suitable selection of the weighted function can enhance the system robustness. A better performance is obtained by a fuzzy switching control. Finally, the experiments of the IRS on the horizontal plane with (or without) payload are given.

W211 *Car Navigation and Collision Avoidance System with Fuzzy Logic [#1100]*

Andri Riid, Dmitri Pahhomov and Ennu Rustern, Tallinn Technical University, Estonia

A navigation control and collision avoidance system for delivering a car to the arbitrarily positioned loading dock is designed, based on the fuzzy trajectory mapping unit (TMU). Simulated driving experiments in different environmental conditions demonstrate that the designed system shows good performance. Modular structure of the control system facilitates both efficient control knowledge acquisition (which is encapsulated in TMU) as well as further development of the control system to accomplish more demanding tasks.

W212 *Adaptive Control Of Robot Manipulators Using Fuzzy Logic Systems Under Actuator Constraints [#1104]*

Shubhi Purwar, Inder Narayan Kar and Amar Nath Jha, Indian Institute Of Technology, Delhi, India

In this paper, the stable adaptive fuzzy controller for trajectory tracking is developed for robot manipulators without velocity measurements, taking into account the actuator constraints. The gravity torque which may include payload variation etc. represents system uncertainty, which is estimated by a fuzzy logic system (FLS). The adaptive controller represents an amalgamation of a filtering technique to eliminate velocity measurements and the theory of function approximation using FLS to estimate the gravity torque. The proposed controller ensures the local asymptotic stability and the convergence of the position error to zero. The validity of the control scheme is shown by simulations of a two link robot manipulator.

W213 *Accuracy based Fuzzy Q-Learning for Robot Behaviours [#1126]*

Dongbing g and Huosheng Hu, University of Essex, United Kingdom

This paper presents a learning approach to fuzzy classifier systems. Q- learning algorithm is employed to implement credit assignment of the learning. GA operators are used as an action selection mechanism of the learning. The learning approaches can be viewed as a fuzzy learning classifier system or a Q- learning algorithm that adopts fuzzy logic to generalise Q-learning results. Rule accuracies are treated as rule fitness values. The learning algorithm is applied to a control robot behaviour.

W214 *Feature Based Robot Navigation: Using Fuzzy Logic and Interval Analysis [#1302]*
Immanuel Ashokaraj, Antonios Tsourdos, Peter Silson, Brian White and John Economou, Cranfield University, Shrivenham, United Kingdom; Cranfield University, Shrivenham, United Arab Emirates

This paper describes a new approach for mobile robot navigation using Interval Analysis (IA) and fuzzy logic. Here we propose a new approach using IA with multiple sets of measurements. IA has been already successfully applied in the past for robot localisation. But the results obtained may be conservative. Therefore this approach is extended using multiple sets of ultrasonic measurements, which will result in estimation of multiple interval robot positions. These multiple interval robot positions are fused using fuzzy logic to give a less conservative interval robot position estimate. This problem is overcome here using additional sensors, which gives an estimate of the robot position using fuzzy logic in the absence of land marks.

Thursday, 29 July, 9.00–9.50

Plenary Talk: Taxonomy-based Soft Similarity Measures

Thursday, 29 July, 9.00–9.50, Room: C, Chair: Janusz Kacprzyk, Authors: James Keller, Mihail Popescu and Joyce Mitchell,, University of Missouri-Columbia, United States

One of the most important objects in bioinformatics is a gene product (a protein or an RNA). Besides the gene sequence and expression values found following a microarray experiment, for many gene products, additional functional information comes from the set of Gene Ontology (GO) annotations and the set of journal abstracts related to the gene product. For these genes, it is reasonable to include similarity measures based on the terms found in the GO and/or the index term sets of the related documents (MeSH annotations). In this paper we propose a fuzzy measure-based similarity (FMS) for computing the similarity of two gene products annotated with terms from an ontology. The advantage of FMS is that it takes into consideration the context of the whole set when computing the similarity

Thursday, 29 July, 10.10–12.10

Fuzzy Control and Robotics 1

Thursday, 29 July, 10.10–12.10, Room: I, Chair: L. Wang

10.10 *Fuzzy Controller Design for Discrete Time-Delay Affine Takagi-Sugeno Fuzzy Systems [#1015]*
Wen-Jer Chang and Wei Chang, National Taiwan Ocean University, Taiwan

In this paper, a Parallel Distributive Compensation (PDC) based fuzzy controller design issue to discrete time-delay affine Takagi-Sugeno (T-S) fuzzy systems is considered. It is noted that the discrete time-delay affine T- S fuzzy systems stabilization matrix inequalities belong to a class of Bilinear Matrix Inequalities (BMI) and cannot be solved by a convex optimization algorithm. Due to this reason, an Iterative Linear Matrix Inequality (ILMI) algorithm is used to represent the BMI problem into a Linear Matrix Inequality (LMI) problem and to obtain the feasible solution for the synthesis of the discrete time-delay affine T-S fuzzy systems.

10.34 *Fuzzy Stability Supervision of Robot Grippers [#1122]*
Ralf Mikut, Arne Lehmann and Georg Bretthauer, Forschungszentrum Karlsruhe GmbH, Germany

Due to the complexity of many nonlinear control systems an off-line stability analysis might be extremely difficult. Hence this article presents an on-line fuzzy-based stability supervision system. This system is able to detect and evaluate occurring safety and stability problems. Therefore the supervisor classifies on-line the stability by means of a fuzzy degree of stability between zero and one. The functionality of the supervision system is shown by simulated grasp studies with the elastic robot gripper of the Research Center Karlsruhe.

10.58 *A Design for a Class of Fuzzy Control Systems with State Observer [#1161]*
Hugang Han, Hiroshima Prefectural University, Japan

This paper addresses the fuzzy control problem using the Lyapunov synthesis approach. With the proposed state observer, the whole system behavior can be attributed to a kind of the standard singularly perturbed form. At the same time, to deal with the gap, if any, between the real state and its estimated value, we view it as a part of system disturbance, and propose a unique way to treat the disturbance, i.e., adopt a switching function with an alterable coefficient, which is tuned by adaptive law based on the tracking error between the system output and the desired value. Finally, it is shown that the fuzzy controller proposed guarantees the tracking error to be shrunken to zero, while maintaining all signals involved in the system stable.

11.22 *Fuzzy Logic Based Nonlinear Kalman Filter Applied to Mobile Robots Modelling [#1033]*
Rodrigo Carrasco and Aldo Cipriano, Pontificia Universidad Catolica de Chile, Chile

In order to reduce false alarms in fault detection systems in mobile robots, accurate estimation is needed. Through this work, a new method for accurate localization is presented. First, a fuzzy model of a mobile robot is determined, which is then optimized using genetic algorithms. Then, a Takagi - Sugeno fuzzy structure is used to design a new extension of the Kalman filter, based on several linear Kalman filters. Finally, the fuzzy extension is compared to the conventional extended Kalman filter, showing an improvement over the estimation made. The fuzzy extension also presents advantages in implementation, due to the fact that the covariance matrices needed are easier to estimate, increasing the estimation frequency.

11.46 *Genomic Systems Design: A Novel, Biologically-based Framework for Enhancing the Adaptive, Autonomous Capabilities of Computer Systems [#1246]*
William Combs, Jeffrey Weinschenk and Robert Marks, The Boeing Company, United States; University of Washington, United States; Baylor University, United States

Genomic Systems Design (GSD) is an outgrowth of the Union Rule Configuration (URC), a propositional logic construct that eliminates the combinatorial problem for rule-based systems. GSD is similar in architecture to a biological process called symbiogenesis. This biological process is said to facilitate the evolution of new species through the inheritance of genomes from organisms that are participating in symbiotic relationships. This similarity, together with the characteristics of the URC, enables Genomic Systems Design to offer a promising alternative methodology for the design of autonomous agents/robots, fault-tolerant and adaptive control systems, cellular automata and bioinformatics.

Advanced Algorithms in Fuzzy Clustering (Invited) + Information Systems

Thursday, 29 July, 10.10–12.10, Room: H, Chair: Y. Endo

10.10 *LVQ Clustering and SOM Using a Kernel Function [#1077]*

Ryo Inokuchi and Sadaaki Miyamoto, University of Tsukuba, Ibaraki 305-8573, Japan, Japan

This paper aims at discussing clustering algorithm based on Learning Vector Quantization (LVQ) using a kernel function in support vector machines. Furthermore, Self-Organizing Map (SOM) using a kernel function is considered. Examples of clustering using different techniques are shown and effects of the kernel function is discussed.

10.30 *On Parameter Setting in Applying Dave's Noise Fuzzy Clustering to Gaussian Mixture Models [#1090]*

Hidetomo Ichihashi and Katsuhiro Honda, Osaka Prefecture University, Japan

When applying the robust fuzzy clustering approach by Dave to the GMM, careful parameter setting is required. From the consideration of the Gustafson and Kessel's constraint we propose a way of defining a parameter in a fuzzy counterpart of the GMM. Numerical examples show that the Dave's noise clustering approach is quite robust for detecting linear clusters from heavily noisy data sets. This approach is further applied to a relational version in which clusters are formed using the matrix R of relational data corresponding to pairwise distances between objects.

10.50 *Detection of Local Linear Structure from Data with Uncertainties [#1093]*

Katsuhiro Honda and Hidetomo Ichihashi, Osaka Prefecture University, Japan

Fuzzy c-Lines (FCL) is a technique for detecting local linear structure and is a modified version of Fuzzy c-Means (FCM), in which prototypes are replaced with lines. In this paper, we consider the linear fuzzy clustering of data with uncertainties based on intervals, and propose a new clustering algorithm that can handle component-wise uncertainties. The clustering criterion is defined by considering two different metrics, Minimum Distance and Maximum Distance, and the optimal prototypes are estimated by using a linear search algorithm. Numerical example shows that the result of the proposed method provides a tool for interpretation of local features of the data with uncertainties.

11.10 *On Some Hierarchical Clustering Algorithms Using Kernel Functions [#1106]*

Yasunori Endo, Hideyuki Haruyama and Takayoshi Okubo, University of Tsukuba, Japan

Recently, kernel functions are remarked in the field of clustering or pattern recognition. Using the functions, good results of clustering can be obtained for data with hard nonlinear distribution. But there is the problem that the calculation cost increases using the kernel functions. In this paper, new hierarchical clustering algorithms using kernel functions are proposed. Moreover, the availability of proposed algorithms is discussed through some numerical examples. The proposed methods do not include the kernel functions positively so that the methods can be introduced into the existing resources easily.

11.30 *An Adaptive Bidding Agent for Multiple English Auctions: A Neuro-Fuzzy Approach [#1289]*

Minghua He, Nicholas Jennings and Adam Prugel-Bennett, The University of Southampton, United Kingdom

This paper presents the design, implementation and evaluation of a novel bidding strategy for obtaining goods in multiple overlapping English auctions. The strategy uses fuzzy sets to express trade-offs between multi-attribute goods and exploits neuro-fuzzy techniques to predict the expected closing prices of the auctions and to adapt the agent's bidding strategy to reflect the type of environment in which it is situated. We show, through empirical evaluation against a number of methods proposed in the multiple auction literature, that our strategy performs effectively and robustly in a wide range of scenarios.

11.50 *Construction of Pedestrian Navigation System and Its Evaluation [#1392]*

Yuta Akasaka and Takehisa Onisawa, University of Tsukuba, Japan

This paper mentions the construction of the pedestrian navigation system which deals with subjective information. This system consists of the route setting part and the instruction generation part. The route setting part chooses the route with highest subjective satisfaction degree which are obtained by fuzzy measures and integrals. The instruction generation part gives users the instructions with linguistic terms which have the highest fitness value for the users' sensuous feeling of distance. The instruction generation part has database of users' cognitive distance which is expressed by a fuzzy set. This paper also evaluates the present system by the subjective experiments and the analysis of fuzzy measures.

Fuzzy Logic and Mathematics

Thursday, 29 July, 10.10–12.10, Room: E, Chair: R. Mesiar

10.10 *Towards argumentation-based decision making: A possibilistic logic approach [#1348]*

Leila Amgoud and Henri Prade, Institut de Recherche en Informatique de Toulous, France

Argumentation-based decision provides a way for explaining choices which are already made, and for evaluating potential choices in terms of arguments. Each potential choice has arguments of various strengths. Depending on the pessimistic, or optimistic nature of the decision-maker's attitude, arguments in favour of or against a possible choice have slightly different structures. When the available, maybe uncertain, knowledge is consistent, as well as the set of prioritized goals the method for evaluating decisions on the basis of arguments agrees with the possibility theory-based approach to decision-making under uncertainty. The proposed framework can be generalized in case of partially inconsistent knowledge or goals.

10.27 *A Comparison of Three Methods for Computing the Center of Gravity Defuzzification [#1144]*

Ester Van Broekhoven and Bernard De Baets, Ghent University, Belgium

In this article three methods are presented to perform the center of gravity defuzzification method: one well-known method, the discretisation method, and two new methods, the slope-based method and the modified transformation function method. The methods are worked out for trapezoidal membership functions forming a fuzzy (Ruspini) partition. Experimental results show that the newly introduced methods exhibit excellent accuracy at an extremely low computational cost compared to the widely applied discretisation method.

10.44 *Application of Interpolation-based Fuzzy Logic Reasoning in Behaviour-based Control Structures [#1388]*
Szilveszter Kovács and László T. Kóczy, University of Miskolc, Hungary; Technical University of Budapest, Hungary

Some difficulties of constructing the fuzzy behaviour-based control structures are inherited from the type of the applied fuzzy reasoning. The fuzzy rulebase requested for many reasoning methods needed to be complete. In case of fetching fuzzy rules directly from expert knowledge e.g. for the behaviour coordination module, the way of building complete rulebase is not always straightforward. One simple solution for overcoming these difficulties is the application of interpolation-based fuzzy reasoning methods, where the rulebase is not required to be complete. For demonstrating the applicability of the proposed structure, an interpolation- based fuzzy reasoning method and its adaptation for behaviour-based control is briefly introduced.

11.01 *Efficient fuzzy arithmetic for nonlinear functions of modest dimension using sparse grids [#1217]*
Andreas Klimke and Barbara Wohlmuth, University of Stuttgart, Germany

Fuzzy arithmetic provides a powerful tool to introduce uncertainty into mathematical models with Zadeh's extension principle. We consider expensive multivariate objective functions of modest dimension (say d up to 16). This often poses a difficult problem due to non-applicability of common fuzzy arithmetic algorithms, severe overestimation, or very high computational complexity. Our approach is composed of two parts: First, we compute a surrogate function using sparse grid interpolation. Second, we perform the fuzzy-valued evaluation of the surrogate function by a suitable implementation of the extension principle based on real or interval arithmetic. The new approach gives accurate results and requires only few function evaluations.

11.18 *Fuzzy Relational Equations in Monoidal Logics [#1328]*
Ladislav Kohout, Dept. of Comp. Sci., Florida State University., United States

In this paper we present a general framework for solving fuzzy relational quations in monoidal logics. This framework yields the general solution equations for relational systems based on large family of many-valued logics. The proofs use as a tool certaing relational inequalities that we call BK-Residuated Bootstrap. In computer science, fuzzy relational equations in monoidal logics have applications in specificaton of computing systems by means of their behavioral characteristics as well as in computing with words.

11.35 *Computationally Efficient Incremental Transitive Closure of Sparse Fuzzy Binary Relations [#1148]*
Manolis Wallace and Stefanos Kollias, National Technical University of Athens, Greece

Existing literature in the field of transitive relations focuses mainly on dense, Boolean, undirected relations. With the emergence of a new area of intelligent retrieval, where sparse transitive fuzzy ordering relations are utilized, existing theory and methodologies need to be extended, as to cover the new needs. This paper discusses the incremental update of such fuzzy binary relations, while focusing on both storage and computational complexity issues. Moreover, it proposes a novel transitive closure algorithm that has a remarkably low computational complexity (below O(n^2)) for the average sparse relation; such are the relations encountered in intelligent retrieval.

11.52 *Indistinguishability Operators generated by fuzzy Numbers [#1055]*
Joan Jacas and Jordi Recasens, Technical University of Catalonia (UPC), Spain

In this paper, we give a new way to generate indistinguishability operators from fuzzy numbers that are compatible with the underlying ordering structure of the real line. This compatibility is understood in the sense that this structure should be compatible with the fuzzy betweenness relation generated by the relation. It is shown that, in the case of trapezoidal fuzzy numbers, the relations generated using the Lukasievicz t-norm have dimension 2

Philosophy of Soft Computing (Invited)

Thursday, 29 July, 10.10–12.10, Room: D, Chair: V. Niskanen

10.10 *Ontological Grounding of Fuzzy Theory [#1233]*
I. Burhan Turksen, University of Toronto, Canada

A schema for the investigation of the philosophical grounding of fuzzy theory is proposed. In particular, the ontological grounding is investigated. It is shown that certain equivalences that exists in classical theory break down in fuzzy theory. In turn, this leads to the generation of new formulas and the laws of conservation fuzzy theory.

10.27 *Scientific Outlook from Soft-Computing Standpoint [#1288]*
Vesa Niskanen, Univ. of Helsinki, Finland

Scientific Outlook from Soft-Computing Standpoint. If we consider philosophical aspects of Soft Com-puting (SC), we first have to know the prevailing outlooks and other underlying views that influence on our methods and research areas. On the other hand, if we consider our scientific outlook, we must take into account the philosophical ideas provided in SC. Below we mainly consider the latter ap-proach.

10.44 *DNA Computing Approach to Optimal Decision Problems [#1414]*
Junzo Watada, Satoshi Kojima, Satomi Ueda and Osamu Ono, Waseda University, Japan; Meiji University, Japan

Recently, artificial intelligence is employed to controlling elevators. On the other hand, we encounter such inefficient situations that all elevators are moving in the same direction even in rush hours of the morning or that all elevators come to the same floor. In order to resolve such situations all elevators should be controlled to assign the best elevator to passengers according time to time change of passengers. The group control system is employed in selection of driving patterns according to the change of traffic volumes or driving management in accidents. Such a group control realizes comfortable, safe and economical management of elevators.

11.01 *On Aristotelian Tradition and Fuzzy Revolution [#1422]*
Jorma Mattila, Lappeenranta University of Technology, Finland

Aristotelian tradition of science and Aristotelian attitude to world are considered. Some considerations of the relationship between Aristotelian tradition and modal-based logics and between that and many-valued logics are done. Prof. Zadeh's early fuzzy set theory is presented as a special quasi- Boolean algebra. It is shown by examples that Aristotelian tradition of science remains as a part of new tradition of science, and Aristotelian attitude to world is ruined.

11.18 *40 years ago: "Fuzzy Sets" is going to be published [#1260]*
Rudolf Seising, Medical University of Vienna, Austria

In this paper the reader will find original research work on the rise of the theory of fuzzy sets. It is a reconstruction of Lotfi Zadeh's contributions to system theory which was a very new scientific discipline at that time. Some details on the historical background of the development of the theory of fuzzy sets are given. A result of this contribution in the history of sciences is: The genesis of the concepts of fuzzy sets and fuzzy systems is a part of system theory in the 1960s.

11.35 *Spatial Knowledge Creation In A Circular World - Perspectives On Logical And Visual Communication In A Social Space [#1421]*
Susanne Kratochwil and Josef Benedikt, Vienna University of Technology, Austria; GEOLOGIC Dr. Benedikt, Austria

Space communication bridges the gap between planning issues and social studies. Linguistic and visual uncertainties are crucial in communicating knowledge

successfully among all actors involved. The paper discusses extensions on foundations and future steps in enhancing mapping technologies.

11.52 *A Philosophical Study on Meaning and Fuzzy Sets [#1427]*

Tero Joronen, Metso Automation, Finland

This article reaches the meaning of fuzzy sets from a new philosophical point of view. The topic arises from authors practical control cases in which a simultaneous handling for fuzziness and uncertainty is need. The fuzzy sets are approached from semantics, the meaning of language. The fuzzy sets are handled philosophically as textual expressions more than data extractions. First, the problem of the meaning of a word is studied from several philosophical point of views. The meaning is concluded to be incommensurable. The meaning articulation paradigm, conducted from philosophies of Wittgenstein and Bergson in a previous study is applied to illustrate the semantics of fuzzy sets...

Thursday, 29 July, 14.00–16.00

Fuzzy Control and Robotics 2

Thursday, 29 July, 14.00–16.00, Room: E, Chair: M. Sugeno

14.00 *Stabilization of Nonlinear Systems based on Piecewise Lyapunov Functions [#1169]*

Tadanari Taniguchi and Michio Sugeno, Riken, Japan

This paper presents a stabilization algorithm for piecewise approximated nonlinear systems based on piecewise Lyapunov functions. The stabilizing conditions are expressed in terms of bilinear matrix inequalities (BMIs). A large scale BMI problem is decomposed in regional BMI problems. Connecting regional solutions of BMIs, we propose a design algorithm for a semi-global stabilizing controller. Some illustrated examples are given to show the validity of the proposed method.

14.20 *Output Regulation Control via Fuzzy Operational Point Reference Approach [#1201]*

Chian-Song Chiu, Tung-Sheng Chiang and Peter Liu, Chien-Kuo Institute of Technology, Taiwan; Ching-Yun University, Taiwan; BENQ Corporation, Taiwan

This study introduces an output regulation design methodology for a class of nonlinear systems with a constant or dynamical biasing terms. First, the T-S fuzzy model is employed to represent biasing nonlinear systems about the operational point, which has the desired concerned output. Then the control objective is transformed to stabilizing the new expressed fuzzy system. Next, based on the fuzzy representation, an output regulation controller is derived to achieve H-inf regulating performance. This design is parameterized in terms of a linear matrix inequality problem (LMIP). Numerical simulation examples are given to verify the control performance of the proposed methods.

14.40 *Internet-Based Remote Stabilization for Nonlinear Systems [#1211]*

Kazuo Tanaka, Hiroshi Ohtake and Hua Wang, The University of Electro-Communications, Japan; Boston University, United States

This paper presents internet-based remote stabilization for nonlinear systems. In internet-based remote control, we need to deal with time varying delays. First, a class of nonlinear time varying delay systems is represented as the Takagi-Sugeno fuzzy model. A model-based fuzzy stabilization design utilizing the parallel distributed compensation is employed. A design condition is derived by considering time delay dependent conditions for ensuring the stability of closed-loop systems. In addition, the maximum time-delay for ensuring the stability of internet-based remote control system can be obtained from the derived design condition. Simulation results show the utility of this proposed design approach.

15.00 *Fuzzy Reference Gain-Scheduling Approach as Intelligent Agents: FRGS Agent [#1220]*

Jose Ernesto Araujo, Karl Heinz Kienitz, Sandra A. Sandri and Jose Demisio S. da Silva, INPE - Instituto Nacional de Pesquisas Espaciais, Brazil; ITA - Instituto Tecnologico de Aeronautica, Brazil

An adaptive and goal-driven agent based on fuzzy reference gain-scheduling (FRGS) approach is presented in this paper. The FRGS approach may be viewed as an autonomous goal-based agent, that is, a fuzzy logic based agent able to autonomously adapt itself to environmental changes introduced by external inputs. The concept of fuzzy systems and intelligent agent are employed in decision-making problems to lead to a certain degree of autonomy in decision support system. This new agent approach uses the external input also denominated reference (goal) as the driven mechanism to determine the behavior of the system. Thus, the FRGS approach can be modeled in the framework of an adaptive and goal (also context or environment) driven agent.

15.20 *Fuzzy Control for Fuzzy Interval Systems. Part I: Solving First Order Fuzzy Equations [#1301]*

Reda Boukezzoula, Laurent Foulloy and Sylvie Galichet, Listic - University of Savoie, France

This two part paper proposes a methodology of designing and analyzing an inverse controller for stable fuzzy interval linear systems according to fuzzy interval arithmetic. The first part aims at revisiting the solving of first order fuzzy linear equations. The general solution is expressed in a compact form which is directly used for deriving the condition of the solution existence. The suggested method is inspired from the a-cut principle where the fuzzy interval arithmetic is defined in terms of well-established interval arithmetic operations on closed intervals of real numbers. The so-built solution will be useful for the inverse controller synthesis dealt with in part II of this paper.

15.40 *Obtaining a Fuzzy Controller with High Interpretability in Mobile Robots Navigation [#1313]*

Manuel Mucientes and Jorge Casillas, University of Santiago de Compostela, Spain; University of Granada, Spain

The paper presents the design of a fuzzy controller for the wall-following behavior in mobile robotics using the COR (Cooperative Rules) methodology with Ant Colony Optimization. The system has been tested in several simulated environments using the Nomad 200 robot software, and compared with other controller based on genetic algorithms. The proposed approach obtains a highly interpretable knowledge base in a reduced time, and the designer only has to define the number of membership functions and the universe of discourse of each variable.

Fuzzy Modeling (Invited)

Thursday, 29 July, 14.00–16.00, Room: F, Chair: L. T. Kóczy & J. Botzheim

14.00 *Two Step Feature Selection: Approximate Functional Dependency Approach Using Membership Values [#1024]*

Ozge Uncu and I. Burhan Turksen, Middle East Technical University, Turkey; University of Toronto, Canada

Feature selection is one of the most important issues in fields such as system modelling. In this study, a new feature selection algorithm that combines feature wrapper and filter approaches is proposed in order to identify the significant input variables in systems with continuous domains. The proposed method utilizes functional dependency concept and K-Nearest Neighbourhood method to implement the feature filter and feature wrapper, respectively. It is common to have outliers and noise in real-life data. In order to make the proposed feature selection algorithm noise and outlier resistant, approximate functional dependencies are used by utilizing membership values that inherently cope with uncertainty in the data.

14.20 *Construction of Fuzzy Signature from Data: An Example of SARS Pre-clinical Diagnosis System [#1353]*
Kok Wai Wong, Tamás D. Gedeon and László T. Kóczy, Nanyang Technological University, Singapore; Australian National University, Australia; Budapest University of Technology and Economics, Hungary

There are many areas where objects with very complex and sometimes interdependent features are to be classified; similarities and dissimilarities are to be evaluated. This makes a complex decision model difficult to construct effectively. Fuzzy signatures are introduced to handle complex structured data and interdependent feature problems. Fuzzy signatures can also used in cases where data is missing. This paper presents the concept of a fuzzy signature and how its flexibility can be used to quickly construct a medical pre-clinical diagnosis system. A Severe Acute Respiratory Syndrome (SARS) pre-clinical diagnosis system using fuzzy signatures is constructed as an example to show many advantages of the fuzzy signature.

14.40 *Regularized Numerical Optimization of Fuzzy Rule Bases [#1384]*
Johannes Himmelbauer and Mario Drobics, Software Competence Center Hagenberg, Austria

This paper is devoted to the mathematical analysis and the numerical solution of data-driven optimization for Sugeno controllers using a linear approximation of the output variable according to the input data. This results in a free, linear least squares system to be solved. Therefore this approach can be used for high dimensional problems as well, when due to the increasing complexity nonlinear systems are no longer applicable. By applying Tikhonov regularization we get stable and fast algorithms that create sufficiently optimized controllers; with saving their interpretability. Finally we will show, how variable selection can be used to increase interpretability and to reduce computation time.

15.00 *3D Model Estimation from Multiple Images [#1415]*
András Rövid, Annamária R. Várkonyi-Kóczy and Péter Várlaki, Budapest University of Technology and Economics, Hungary; Széchenyi István University, Hungary

3D reconstruction plays a very important role in computer vision. The determination of the 3D model from multiple images is of key importance. In this paper a 3D reconstruction algorithm is introduced, which uses as input images taken from different camera positions. The method applies fuzzy filtering, fuzzy edge detection and a new method based on the results of epipolar geometry. With the help of this technique 3D models can be produced without any external (human) intervention, thus it can be advantageous in many 3D applications and in computer vision.

15.20 *Estimating fuzzy membership functions parameters by the Levenberg-Marquardt algorithm [#1383]*
János Botzheim, Cristiano Cabrita, László T. Kóczy and Antonio Ruano, Budapest University of Technology and Economics, Hungary; University of Algarve, Portugal

In our previous papers fuzzy model identification methods were discussed. The bacterial algorithm for extracting fuzzy rule base from a training set was presented. The Levenberg-Marquardt algorithm was also prented for determining membership functions in fuzzy systems. In this paper the Levenberg-Marquardt technique is improved to optimise the membership functions in the fuzzy rules without Ruspini-partition. The class of membership functions investigated is the trapezoidal one as it is general enough and widely used. The method can be easily extended to arbitrary piecewise linear function as well.

15.40 *A New Cluster Validity Criterion for Fuzzy C-Regression Model and Its Application to T-S Fuzzy Model Identification [#1190]*
Chung-Chun Kung and Chih-Chien Lin, Department of E. E., Tatung University, Taiwan

This paper proposes a new cluster validity criterion designed for the fuzzy c-regression model (FCRM) clustering algorithm. The proposed cluster validity criterion is utilized to determine the appropriate number of clusters in the FCRM. A systematic procedure for the T-S fuzzy model identification is proposed based on the FCRM accompanied with the new cluster validity criterion. Simulation results show that for a given nonlinear system, the proposed algorithm can effectively and accurately obtain a T-S fuzzy model for it.

Database Mining and Decision Making

Thursday, 29 July, 14.00–16.00, Room: H, Chair: Quiang Shen

14.00 *Modifying Weighted Fuzzy Subsethood-based Rule Models with Fuzzy Quantifiers [#1132]*
Khairul Rasmani and Qiang Shen, University of Edinburgh, United Kingdom

This paper proposes an application of fuzzy quantification to replace crisp weights in subsethood-based fuzzy rule models. In addition to the concern that fuzzy models should have high accuracy rate, attention has also been taken to maintain the simplicity of the generated fuzzy model. The classification accuracies of fuzzy models that use crisp weights, multi-valued quantifiers and continuous quantifiers are compared. Experimental results show that the classification accuracy of the fuzzy model that uses continuous quantifiers is: 1) as good as the classification accuracy of the fuzzy models that use crisp weights, and 2) in most cases, better than fuzzy models that use multi-valued quantifiers.

14.20 *Clustering-based Identification of TS-models: Comparison on a Groundwater Model Case Study [#1150]*
Hilde Vernieuwe, Bernard De Baets and Niko Verhoest, Ghent University, Belgium

In this paper, we apply different clustering algorithms for the identification of Takagi--Sugeno models. All of the fuzzy c-means, Gustafson--Kessel, simplified Gustafson--Kessel, Gath and Geva, simplified Gath and Geva, and modified Gath and Geva clustering algorithms try to minimize the same objective function. First, an algorithm for determining the optimal number of clusters is presented. The Takagi--Sugeno models with the optimal number of clusters are then incorporated into a groundwater model, and compared with measurements of the EMSL experiment and the results of a numerical groundwater model.

14.40 *Fuzzy Rules from Ant-Inspired Computation [#1153]*
Michelle Galea and Qiang Shen, University of Edinburgh, United Kingdom

A new approach to fuzzy rule induction from historical data is presented. The implemented system - FRANTIC - is tested on a simple classification problem against a fuzzy tree induction algorithm, a genetic algorithm, and a numerical method for inducing fuzzy rules based on fuzzy subsethood values. The results obtained by FRANTIC indicate comparable or better classification accuracy, superior comprehensibility, and potentially more flexibility when applied to larger data sets. The impact of the knowledge representation used when generating fuzzy rules is also highlighted.

15.00 *Active Fuzzy Clustering for Collaborative Filtering [#1359]*
Narayan Srinivasa and Swarup Medasani, HRL Laboratories, LLC, United States

In this paper, we present a fuzzy clustering approach to collaborative filtering. Our approach allows for users to be clustered into multiple user groups. Furthermore, our approach is active in that it can rapidly adapt to both short and long term user interest changes.. Our approach is capable of on- line collaborative filtering with simultaneous clustering at the document content level, user group level as well as document clustering based on similarity of user interests. We demonstrate the various features of the approach using an example.

15.20 *Identification of Recurrent Fuzzy Systems with Genetic Algorithms [#1376]*
Alexandre G. Evsukoff and Nelson F. F. Ebecken, COPPE/Federal University of Rio de Janeiro, Brazil

This work presents an algorithm for identification of fuzzy recurrent models of non-linear dynamic systems. The identification algorithm is based on a general purpose genetic algorithm. The resulting recurrent fuzzy system is encoding into a fuzzy finite state automaton in which the linguistic terms of the fuzzy model are the states and rule base weights are transition possibilities. The identification algorithm is tested against benchmark identification problems found in literature.

15.40 *A Fuzzy Multiple Criteria Decision Making Model for Software Selection [#1272]*
Hsuan-Shih Lee, Pei-Di Shen and Wen-Li Chih, National Taiwan Ocean University, Taiwan; Ming Chuan University, Taiwan

Inspired by SWOT which is a method for strategic analysis, we propose a new FMCDM for software selection. In our method, two matrices are constructed to represent the strength and weakness of alternatives. With our method, we provide decision makers more information than just single index to make more sophisticated decision.

Clustering and Image Processing 2

Thursday, 29 July, 14.00–16.00, Room: D, Chair: D. Dubois

14.00 *Generation of Various Eigen Fuzzy Sets by Permutation Fuzzy Matrix and its Application to Image Analysis [#1270]*
Hajime Nobuhara, Kaoru Hirota and Barnabás Bede, Tokyo Institute of Technology, Japan; University of Oradea, Romania

In order to generate various eigen fuzzy sets with respect to the original image, an algorithm based on a permutation fuzzy matrix is proposed. The proposed algorithm is based on a rotation of the original fuzzy relation by using permutation fuzzy matrix and the periodicity of the permutation matrix is studied in the setting of fuzzy relational calculus. Through the experiment using image extracted from 'View Shpere Database', the properties of various eigen fuzzy sets obtained by the proposed algorithm is shown.

14.20 *Fuzzy Hamming Distance in a Content-Based Image Retrieval System [#1319]*
Mircea Ionescu and Anca Ralescu, University of Cincinnati, United States

The performance of Content-Based Image Retrieval (CBIR) systems is mainly depending on the image similarity measure it use. The Fuzzy Hamming Distance (FHD) is an extension of Hamming Distance for real-valued vectors. Because the feature space of each image is real-valued the Fuzzy Hamming Distance can be successfully used as image similarity measure. The current study reports on the results of applying FHD as a similarity measure between the color histograms of two images. The Fuzzy Hamming Distance is suitable for this application because it can take into account not only the number of different colors but also the magnitude of this difference.

14.40 *A Fuzzy Classifier for Imbalanced and Noisy Data [#1411]*
Sofia Visa and Anca Ralescu, University of Cincinnati, United States

This paper addresses learning of imbalanced and noisy classes. It assumes that recognition of the smaller class is more important than that of the larger class. A fuzzy classifier capable to achieve this is studied here. Underlying this classifier is the relation between fuzzy sets and probability distributions as mediated by the theory of mass assignment. Two approaches to construct fuzzy sets - basic and modified - using the lpd and mpd selection rules are investigated. The results suggest that use of the mpd selection rule in conjunction with the modified approach is better for recall of the small class at a small cost to the recognition of the large class.

15.00 *Fuzzy Algorithm for Contextual Pattern Recognition [#1349]*
Waibhav Tembe and Anca Ralescu, University of Cincinnati, United States

Measuring likeness between data in different ways is an important part of pattern recognition and, over the years, many such measures have been developed. This paper proposes an asymmetric measure of likeness based on the concept of "context dependent divergence". This is used to construct a numerical descriptor for images and, in conjunction with fuzzy sets, to develop a supervised learning algorithm. When applied to the problem of handwritten digit recognition, the algorithm produces promising, highly accurate results.

15.20 *Aggregation as similarity in a morphological framework for the processing of textile images [#1318]*
Aureli Soria-Frisch, Mario Koeppen and Bertram Nickolay, Fraunhofer IPK, Germany

Mathematical Morphology has demonstrated to be a very powerful mean for processing grayvalue images. The extension of mathematical morphology to color images results non-trivial due to its vectorial nature. The paper presents an approach of color morphology based on the fuzzy integral, which is employed within a framework for the computation of similarities. The main feature of the new defined morphological framework is the possibility to apply so-called targeted morphological operations. The usefulness of this approach is demonstrated in the here presented paper on hand of the results of different pre-processing operations for an automated visual inspection system, whereby textile images are inspected.

15.40 *Landmine Detection with Ground Penetrating Radar using Fuzzy K-Nearest Neighbors [#1366]*
Hichem Frigui, Paul Gader and Kotturu Satyanarayana, University of Memphis, United States; University of Florida, United States

This paper introduces a system for landmine detection using sensor data generated by ground penetrating radar (GPR). The GPR produces a three- dimensional array of intensity values, representing a volume below the surface of the ground. First, a constant false alarm rate (CFAR) detector is used to focus attension and identify candidates that resemble mines. Next, we apply a feature extraction algorithm based on projecting the data onto the dominant eigenvectors in the training data. The training signatures are then clustered to identify few representatives, and a fuzzy K-nearest neighbor rule is used to distinguish true detections from false alarms.

Thursday, 29 July, 16.20–16.50

Plenary Talk: Closing

Thursday, 29 July, 16.20–16.50, Room: C, Speaker: Kaoru Hirota,

AUTHORS' INDEX

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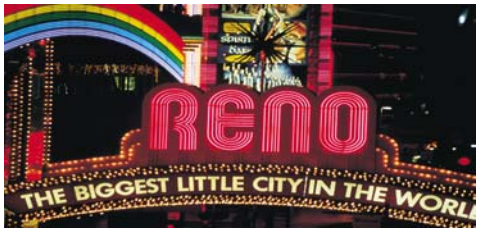

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