

FUZZ-IEEE 2009

**2009 IEEE International Conference on
Fuzzy Systems**

Program & Abstracts

August 20-24, 2009

**ICC Jeju
Jeju Island, Korea**

Table of Contents

□ Welcome to FUZZ-IEEE 2009	3
□ Program Committee Chair Message	4
□ Organizing Committee	5
□ Advisory Committee International	6
□ Advisory Committee Internal	6
□ Program Committee	6
□ Timetable	8
□ Floor Map	12
□ General Information	13
□ Social Program	13
□ Conference Tour Program	14
□ Tutorials	16
□ Special Invited Lecturer	17
□ Keynote Speakers	17
□ Plenary Speaker	21
□ IEEE WCI Meeting	22
□ Invited Session: Computer Go	23
□ Technical Program	
Thursday, August 20, 2009	26
Friday, August 21, 2009	26
Saturday, August 22, 2009	39
Sunday, August 23, 2009	59
Monday, August 24, 2009	74
□ Author Index	83

Welcome to FUZZ-IEEE 2009

We are pleased to welcome you to FUZZ-IEEE 2009, the 18th IEEE International Conference on Fuzzy Systems. It is of great honor and privilege to host FUZZ-IEEE 2009 on the beautiful island of Jeju, which has a full variety of tourist attractions in a culturally unique atmosphere. FUZZ-IEEE 2009 is the second FUZZ-IEEE conference held in Korea. The prior one was FUZZ-IEEE 1999 that was held in Seoul.

FUZZ-IEEE has been the premier technical conference for providing not only outstanding research, but also important new advances to the world, especially to researchers and professionals in the area of fuzzy sets and systems.

This year, the technical program covers five days of presentations including one special invited lecture, three keynote speeches, and one plenary speech given by well-known world class researchers in various fuzzy related subject areas. As for the papers, a total of 383 papers (302 oral presentations and 81 poster presentations) will be presented for this conference. A program booklet containing the abstracts of the papers will be provided as well as a CD-ROM version of the conference proceedings. We would like to express our sincere gratitude to all the authors who have made so many efforts for the preparation of their latest research.

In addition to our rich technical program, a welcome reception and conference banquet has been planned for gathering and entertainment. A rich program for optional tours of historic sights and museums in Jeju will be provided.

Our sincere appreciation for the conference preparation extends to all those who have worked together in organizing the conference and running the conference meeting. In particular, we are grateful for the tremendous effort and hard work of 11 area co-chairs of the program committee in arranging the technical program. Our special appreciations also go to the sacrifices and perspirations of our colleagues, S. J. Lee (Local Arrangement Chair), M. G. Chun (Finance Chair), J. W. Jung (Finance Co-Chair), Y. I. Cho (Registration Chair), J. H. Lee (Publicity Chair), D. W. Kim (Publicity Co-Chair), C. S. Kim (Publication Chair), and S. H. Jun (Website Chair), in making this conference possible.

Most of all, we thank you for attending FUZZ-IEEE 2009. We hope that this meeting will benefit all of us in advancing research activities and building new friendship.

General Chair

Hong Tae Jeon (Chung-Ang University, Korea)

General Co-Chair

Kyung Chan Min (Yonsei University, Korea)

Vice General Chair

Kyung-Whan Oh (Sogang University, Korea)

Program Committee Chair Message

We are pleased to welcome you to the 18th IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2009) held on Jeju Island, Korea, which is one of the most beautiful islands in Asia that possesses a historical wealth of cultural and tourist attractions. The FUZZ-IEEE 2009 conference is the venue where academia and industrial research laboratories share current trends as well as latest advances in the area of fuzzy sets and systems.

It has been a privilege to serve as the chair of the technical program committee that is composed of 11 internationally distinguished area co-chairs with the excellent support of 36 internationally distributed program committee members that coordinated the program and review process. The technical program provides a comprehensive view of current research that includes 60 oral sessions (regular and special) and a poster session comprised of 81 papers on a wide range of research and applications in fuzzy systems and soft computing. Tutorial, keynote, plenary, panel, and competition sessions dedicated to recent research experiences and future trends are also included.

This year, we received 485 papers from 37 different countries, of which 302 papers have been accepted for oral presentation and 81 for poster presentation. Submissions were reviewed by three reviewers, with no specific treatment given to papers submitted for special sessions.

We wish to express our sincere gratitude to the authors for their commitment to share their studies, to the reviewers for their professional evaluation, and to the program committee members for their dedication to the making of FUZZ-IEEE 2009 conference a successful and technically sound event. Especially, we would like to thank the entire organizing committee members for their excellent collaboration.

We truly believe you will enjoy the technical program of FUZZ-IEEE 2009 and find this conference to be an informative, inspiring, and enjoyable experience.

Thank you and enjoy beautiful Jeju Island.

Program Chair FUZZ-IEEE 2009

Frank Chung-Hoon Rhee (Hanyang University, Korea)

Program Area Co-Chairs

Sansanee Auephanwiriyaikul (Chiang Mai University, Thailand)

Hichiem Frigui (University of Louisville, USA)

Hani Hagrass (University of Essex, UK)

Hisao Ishibuchi (Osaka Prefecture University, Japan)

Robert John (De Montfort University, UK)

Jim Keller (University of Missouri, USA)

Sungshin Kim (Pusan National University, Korea)

Naoyuki Kubota (Tokyo Metropolitan University, Japan)

Jerry Mendel (University of Southern California, USA)

Qiang Shen (University of Wales Aberystwyth, UK)

Hao Ying (Wayne State University, USA)

Organizing Committee

- **Honorary Chair:** Zeungnam Bien (KAIST, Korea)
- **General Chair:** Hong Tae Jeon (Chung-Ang University, Korea)
• **General Co-Chair:** Kyung Chan Min (Yonsei University, Korea)
- **Vice General Chair:** Kyung-Whan Oh (Sogang University, Korea)
- **Program Committee Chair:** Frank Chung-Hoon Rhee (Hanyang University, Korea)
- **Area Co-Chairs:**
 - **Systems and Hybrid Computational Intelligence:**
Hisao Ishibuchi (Osaka Prefecture Univ., Japan)
 - **Signal Processing:**
Sansanee Auephanwiriyakul (Chiang Mai University, Thailand)
 - **Control:**
Hani Hagrass (University of Essex, UK)
 - **Information:**
Hichiem Frigui (University of Louisville, USA)
 - **Basic Concepts and Mathematics:**
Qiang Shen (University of Wales Aberystwyth, UK)
 - **Fuzzy Related Applications:**
Sungshin Kim (Pusan National University, Korea)
 - **Special Sessions:**
Naoyuki Kubota (Tokyo Metropolitan University, Japan)
 - **Tutorial Sessions:**
Jim Keller (University of Missouri, USA)
 - **Panel and Invited Sessions:**
Robert John (De Montfort University, UK)
 - **Keynote Sessions:**
Jerry Mendel (University of Southern California, USA)
- **Special Invited Session Talk:** Lotfi Zadeh (University of California, USA)
- **Fuzzy Competition:** Hao Ying (Wayne State University, USA)
- **Local Arrangement Chair:** Seok Jong Lee (Chungbuk National University, Korea)
- **Finance Chair:** Myung Geun Chun (Chungbuk National University, Korea)
• **Finance Co-Chair:** Jin-Woo Jung (Dongguk University, Korea)
- **Registration Chair:** Young Im Cho (The University of Suwon, Korea)
- **Publicity Chair:** Jee-Hyong Lee (Sungkyunkwan University, Korea)
• **Publicity Co-Chair:** Dae-Won Kim (Chung-Ang University, Korea)
- **Publication Chair:** Chang Suk Kim (Kongju National University, Korea)
- **Website Chair:** Sung-Hae Jun (Cheongju University, Korea)

Advisory Committee International

James C. Bezdek
Janusz Kacprzyk
Enrique H. Ruspini
Michio Sugeno

Advisory Committee Internal

Hwan Muk Chung
Young Hoon Joo
Geun Taek Kang
Yi Gon Kim
Kwang Hyung Lee
Chongkug Park
Kwee-Bo Sim

Program Committee

Plamen Angelov (Lancaster University, UK)
Robert Babuska (Delft University of Technology, Netherlands)
Gleb Beliakov (University of Melbourne, Australia)
Hamid Berenji (Intelligent Inference Systems Corp, USA)
Michael Berthold (University of Konstanz, Germany)
Hamid Bouchachia (Universität Klagenfurt, Austria)
Quek Hiok Chai (Nanyang Technological University, Singapore)
Seungjin Choi (Pohang University of Science and Technology, Korea)
Simon Coupland (De Montfort University, UK)
Gary Feng (City University of Hong Kong, Hong Kong)
Dimitar Filev (Ford Research, USA)
Paul Gader (University of Florida, USA)
Masafumi Hagiwara (Keio University, Japan)
Isao Hayashi (Kansai University, Japan)
Francisco Herrera (University of Granada, Spain)
Richard Jensen (University of Wales Aberystwyth, UK)
Seul Jung (Chungnam National University, Korea)
Janusz Kacprzyk (Polish Academy of Sciences, Poland)
Okyay Kaynak (Bogazici University, Turkey)
Euntai Kim (Yonsei University, Korea)
Jin Young Kim (Chonnam National University, Korea)
Kwang Baek Kim (Silla University, Korea)
Baoding Liu (Tsinghua University, China)
Trevor Martin (University of Bristol, UK)
Radko Mesiar (Slovak University of Technology Bratislava, Slovakia)
Eduard Montseny (Universitat Politècnica de Catalunya, Spain)
Mihail Popescu (University of Missouri, USA)
Thomas Runkler (Siemens AG Corporate Technology, Germany)

Hideyuki Sawada (Kagawa University, Japan)
Pilar Sobrevilla (Universitat Politècnica de Catalunya, Spain)
Woei Wan Tan (National University of Singapore, Singapore)
Nipon Theera-Umpon (Chiang Mai University, Thailand)
Vicenc Torra (IIIA-CSIC, Spain)
Enrique Herrera Viedma (University of Granada, Spain)
Bo-Hyeun Wang (Kangnung National University, Korea)
Xiao-Jun Zeng (University of Manchester, UK)

Thursday, August 20, 2009

Room #	Samda A	Samda B	302
09:00	T1: Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems (1) Hisao Ishibuchi and Rafael Alcalá	T2: Towards a Unified Framework for Intelligent Robotics (1) Honghai Liu and Naoyuki Kubota	
11:00	Coffee Break		
11:15	T1: Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems (2)	T2: Towards a Unified Framework for Intelligent Robotics (2)	
12:30	Lunch Break		
14:00	T3: Theoretical and Practical Aspects of Type-2 Fuzzy Systems (1) Jerry Mendel, Bob John, and Hani Hagras	T4: Bacterial Algorithms in Building Fuzzy Models from I/O Data (1) Laszlo T. Koczy	T5: Lattice and Poset Valued Fuzzy Structures: From Theory to Applications (1) Branimir Seselja and Andreja Tepavcevic
16:00	Coffee Break		
16:15	T3: Theoretical and Practical Aspects of Type-2 Fuzzy Systems (2)	T4: Bacterial Algorithms in Building Fuzzy Models from I/O Data (2)	T5: Lattice and Poset Valued Fuzzy Structures: From Theory to Applications (2)
17:30	Welcoming Reception (Delizia)		
19:00	End of day		

Friday, August 21, 2009

Room #	Samda A	Samda B	302	303	401	402
09:00	Opening Session (Halla Hall)					
09:10	Keynote #1 (Halla Hall) Spatial Reasoning: From Sketch-to-Text towards Text-to-Sketch Prof. James Keller					
10:10	Coffee Break (Main Lobby, 3rd Fl.)					
10:30	G01	N01	SS27	SS15	SS16	SS08A
11:50						Invited Session Intro. Computer Go
12:30	Lunch Break (TFS AE Lunch Meeting)					
14:00	A01	L	Q	SS0102A	SS06	Human vs. Computer Go Competition #1
15:40	Coffee Break (Main Lobby, 3rd Fl.)					
16:00	Special Invited Lecture (Halla Hall) Fuzzy Logic and Beyond: A New Perspective Prof. Lotfi Zadeh					
17:00	H	N02	I02	SS05	SS14	Human vs. Computer Go Competition #2
19:20~ 21:00	WCI Meeting					

Saturday, August 22, 2009

Room #	Samda A	Samda B	302	303	401	402
09:00	SS20	SS22A	SS23	SS24	SS07	Human vs. Computer Go Competition #3
11:00	Coffee Break (Main Lobby, 3rd Fl.)					
11:20	<p align="center">Keynote #2 (Halla Hall) Statistics Powered Conceptual Fuzzy Sets and Word Computing System Prof. Tomohiro Takagi</p>					
12:20	Lunch Break (FSTC Lunch Meeting)					
14:00	G02	B02	E01	SS29A	J04	Human vs. Computer Go Competition #4
15:40	Coffee Break (Main Lobby, 3rd Fl.)					
16:00	<p align="center">Plenary Lecture (Halla Hall) Perceptual Computing: One Implementation of Zadeh's Computing with Words Paradigm Prof. Jerry Mendel</p>					
17:00	Poster Session (Main Lobby, 3rd Fl.)				Fuzzy Competition	Panel Session Emergent Technologies for Computer Go
19:00	End of Sessions					
19:30	Banquet (Tamna Hall B)					
22:00	End of Day					

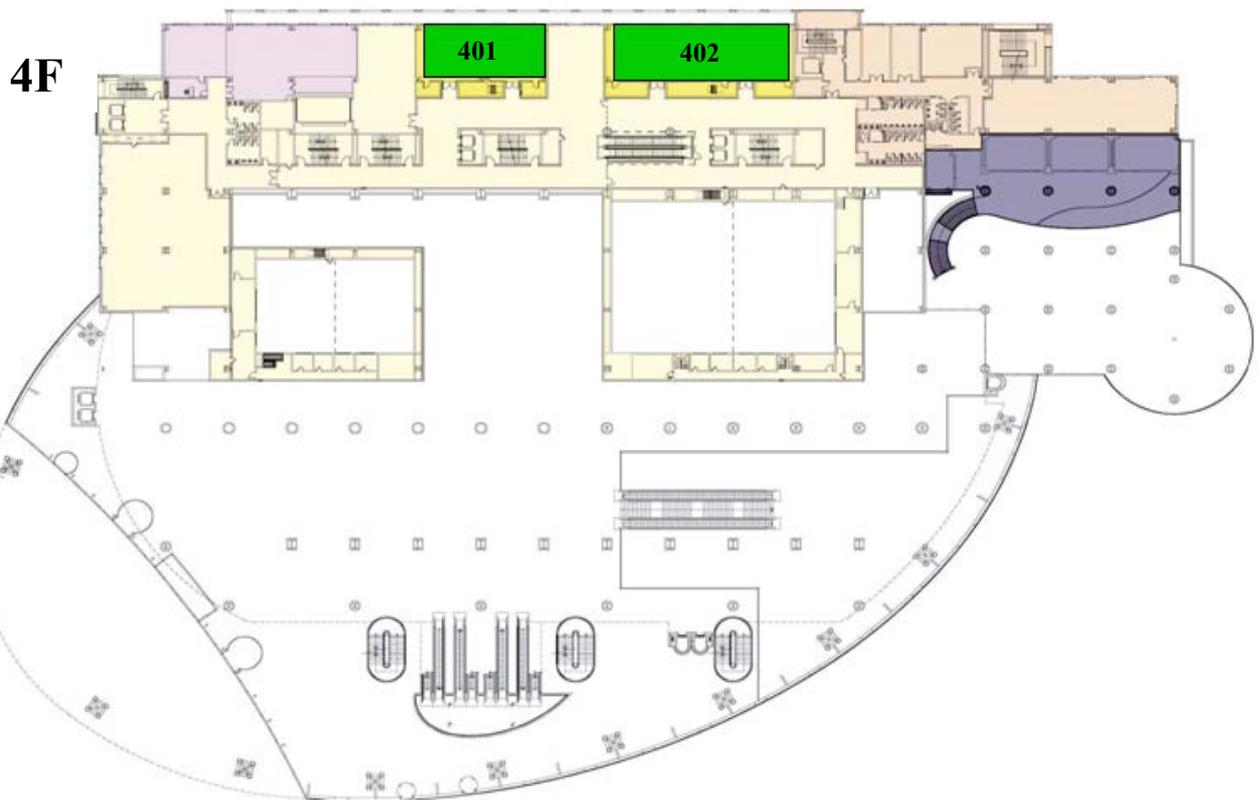
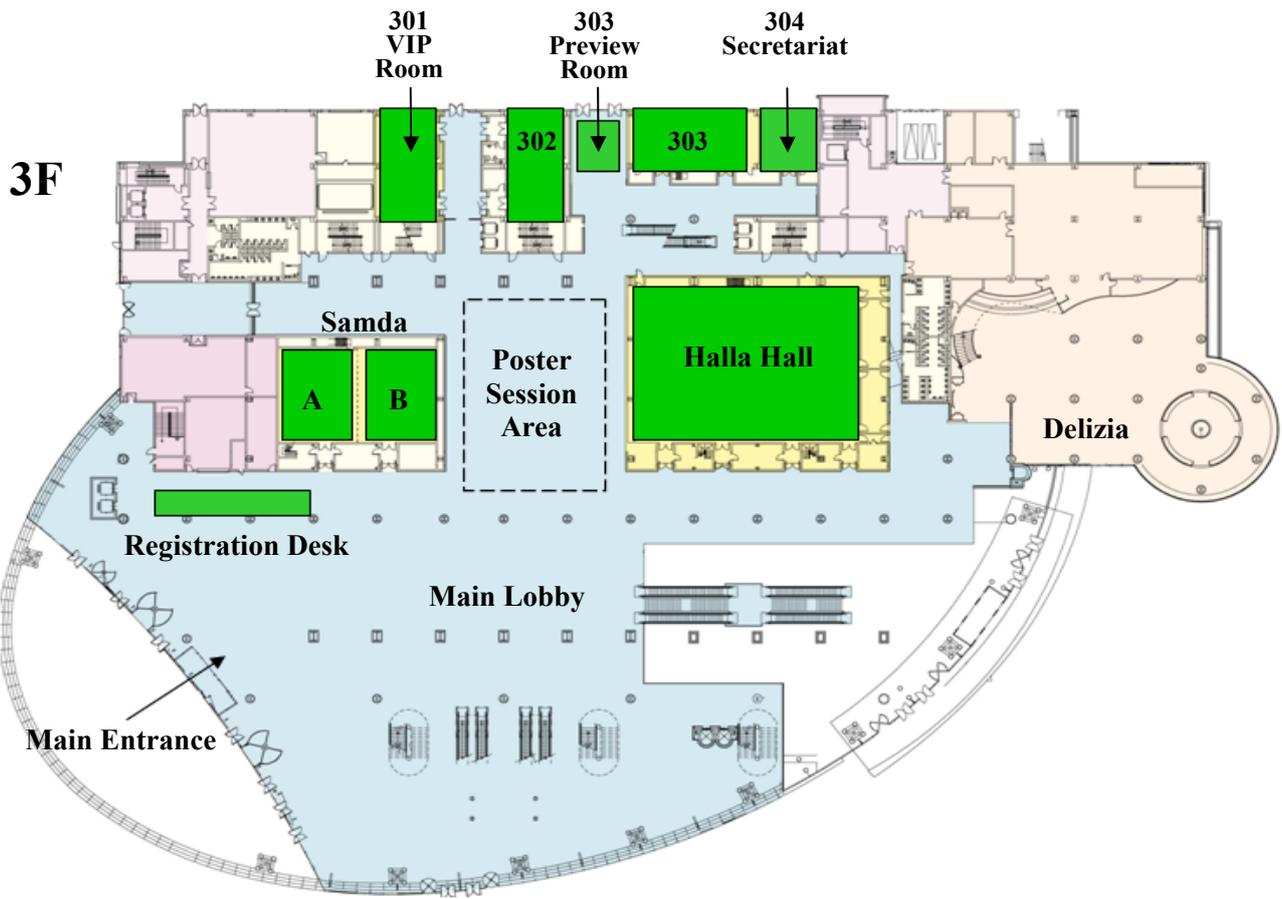
Sunday, August 23, 2009

Room #	Samda A	Samda B	302	303	401
09:00	A02	SS04A	SS12	SS17A	J02
10:40	Coffee Break (Main Lobby, 3rd Fl.)				
11:00	Keynote #3 (Halla Hall) Fuzzy-Based Learning of Human Behavior Patterns Prof. Zenn Bien				
12:00	Lunch Break (ETTC and Computer Go Lunch Meeting)				
13:30	SS03	SS04B	SS18A	SS29B	J03
15:10	Coffee Break (Main Lobby, 3rd Fl.)				
15:30	SS0102B	SS10	SS18B	SS17B	E02
16:50	Break				
17:00	SS26	SS22B	I01	SS25	SS28
19:20	End of Day				

Monday, August 24, 2009

Room #	Samda A	Samda B	302	303	401
09:00	SS13	SS19	P	SS21	
10:40	Coffee Break (Main Lobby, 3rd Fl.)				
11:00	K	SS08B	CD	J01	
12:40	Lunch Break				
14:00	O	B01	SS09	SS11	F
15:00	End of Day				

Floor Map



General Information

Official Language

The official language of the conference is English.

Registration Desk

The registration desk on the main lobby (3rd Floor) in the venue will be open as follows.

Thursday, August 20, 2009	08:30-18:00
Friday, August 21, 2009	08:30-18:00
Saturday, August 22, 2009	08:30-19:30
Sunday, August 23, 2009	08:30-18:00
Monday, August 24, 2009	08:30-15:00

Oral Presentation

All rooms are equipped with a LCD projector and a Windows operated laptop installed with PowerPoint and Acrobat PDF reader. Please make proper use of the room laptop by uploading and testing your presentation files before the beginning of the session. If you really need to use your own laptop (i.e., cases where special software is required or due to compatibility issues), make sure to test your connection with the projector before the session starts. Please note that time lost in setting up your laptop during the session cannot be recovered. This will result in a shorter time allowance for your presentation. Be sure to contact the session chair before the session starts. Please arrive early to confirm your name, affiliation, and the title of your paper. The presentation time is 20 minutes. This includes speaker transition, setting your computer (if needed), and questions & answers. It is recommended that each speaker finish their presentation within 15 minutes to have time for questions & answers.

Poster Presentation

Time: 17:00-19:00

Date: Saturday, August 22, 2009

Place: Main Lobby (3rd Floor), ICC Jeju

The dimensions of the poster board are 100 cm (width) × 180 cm (length). You will need to attach your poster materials on the provided poster boards in the main lobby (3rd Floor) at least 15 minutes prior to the beginning of the poster session, and then remove your poster materials after the conclusion of the session. You should preside at your poster board location throughout the poster session for anticipated discussions with participants.

Social Program

Welcome Reception

Time: 17:30-19:00

Date: Thursday, August 20, 2009

Place: Delizia (3rd Floor), ICC Jeju

The welcome reception will be held at the Delizia in the venue. The welcome reception is open to all participants including registered students.

Banquet

Time: 19:30 ~

Date: Saturday, August 22, 2009

Place: Tamna Hall B (5th Floor), ICC Jeju

We hope the banquet will offer you a good opportunity to promote friendship with the conference participants. Good food, musical performance (string quartet), and Korean traditional/modern performance will be offered at the banquet. A banquet ticket is included in the Regular Registration (R1~R3). Student Registration (R4) does not include the banquet. They may be purchased separately.

Conference Tour Program

The tour desk will be operated by Hanjin Travel Service in the main lobby (3rd Floor) of the venue during the Conference dates. Tour options are described as follows.

Daily Option Tours

OP-1 Half-day Tour 1

*Date & time: Aug. 20, 21, 22, 23, 24 / 09:00~13:00

*Price per person: US\$45

(Minimum 10 persons are required for tour to take place)

*Price includes private vehicle, English speaking guide, and Admissions per itinerary

*Itinerary: Meet at ICC Jeju / Tour desk→O'Sulloc Tea Museum→Hallim Park→Return to ICC

OP-2 Half-day Tour 2

*Date & time: Aug.20, 21, 22, 23, 24 /14:00~18:30

*Price per person: US\$45

(Minimum 10 persons are required for tour to take place)

*Price includes private vehicle, English speaking guide, and Admissions per itinerary

*Itinerary: Meet at ICC Jeju / Tour desk→Bijarim Forest→Seongsan Sunrise Peak→Return to ICC

OP-3 Half-day Tour 3

*Date & time: Aug.20, 21, 22, 23, 24 /14:00~18:30

*Price per person: US\$55

(Minimum 10 persons are required for tour to take place)

*Price includes private vehicle, English speaking guide, and Admissions per itinerary

*Itinerary: Meet at ICC Jeju / Tour desk→TV Drama Set "Southern Land"→Majanggul Cave→Return to ICC

OP-4 ATV Ride

*Date & time: Aug.22, 23, 24 /09:00~12:30

*Price per person: US\$70

(Minimum 10 persons are required for tour to take place)

*Price includes private vehicle, English speaking guide, and Admissions per itinerary

*Itinerary: Meet at ICC Jeju / Tour desk→Yongmeori Coast (Hamel Memorial Monument)→Thrill ride of ATV→Return to ICC

OP-5 Yacht ride

*Date & time: Aug.20, 21 /13:30~16:30

*Price per person: US\$90

(Minimum 10 persons are required for tour to take place)

*Price includes private vehicle, English speaking guide, Admissions, Souvenir Photo, Fishing, and Soft drink

*Itinerary: Meet at ICC Jeju / Tour desk→Romantic Yacht ride (Photo, fishing, soft drink are inclusive)→Yakcheonsa Temple→Return to ICC

OP-6 Golf

*Date & time: Aug.20, 21 / 5 hours

*Price per person: US\$320

(Minimum 4 persons are required for tour to take place)

*Price includes private vehicle, English speaking guide, Green fee, Caddie fee, Clubs, and Cart

*Itinerary: Meet at ICC Jeju /Golf at Elysian Country Club (Golf club is subject to change)→Return to ICC

Conference Tour Program (cont.)

Post-Conference Tours

PT-1 Seoul Tour

*Date: Aug. 25~27, 2009 (3 days & 2 nights)

*Price per person: US\$430 (TWN room sharer) / US\$570 (SGL room user)
(Minimum 10 persons are required for tour to take place)

*Price includes

- Hotel: 2 persons per room use at Seoul Garden Hotel (4 star) or similar for 2 nights
- Meals: As described on itinerary
- Transportation: Private vehicle and One-way Airfare (Jeju→Seou)
- Tour guide: English-speaking
- Other: Admissions per itinerary and parking fee

*Itinerary:

Aug. 25 (Tue)

Transfer to Jeju airport→Fly to Seoul (Gimpo Airport) & greeted by a tour guide→Seoul City Tour including Presidential Residence “Cheongwadae” Road→Gyeongbokgung Palace & Folk Museum→N Seoul Tower (L)

Aug. 26 (Wed)

Meet a guide at hotel→DMZ (The 3rd Underground Tunnel & Unification Observatory)→Namsan Hanok Village→Dongdaemun Market (B/L)

Aug. 27 (Thu)

Transfer to Incheon Int’l Airport on your own (B)

PT-2 Busan/Gyeongju Tour

*Date: Aug. 25~27, 2009 (3 days & 2 nights)

*Price per person: US\$415 (TWN room sharer) / US\$545 (SGL room user)
(Minimum 10 persons are required for tour to take place)

*Price includes

- Hotel: 2 persons per room use at Haeundae Centum Hotel (4 star) or similar for 2 nights
- Meals: As described on itinerary
- Transportation: Private vehicle and One-way Airfare (Jeju→Busan)
- Tour guide: English-speaking
- Other: Admissions per itinerary and parking fee

*Itinerary:

Aug. 25 (Tue) Tour of Busan including→APEC House “Nurimaru”→Yonggungsa Temple→Haeundae Sightseeing Cruise (L)

Aug.26 (Wed)

Meet guide at hotel→Leave Busan for Gyeongju→Bulguksa Temple→Cheonmachong Tomb→Back to Busan →Yongdusan Park→Jagalchi Fish Market- (B/L)

Aug. 27 (Thu)

Meet guide at hotel→Transfer to Busan airport on your own (B)

Tutorials

Thursday, August 20, 2009

Morning Session: 9:00 ~ 12:30

Room: Samda A

T1: Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems

Hisao Ishibuchi

Osaka Prefecture University, Japan

Rafael Alcalá

University of Granada, Spain

Room: Samda B

T2: Towards a Unified Framework for Intelligent Robotics

Honghai Liu

Institute of Industrial Research, University of Portsmouth, UK

Naoyuki Kubota

Tokyo Metropolitan University, Japan

Afternoon Session: 14:00 ~ 17:30

Room: Samda A

T3: Theoretical and Practical Aspects of Type-2 Fuzzy Systems

Jerry Mendel

University of Southern California, USA

Bob John

De Montfort University, UK

Hani Hagrás

University of Essex, UK

Room: Samda B

T4: Bacterial Algorithms in Building Fuzzy Models from I/O Data

Laszlo T. Koczy

Szechenyi Istvan University (SZE, Gyor) and

Budapest University of Technology and Economics (BME) Hungary

Room: #302

T5: Lattice and Poset Valued Fuzzy Structures: From Theory to Applications

Branimir Seselja

University of Novi Sad, Serbia

Andreja Tepavcevic

University of Novi Sad, Serbia

Special Invited Lecturer

16:00-17:00, Friday, August 21, 2009

Room: Halla Hall

Fuzzy Logic and Beyond: A New Perspective

Lotfi A. Zadeh

University of California, Berkeley, USA

Biography

LOTFI A. ZADEH is a Professor in the Graduate School, Computer Science Division, Department of EECS, University of California, Berkeley. In addition, he is serving as the Director of BISC (Berkeley Initiative in Soft Computing).

Lotfi Zadeh is an alumnus of the University of Teheran, MIT and Columbia University. He held visiting appointments at the Institute for Advanced Study, Princeton, NJ; MIT; IBM Research Laboratory, San Jose, CA; SRI International, Menlo Park, CA; and the Center for the Study of Language and Information, Stanford University. His earlier work was concerned in the main with systems analysis, decision analysis and information systems. His current research is focused on fuzzy logic, computing with words and soft computing, which is a coalition of fuzzy logic, neurocomputing, evolutionary computing, probabilistic computing and parts of machine learning. The guiding principle of soft computing is that, in general, better solutions can be obtained by employing the constituent methodologies of soft computing in combination rather than in stand-alone mode.

Lotfi Zadeh is a Fellow of the IEEE, AAAS, ACM, AAAI, and IFSA. He is a member of the National Academy of Engineering and a Foreign Member of the Russian Academy of Natural Sciences. He is a recipient of the IEEE Education Medal, the IEEE Richard W. Hamming Medal, the IEEE Medal of Honor, the ASME Rufus Oldenburger Medal, the B. Bolzano Medal of the Czech Academy of Sciences, the Kampe de Fariet Medal, the AACC Richard E. Bellman Central Heritage Award, the Grigore Moisil Prize, the Honda Prize, the Okawa Prize, the AIM Information Science Award, the IEEE-SMC J. P. Wohl Career Achievement Award, the SOFT Scientific Contribution Memorial Award of the Japan Society for Fuzzy Theory, the IEEE Millennium Medal, the ACM 2000 Allen Newell Award, and other awards and honorary doctorates. He has published extensively on a wide variety of subjects relating to the conception, design and analysis of information/intelligent systems, and is serving on the editorial boards of over fifty journals.

Keynote Speakers

09:10-10:10, Friday, August 21, 2009

Room: Halla Hall

Spatial Reasoning: From Sketch-to-Text towards Text-to-Sketch

James M. Keller

University of Missouri, USA

Abstract

With the collaboration of several faculty colleagues and many students, I have been studying the creation and utilization of spatial relations in various sensor-related domains for many years. Scene description, involving linguistic expressions of the spatial relationships between image objects, is a major goal of high-level computer vision. In a series of papers, we introduced the use of histograms of forces to produce evidence for the description of relative position of objects in a digital image. There is a parameterized family of such histograms, for example, the histogram of constant forces (much like the earlier histogram of angles) and the histogram of gravitational forces that highlights areas that are close between the two objects. Utilizing the fuzzy directional membership information extracted from these histograms within fuzzy logic rule-based systems, we have produced high-level linguistic descriptions of natural scenes as viewed by an external observer. Additionally, we have exploited the

Keynote Speakers (cont.)

theoretical properties of the histograms to match images that may be the same scene viewed under different pose conditions. In fact, we can even recover estimates of the pose parameters. These linguistic descriptions have then been brought into an ego-centered viewpoint for application to robotics, i.e., the production of linguistic scene description from a mobile robot standpoint, spatial language for human/robot communication and navigation, and understanding of a sketched route map for communicating navigation routes to robots. This last activity is sketch-to-text. In a newly awarded grant from the National Geospatial Intelligence Agency, we are starting to tackle the inverse problem: given one or more text descriptions of a temporal and spatial event, construct a sketch of the event for subsequent reasoning. The sketch must be grounded in reality by matching to a satellite image or geospatial database. This talk will survey the early applications and end with a demo highlighting our approach to the new problem.

Biography

James M. Keller received the Ph.D. in Mathematics in 1978. He holds the University of Missouri Curators' Professorship in the Electrical and Computer Engineering and Computer Science Departments on the Columbia campus. He is also the R. L. Tatum Professor in the College of Engineering. His research interests center on computational intelligence: fuzzy set theory and fuzzy logic, neural networks, and evolutionary computation with a focus on problems in computer vision, pattern recognition, and information fusion including bioinformatics, spatial reasoning in robotics, geospatial intelligence, sensor and information analysis in technology for eldercare, and landmine detection. His industrial and government funding sources include the Electronics and Space Corporation, Union Electric, Geo-Centers, National Science Foundation, the Administration on Aging, The National Institutes of Health, NASA/JSC, the Air Force Office of Scientific Research, the Army Research Office, the Office of Naval Research, the National Geospatial Intelligence Agency, and the Army Night Vision and Electronic Sensors Directorate. Professor Keller has coauthored over 300 technical publications.

Jim is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for whom he has presented live and video tutorials on fuzzy logic in computer vision, is an International Fuzzy Systems Association (IFSA) Fellow, is a national lecturer for the Association for Computing Machinery (ACM), is an IEEE Computational Intelligence Society Distinguished Lecturer, and is a past President of the North American Fuzzy Information Processing Society (NAFIPS). He received the 2007 Fuzzy Systems Pioneer Award from the IEEE Computational Intelligence Society. He finished a full six year term as Editor-in-Chief of the *IEEE Transactions on Fuzzy Systems*, is an Associate Editor of the *International Journal of Approximate Reasoning*, and is on the editorial board of *Pattern Analysis and Applications*, *Fuzzy Sets and Systems*, *International Journal of Fuzzy Systems*, and the *Journal of Intelligent and Fuzzy Systems*. He was the Vice President for Publications of the IEEE Computational Intelligence Society from 2005-2008, and is currently an elected Adcom member. He was the conference chair of the 1991 NAFIPS Workshop, program co-chair of the 1996 NAFIPS meeting, program co-chair of the 1997 IEEE International Conference on Neural Networks, and the program chair of the 1998 IEEE International Conference on Fuzzy Systems. He was the general chair for the 2003 IEEE International Conference on Fuzzy Systems.

11:20-12:20, Saturday, August 22, 2009

Room: Halla Hall

Statistics Powered Conceptual Fuzzy Sets and Word Computing System

Tomohiro Takagi

Meiji University, Japan

Abstract

According to Gorge Lakoff abstract concepts are acquired as generalization results of experimental similarities and experimental co-occurrences. According to the use theory of meaning by Wittgenstein, the meaning of a word is defined when it is used and can be expressed by other words. Regarding both points, we have proposed conceptual fuzzy sets (CFS henceforth) as augmented fuzzy sets as a system acquiring and representing context sensitive word meanings. Ordinary fuzzy sets are defined with elements with their membership values. In the CFS, the meaning of a word is expressed by the set of relative words and their relationship values.

The strongest cause of word ambiguity is context. As the meaning of a word is not fixed and changes dynamically

Keynote Speakers (cont.)

depending on context which varies depending on specificity of the topic and the viewpoint of a writer. Ordinary fuzzy sets express phenomena with an un-clear boundary. However, when applying them to various realistic matters, problems occur because the ambiguity of the fuzzy sets is fixed. We proposed two methodologies to cope with above problem by representing context dependent word meaning by changing the figures of the CFS reflecting the contexts. In the first method, we generate a conceptual fuzzy set by the superpositioning of prototype concepts, which are obtained as clusters of words. The meaning varying depending on the context can be generated by superpositioning the prototype concepts with similarities to the input. By conceptual matching using this meaning representation method, we won 1st place at ImageCLEF photo retrieval task EN_AUTO_TXT, where participants retrieve a photo only with annotated text description, last year 2008. The second one computes relationship values between words as mutual information. We used a large corpus consisting of 1 million newswire text data in our experiments. We will demonstrate that our method effectively works not only representing word meanings and but obtaining appropriate granularities showing experimental results.

Using the CFS mentioned above we are challenging to build a different word computing system from the CWW system proposed by Prof. Zadeh. When “A implies B” and A’ are given in ordinary fuzzy logic, we obtain B’ as a result of approximate reasoning using similarity between A and A’. Actually however similarity is not a simple idea. For example, “natural gas” is different from “oil” viewing as materials, because the former is gaseous and the latter is liquid. But from a view point of combustibility, their similarity is very high. This example shows viewpoints affect degrees of similarity seriously, which is called metaphor-induced similarity in cognitive linguistics. Thus, building general approximate reasoning, we ought to incorporate functions to deal with the general similarities. Such a reasoning process is illustrated in the following 4-terms reasoning.

car : gasoline = sailboat : x?

We human usually reason "wind" as this x. However ordinary fuzzy reasoning cannot obtain “wind” as a result. To achieve this reasoning the relation of “car” and “gasoline” should be once interpreted in an abstract notion and then x should be reasoned from “sailboat.” An approximate reasoning method using CFS enables “wind” to be reasoned. Here I show the method and experiment results. Now we challenge to apply the above methods to information recommender system in accordance with user profile and economic fluctuation prediction referring past fluctuations.

Biography

Tomohiro Takagi is Professor of Computer Science Course at the Graduate School of Science and Technology, Meiji University, Japan and a Director of the Meiji University Soft Computing Institute. Tomohiro Takagi received a Doctor of Engineering degree from the Tokyo Institute of Technology in 1983. He proposed a fuzzy model which has been called TS-model (Takagi-Sugeno model) in his doctoral dissertation. He was an EECS research fellow at the University of California, Berkeley from 1983 to 1984. From 1987 to 1997, he worked in the Central Research Laboratory and Corporate Multimedia Promotion Division of Matsushita Electric Industrial Co., Ltd. He was also a deputy director at the Laboratory for International Fuzzy Engineering Research, which was a national project supported by the Ministry of International Trade and Industry of Japan, from 1991 to 1993. Since 1998, he has been affiliated with the Department of Computer Science of Meiji University. From 2005 to 2007 he was a Program Officer of the Japan Society for the Promotion of Science.

Keynote Speakers (cont.)

11:00-12:00, Sunday, August 23, 2009

Room: Halla Hall

Fuzzy-based Learning of Human Behavior Patterns

Z. Zenn Bien

KAIST, Korea

Abstract

In designing autonomous service systems in a smart home environment, discovery and prediction of human behaviors are often crucial. For patterns of human behavior with inherent ambiguity and uncertainty, however, their modeling and recognition are known a challenging task. In this talk are presented some effective fuzzy model-based learning techniques, which our research group has devised. These include, in particular, an interpretable probabilistic fuzzy rule base, a non-supervised fuzzy Q-learning, and an application study of human behavior suggestion system for memory impaired people. Efficient learning schemes with less human intervention and less prior knowledge are expected to be developed in this direction of research.

Biography

Zeungnam 'Zenn' Bien received his B.S. degree in Electronics Engineering from Seoul National University, Seoul, Korea, in 1969 and, M.S. and Ph.D. degrees in electrical engineering from the University of Iowa, Iowa City, Iowa, U.S.A., in 1972 and 1975, respectively. During 1976-1977 academic years, he taught at Department of Electrical Engineering, University of Iowa. Then Dr. Bien joined Korea Advanced Institute of Science and Technology, summer, 1977, and had worked for Department of Electrical Engineering & Computer Science, KAIST as professor till February 28, 2009. He has become a Chaired Professor of UNIST (Ulsan National Institute of Science and Technology) since March 1, 2009. He was a visiting faculty at the University of Iowa for a year since Sep. 1981, and a visiting researcher at CASE Center of Syracuse University, New York, while a visiting professor at Department of Control Engineering, Tokyo Institute of Technology during 1987-1988 academic years. He had been in INT, France and TDU, Japan as a visiting professor from Sept. 1, 2006 till August 31, 2007, six month each for his sabbatical year.

Prof. Bien has been serving for a number of professional societies, domestic and overseas. He was the founding president of the Korea Fuzzy Logic and Intelligent Systems Society during 1990-1995 and also, the general chairs for IFSA World Congress 1993, and for FUZZ-IEEE99, respectively. Dr. Bien served as the President of the Institute of Electronics Engineers of Korea (IEEK) for the year 2001. He worked as the president for International Fuzzy Systems Association (IFSA) during 2003-2005. For Korea Academy of Science and Technology, he served as the chairman of Engineering Division for 3 years and is now a member of Board of Directors. Dr. Bien was also the founding president of Korea Robotics Society for 2003~6. At KAIST, Prof. Bien served as Dean of Academic Affairs, Dean of College of Engineering and Director of Human-friendly Welfare Robot System Engineering Research Center for 9 years since 1999. Being a KEPCO-Chaired Professor during 2005~2009, he is now a Professor Emeritus of KAIST. He served as an editorial advisory board member for International Journal of Fuzzy Systems (IJFS), an editorial board member for IEEE Transactions on Fuzzy Systems, and an associate editor for Fuzzy Optimization and Decision Making (FODM). Prof. Bien was the Editor-in-chief of International Journal of Assistive Robotics and Mechatronics. Prof. Bien has been awarded a number of domestic and international prizes including National Hyokshin medal, World Automation Congress Award, Joshep Engelberger Award and many others. He is an IEEE Fellow, also an IFSA FUZZY Fellow and members of KAST and NAEK.

His current research interests include Intelligent System and Control with particular attention to Assistive Service Robotic Systems and Smart Homes-Intelligent Village. Prof. Bien has published more than 460 international journal/proceedings papers, and has authored/coauthored 7 technical books. He has obtained 22 patents registered and 5 pending.

Plenary Speaker

16:00-17:00, Saturday, August 22, 2009

Room: Halla Hall

Perceptual Computing: One Implementation of Zadeh's Computing With Words Paradigm

Jerry Mendel

University of Southern California, USA

Abstract

In 1996 Lotfi Zadeh, who is the father of fuzzy logic, published the paper "Fuzzy Logic = Computing with Words." This title might lead one to incorrectly believe that, since fuzzy logic is a very well developed body of mathematics (with lots of real-world application), it is straightforward to implement his paradigm of Computing with Words. This speaker and his students have been working on one class of applications for Computing with Words for more than ten years, namely *assisting people in making subjective judgments*. The result is the *Perceptual Computer* and its associated methodology—*Perceptual Computing*. This talk describes the methodology of perceptual computing, its many challenges, and how those challenges have been overcome to-date.

Biography

Jerry M. Mendel received the Ph.D. degree in electrical engineering from the Polytechnic Institute of Brooklyn, Brooklyn, NY. Currently he is Professor of Electrical Engineering and Systems Architecting Engineering at the University of Southern California in Los Angeles, where he has been since 1974. He has published over 470 technical papers and is author and/or editor of eight books, including *Uncertain Rule-based Fuzzy Logic Systems: Introduction and New Directions* (Prentice-Hall, 2001). His present research interests include: type-2 fuzzy logic systems and their applications to a wide range of problems, including smart oil field technology and computing with words. He is a Life Fellow of the IEEE, a Distinguished Member of the IEEE Control Systems Society, and a Fellow of the International Fuzzy Systems Association (2009). He was President of the IEEE Control Systems Society in 1986. He is a member of the Administrative Committee of the IEEE

Computational Intelligence Society and was Chairman of its Fuzzy Systems Technical Committee. Among his awards are the 1983 Best Transactions Paper Award of the IEEE Geoscience and Remote Sensing Society, the 1992 Signal Processing Society Paper Award, the 2002 *Transactions on Fuzzy Systems* Outstanding Paper Award, a 1984 IEEE Centennial Medal, an IEEE Third Millennium Medal, a Fuzzy Systems Pioneer Award (2008) from the IEEE Computational Intelligence Society, and a Pioneer Award from the IEEE Granular Computing Conference, May 2006, for Outstanding Contributions in Type-2 Fuzzy Systems.

Education:

- Ph.D. in Electrical Engineering, Polytechnic Institute of Brooklyn, Brooklyn, NY
- M.S. in Electrical Engineering, Polytechnic Institute of Brooklyn, Brooklyn, NY
- B.S. in Mechanical Engineering, Polytechnic Institute of Brooklyn, Brooklyn, NY

Publications:

- More than 470 technical papers
- Author or editor of eight books, including
 - *Uncertain Rule-Based Fuzzy Logic Systems: Introduction and New Directions* (Prentice-Hall, 2001)
 - *Lessons in Estimation Theory for Signal Processing, Communications and Control* (Prentice-Hall, 1995)
 - *Maximum-Likelihood Deconvolution* (Springer-Verlag, 1990)
- Two tutorials published in the IEEE Proceedings:
 - "Fuzzy Logic Systems for Engineering," Proc. of IEEE, vol.83, pp. 345-377, March 1995. Corrections to this paper appear in vol. 83, p. 1293, Sept. 1995.
 - "Tutorial on Higher-Order Statistics (Spectra) in Signal Processing and System Theory: Theoretical Results and Some Applications," Proc. of IEEE, vol. 79, pp. 278-305, 1991

Recent Service:

- Associate Editor of IEEE Trans. on Fuzzy Systems
- Chairman of the Fuzzy Systems Technical Committee for the IEEE Computational Intelligence Society
- Elected member of the Administrative Committee of the IEEE Computational Intelligence Society

IEEE WCI Meeting

19:20-21:00, Friday, August 21, 2009

Room: Samda A

1. Summary of current and future WICI activities

2. Presentation on the “The transfer of academic research on fuzzy systems into industry” by a member of the IEEE Task force on Computational Intelligence in the Market Place (http://www.zalzala.info/CIMI/ECTC_CIMI.html). There are so much more opportunities for Computational Intelligence (CI) adaptation in many industry applications, and overall industry acceptance of CI are still in its infancy. The Task Force aims to assist with the introduction of CI principles and related technologies into the marketplace, presented to industry as a short-term practical solution. This 20 minute presentation will present some of the issues facing academics along with some examples. At the end of the presentation there will be the opportunity for questions.

3. Panel Session: “Coaching and Mentoring within the Computational Intelligence Community.”

At its extreme coaching is goal orientated, in that the coach facilitates the coachee in self directed learning towards the achievement of a goal, for example an improvement in the individual's performance or in learning how to accomplish a particular task. Mentoring also involves facilitation but often without an agenda and takes place in the “arena of life.” Mentors act as sounding boards and cover a person's career and their personal growth. Mentoring can place in both a formal mentoring program or within an informal relationship. Mentees often choose who they wish to be their mentor whilst a person can take on the role of a coach as part of their job. This panel session will look at the experiences of both coaching and mentoring in the Computational Intelligence community and will comprise of a series of short presentations, discussions and an extensive questioning and answering session. The IEEE Mentoring Connection will also be outlined.

Panel Members

- Dr Bernadette Bouchon-Meunier - Director of research at the National Centre for Scientific Research, Head of the Department of Databases and Machine Learning in the Computer Science Laboratory of the University Paris 6 (LiP6)
- Professor Pilar Sobrevilla, Universitat Politecnica de Catalunya, Spain
- Dr Maguelonne Tisseire - Director of Research - Cemagref
- Dr Sandra Bringay - Assistant Professor - l'Université de Montpellier
- Dr Keeley Crockett – Senior Lecturer in Computing, Manchester Metropolitan University, UK

4. Networking and Refreshments

Invited Session: Computer Go

11:50-12:30, Friday, August 21, 2009

Room: #402

Invited Session

Session Chair: Prof. Robert John

Topic: Introduction and Discussion for Computer Go

1. Opening Introduction

Dr. David B. Fogel (IEEE CIS President)
Computational Intelligence & Game Applications

Prof. Frank Chung-Hoon Rhee (FUZZ-IEEE Program Chair)
FUZZ-IEEE2009 & Computer Go Activities

Prof. Robert John (FUZZ-IEEE Panel & Invited Session Chair)
Uncertainty Environment & Type 2 Fuzzy Sets

2. Panel Discussion

Session Co-Chairs:

Prof. Chang-Shing Lee (National University of Tainan, Taiwan)

Prof. Hani Hagrass (University of Essex, UK)

Prof. Shun-Chin Hsu (Chang Jung Christian University, Taiwan/ Computer Go & Its Development)

Panelists:

Dr. Olivier Teytaud (INRIA, France)
Introduction to Computer Go: Past, Present and Future

Prof. Shi-Jim Yen (National Dong Hwa University, Taiwan)
Computer Go & Its Technologies

Prof. Hani Hagrass (University of Essex, UK)
Type 2 Fuzzy Logic System & Computer Go

Prof. Chang-Shing Lee (National University of Tainan, Taiwan)
Computer Go & Knowledge Management

3. Chief Referee

Prof. Shang-Rong Tsai (Chang Jung Christian University, Taiwan)
Computer Go Competition Rules

Invited Session: Computer Go (cont.)

14:00-15:40, Friday, August 21, 2009

Room: #402

Human vs. Computer Go Competition #1

19×19 Game

Chun-Hsun Chou (9P) / **H7** vs. Many Faces of Go (Operator: Prof. Shi-Jim Yen)

Shen-Su Chang (6D) / **H4** vs. Mogo (Operator: Dr. Olivier Teytaud)

17:00-19:20, Friday, August 21, 2009

Room: #402

Human vs. Computer Go Competition #2

9×9 game 2-1 / Komi 7.5 (17:00-18:10)

Chun-Hsun Chou (9P) / **Black** vs. Mogo (Operator: Dr. Olivier Teytaud) / **White**

Shen-Su Chang (6D) / **Black** vs. Many Faces of Go (Operator: Prof. Shi-Jim Yen) / **White**

9×9 game 2-2 / Komi 7.5 (18:10-19:20)

Chun-Hsun Chou (9P) / **White** vs. Mogo (Operator: Dr. Olivier Teytaud) / **Black**

Shen-Su Chang (6D) / **White** vs. Many Faces of Go (Operator: Prof. Shi-Jim Yen) / **Black**

09:00-11:00, Saturday, August 22, 2009

Room: #402

Human vs. Computer Go Competition #3

9×9 game 3-1 / Komi 7.5 (09:00 – 10:00)

Chun-Hsun Chou (9P) / **Black** vs. Fuego (Operator: Dr. Olivier Teytaud) / **White**

Shen-Su Chang (6D) / **Black** vs. Zen (Operator: Prof. Shi-Jim Yen) / **White**

9×9 game 3-2 / Komi 7.5 (10:00 – 11:00)

Chun-Hsun Chou (9P) / **White** vs. Fuego (Operator: Dr. Olivier Teytaud) / **Black**

Shen-Su Chang (6D) / **White** vs. Zen (Operator: Prof. Shi-Jim Yen) / **Black**

14:00-15:40, Saturday, August 22, 2009

Room: #402

Human vs. Computer Go Competition #4

19×19 Game

Chun-Hsun Chou (9P) / **H7** vs. Zen (Operator: Dr. Olivier Teytaud)

Shen-Su Chang (6D) / **H4** vs. Fuego (Operator: Prof. Shi-Jim Yen)

Invited Session: Computer Go (cont.)

17:00-19:00, Saturday, August 22, 2009

Room: #402

Panel Session

Topic: Emergent Technologies for Computer Go

1. Panel Discussion

Session Co-Chairs:

Prof. Chang-Shing Lee (National University of Tainan, Taiwan)
Emergent Technology TC & Computer Go

Prof. Robert John (FUZZ-IEEE Panel & Invited Session Chair)
T2FS for Uncertainty Environment

Dr. Olivier Teytaud (INRIA, France)
Computer Go Performance Analysis for Mogo, Zen, Fuego and Many Face of Go

Panelists:

Prof. Shang-Rong Tsai (Chang Jung Christian University, Taiwan)
Computer Go Competition Results Report

Prof. Shun-Chin Hsu (Chang Jung Christian University, Taiwan)
Traditional Computer Go Technology

Prof. Shi-Jim Yen (National Dong Hwa University, Taiwan)
Novel Computer Go Technology

Prof. Hani Hagraas (University of Essex, UK)
T2FLS & Computer Go Technology

2. Summary

Dr. David B. Fogel (IEEE CIS President)
Computation Intelligence Technologies & Computer Game: Past, Present and Future

Thursday, August 20, 09:00-12:30

Tutorial T1 (Samda A)

Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems

Hisao Ishibuchi and Rafael Alcalá

Tutorial T2 (Samda B)

Towards a Unified Framework for Intelligent Robotics

Honghai Liu and Naoyuki Kubota

Thursday, August 20, 14:00-17:30

Tutorial T3 (Samda A)

Theoretical and Practical Aspects of Type-2 Fuzzy Systems

Jerry Mendel, Bob John, and Hani Hagrass

Tutorial T4 (Samda B)

Bacterial Algorithms in Building Fuzzy Models from I/O Data

Laszlo T. Koczy

Tutorial T5 (Room #302)

Lattice and Poset Valued Fuzzy Structures: from Theory to Applications

Branimir Seselja and Andreja Tepavcevic

Thursday, August 20, 17:30-19:00

Welcome Reception (Delizia)

Friday, August 21, 09:00-09:10

Opening Ceremony (Halla Hall)

Opening Address

Hong Tae Jeon, General Chair

Friday, August 21, 09:10-10:10

Keynote #1 (Halla Hall)

Spatial Reasoning: from Sketch-To-Text towards Text-To-Sketch

James Keller, University of Missouri

Friday, August 21, 10:30-12:30

Fri 10:30-12:30

Samda A

G01: Fuzzy Control and Robotics, Sensors, Fuzzy Hardware, Fuzzy Architectures I

Chair: Jimmy Lauber, LAMIH-University of Valenciennes

1. Relaxed LMI-Based Stability Conditions for Takagi-Sugeno Fuzzy Control Systems Using Regional Membership-Function-Shape-Dependent Analysis Approach

Mohammad Narimani, Hak-Keung Lam

This paper presents relaxed stability conditions for Takagi-Sugeno fuzzy-model-based (FMB) control systems. Similar to many previous approaches, stability conditions are represented in the form of multi-dimensional fuzzy summation. To investigate the system stability, the inequalities of p -dimensional fuzzy summation are expanded to n -dimensional fuzzy summation (n, p). Then the boundary and regional information of membership functions are utilized for relaxation of stability analysis results. In the first step the lower and upper bounds of the membership functions and its products from 2 to n in the full operating domain are considered in the stability analysis. This approach is named Global-Membership-Function-Shape-Dependent (GMFSD). The second approach is named Regional-Membership-Function-Shape-Dependent (RMFSD) of which the operating region is partitioned to sub-regions and the boundary information of membership functions on each operating sub-region is employed to facilitate the stability analysis for further relaxation of stability conditions. Numerical example is given to demonstrate the effectiveness of the proposed stability conditions.

2. Tracking-Error Model-Based PDC Control for Mobile Robots with Acceleration Limits

El-Hadi Guechi, Jimmy Lauber, Michel Dambrine, Saso Blazic, Gregor Klančar

This paper presents a new technique for tracking error model-based PDC control for nonholonomic vehicles. Briefly, this technique consists of rewriting the kinematic error model of the tracking problem for mobile robot into a fuzzy TS representation and finding a stabilizing controller by solving LMI conditions for tracking-error model. The state variables are filtered using a TS fuzzy observer. The reference trajectory is built with taking into account the acceleration limits of the mobile robot. Experimental results are presented here to show the efficiency of the proposed approach.

3. SOS-Based Stability Analysis of Takagi-Sugeno Fuzzy Control Systems via Polynomial Membership Functions

Mohammad Narimani, Hak-Keung Lam

This paper presents stability analysis of fuzzy model-based control systems using Sum-Of-Squares (SOS) approach. Based on the T-S fuzzy model, a fuzzy controller is employed to close the feedback loop to form a FMB control system. It is assumed that the membership functions of TS fuzzy model and fuzzy controller are not necessarily the same. One of the drawbacks in the existing approaches is that the information of membership functions are not brought into stability analysis. Then the stability conditions are valid for any shape of membership functions. As a result it may lead to conservative stability conditions. To take the membership functions' information into stability analysis, SOS approach is employed. The operating domain of membership functions is partitioned to sub-regions. Then corresponding to each product term of membership functions in each sub-region an approximated polynomial is derived to facilitate the stability analysis. Based on the derived conditions in all of the sub-regions applying the

Lyapunov stability, SOS-based conditions are derived. The solution of the SOS-based stability conditions can be found effectively using the SOSTOOLS which is a free third-party MATLAB Toolbox. Numerical example is given to illustrate the effectiveness of the proposed stability conditions.

4. A Fuzzy Decentralized Sliding-Mode Robust Adaptive Under-Actuated Control for Autonomous Dynamic Balance of an Electrical Bicycle

Chih-Lyang Hwang, Hsiu-Ming Wu, Ching-Long Shih

Based on the previous studies, the dynamic balance of an electrical bicycle includes two control inputs: steering and pendulum torques, and three system outputs: steering, lean and pendulum angles. Two novel reference signals are first designed so that the uncontrolled mode is simultaneously included into these two control modes. Two scaling factors for each subsystem are first employed to normalize the sliding surface and its derivative. The so-called fuzzy decentralized sliding-mode under-actuated control (FDSMUC) is first designed. Because the uncertainties of a bicycle system, caused by different ground conditions, gusts of wind, and interactions among subsystems, are often huge, an extra compensation of learning uncertainty is plunged into FDSMUC to enhance system performance. We call it as “fuzzy decentralized sliding-mode adaptive under-actuated control” (FDSMAUC). To avoid the unnecessary transient response and then destroy the balance of the bicycle, the combination of FDSMUC and FDSMAUC with a transition (i.e., fuzzy decentralized sliding-mode robust adaptive under-actuated control, FDSMRAUC) is designed. Finally, the compared simulations for an electrical bicycle among the FDSMUC, FDSMAUC and FDSMRAUC validate the efficiency of the proposed method.

5. Seismic Response Control of a Large Civil Structure Equipped with Magnetorheological Dampers

Yeesock Kim, Reza Langari, Stefan Hurlbaas

This paper proposes a systematic design framework for vibration control of seismically excited civil structures employing magnetorheological (MR) dampers. The framework consists of nonlinear system identification and semiactive nonlinear control system: (1) a multi-input, multi-output (MIMO) autoregressive exogenous (ARX) input model-based Takagi-Sugeno (TS) fuzzy identifier is applied to a large building structure equipped with highly nonlinear hysteretic MR dampers subjected to earthquake disturbances (2) Based on the identified building-MR damper system model, a set of Lyapunov-based controllers are designed such that the building-MR damper system is globally asymptotically stable and its performance on transient responses is also satisfied. To demonstrate the performance of the proposed design framework, a twenty-story building structure employing multiple MR dampers is studied. It is shown from the simulation that the proposed control system design framework is effective to mitigate seismically excited responses of a large building-MR damper system.

6. Relaxed Stability Conditions for Discrete-Time Fuzzy-Model-Based Control Systems

Ginny Y. Wong, Frank H. Leung, Hak-Keung Lam

This paper presents the stability conditions for discrete-time fuzzy-model-based control systems subject to parameter uncertainties. The nonlinear plant subject to parameter uncertainties is represented by a Takagi-Sugeno fuzzy model with uncertain grades of memberships. Relaxed stability conditions for this class of fuzzy control systems will be derived to guarantee the system stability. A numerical example will be presented to show the effectiveness of the proposed approach.

N01: Fuzzy Set Theory, Fuzzy Measures, Fuzzy Integrals I

Chair: Qiang Shen, Aberystwyth University

1. A Novel Framework of Fuzzy Complex Numbers and Its Application to Compositional Modelling

Xin Fu, Qiang Shen

Dealing with various inexact pieces of information has become an intrinsically important issue in knowledgebased reasoning, because many problem domains involve imprecise, incomplete and uncertain information. Indeed, different approaches exist for reasoning with inexact knowledge and data. However, the common strategy they adopt is to integrate various types of inexact information into a global measure. This may destroy the underlying semantics associated with different information components. This paper presents an innovative notion of fuzzy complex numbers (FCNs), which extends real complex numbers to representing two-dimensional uncertainties conjunctively without necessarily integrating them. This new framework is applied to supporting Compositional Modelling (CM). In particular, calculus of FCNs over arithmetic and propositional relations is developed to entail scenario model synthesis from model fragments, and modulus of FCNs is introduced to constrain the scenario descriptions. The utility and usefulness of this work are illustrated by means of an example for constructing possible scenario descriptions from given evidence in the crime investigation domain.

2. Towards Adaptive Interpolative Reasoning

Longzhi Yang, Qiang Shen

Fuzzy interpolative reasoning has been extensively studied due to its ability to enhance the robustness of fuzzy systems and to reduce system complexity. However, during the interpolation process, it is possible that multiple object values for a common variable are inferred which may lead to inconsistency in interpolated results. Such inconsistencies may result from defective interpolated rules or incorrect interpolative transformations. This paper presents a novel approach for identification and correction of defective rules in transformations, thereby removing the inconsistencies. In particular, an assumption-based truth maintenance system (ATMS) is used to record dependencies between reasoning results and interpolated rules, while the underlying technique that the general diagnostic engine (GDE) employs for fault localization is adapted to isolate possible faulty interpolated rules and their associated interpolative transformations. From this, an algorithm is introduced to allow for the modification of the original linear interpolation to become first-order piecewise linear. The approach is applied to a carefully chosen practical problem to illustrate the potential in strengthening the power of interpolative reasoning.

3. Fuzzy Portfolio Selection Problem under Uncertain Exit Time

Wei Chen, Shaohua Tan

Uncertainty over exit time is an important practical issue faced by most investors. In this paper, we introduce the notations of the possibilistic mean, variance and covariance of fuzzy numbers to generalize Markowitz analysis. In the first time, we consider the uncertain investment period from the point of view of possibilistic analysis, and build the possibilistic models of portfolio selection under the situations involving uncertainty over the time horizon. The exit time can be either independent or dependent of asset price behavior. Moreover, a numerical example is presented to show the application of our results.

4. A New Kind of Fuzzy Relation Equations

Feng Qin, Ping Fang

In this paper, a new kind of fuzzy relation equations (FREs for short) $A \circ^{R^*} x = b$ is first introduced, and then the problem of solving solution to the FREs is discussed, where A is an $m \times n$ matrix, x and b are an n and an m dimension column vectors, respectively. More specifically, its solvability and unique solvability are investigated, the corresponding necessary and sufficient conditions are presented, the complete solution set is obtained. It is worth noting the method to construct the complete solutions set.

5. Contrapositive Symmetry of Distributive Fuzzy Implications Revisited

Yang Li, Qin Feng

In this paper, we explore the solution of functional equations $I(x, T(y, z)) = T(I(x, y), I(x, z))$ and $I(x, y) = I(N(y), N(x))$ satisfied simultaneously, where T is a strict tnorm, I a fuzzy implication and N a strong negation. Under the assumptions of I continuous except the points $(0, 0)$ and $(1, 1)$, we get the full characterizations of the solutions for this functional equations.

6. Approximate Fuzzy Preorders and Equivalences

Dionis Boixader, Jordi Recasens

Although Fuzzy Preorders and Fuzzy Equivalences are well established types of fuzzy relations, they are defined in terms of properties to be fulfilled in a crisp way. In this paper we relax those requirements by making them gradual in some way. As a result, a number of relations which are not strictly reflexive, symmetric or transitive with respect to any t-norm T , would be regarded as (Approximate) Fuzzy Preorders or Equivalences.

Fri 10:30-12:30

Room #302

SS27: Application of Fuzzy Logic to Intelligent Transportation Systems

Chair: Goutam Chakraborty, Iwate Prefectural University

1. Autonomous Car Fuzzy Control Modeled by Iterative Genetic Algorithms

Enrique Onieva, Javier Alonso, Joshu'E P'Erez, Vicente Milan'Es, Teresa De Pedro

The techniques of Soft Computing are recognized as having a strong learning and cognition capability as well as good tolerance to uncertainty and imprecision. These properties allow them to be applied successfully to Intelligent Transportation Systems (ITS), a broad range of diverse technologies that designed to answer many transportation problems. The unmanned control of the steering wheel is one of the most important challenges faced by researchers in this area. This paper presents a method of automatically adjusting a fuzzy controller to manage the steering wheel of a mass-produced vehicle. Information about the state of the car while a human driver is handling it is captured and used to search, via genetic algorithms, for the best fit of an appropriate fuzzy controller. Evaluation of the fuzzy controller will take into account its adjustment to the human driver's actions and the absence of abrupt changes in its control surface, so that not only is the route tracking good, but the drive is smooth and comfortable for the vehicle's occupants.

2. Adaptive Backoff Scheme for Contention-Based Vehicular Networks Using Fuzzy Logic

Tamer Abdelkader, Kshirasagar Naik, Amiya Nayak, Fakhry Karray

In contention-based wireless networks, collisions between data packets can be reduced by introducing a random delay before each transmission. Backoff schemes are those that provide the backoff interval from which the random delay is drawn. In this paper, we propose a new scheme which calculates the backoff interval dynamically according to the network conditions. The network conditions are measured locally by each node, which supports the distributed nature of the vehicular networks. The measures are used by a fuzzy inference system to calculate the backoff interval. We compare the proposed scheme with other known schemes: the binary exponential backoff (BEB), the sensing backoff algorithm (SBA) and an optimal scheme which requires the knowledge of the number of nodes in the network (Genie). The evaluation measures are the throughput and fairness. Results show an improvement of the fuzzy-based schemes compared to the BEB and SBA, especially for large number of nodes in the network.

3. Distributed Multi-Agent Type-2 Fuzzy Architecture for Urban Traffic Signal Control

Balaji Parasumanna, Dipti Srinivasan

Rapid advances made in vehicle technology and increased level of urbanization have caused an exponential increase in road traffic congestion levels. This has necessitated the implementation of intelligent traffic responsive signal controllers capable of maintaining the saturation levels in each link thereby reducing congestion and increasing utilization of existing infrastructure. This paper presents one such distributed multi-agent architecture based on weighted type-2 fuzzy inference engine for the urban traffic signal control. Agents have been programmed in PARAMICS microscopic traffic simulator and tested on a simulated section of Central Business District in Singapore with twenty five interconnected intersections. A comparative analysis of the proposed architecture with the existing traffic signal controller HMS - Hierarchical multi-agent system, was performed for two different traffic scenarios. The results clearly indicates better performance of the proposed agent architecture over the benchmark controller and offers scope for improvement in the future.

4. KCMAC-TSK: A Fuzzy Cerebellar Model with Localized TSK Learning for Non-Linear System Identification

Sintiani Dewi Teddy, See Kiong Ng

Many real-world systems exhibit complex dynamic nonlinear characteristics that cannot be modeled by typical statistical and machine learning models. The human cerebellum is a vital part of the brain system that possesses the capability to accurately model highly nonlinear physical dynamics. We can exploit our increasing knowledge of the human cerebellum to construct an intelligent computational model to effectively handle the complexity of nonlinear dynamic systems in the real world. This paper presents a novel braininspired computational model of the human cerebellum named the kernel density-based CMAC with Takagi-Sugeno-Kang fuzzy inference model (KCMAC-TSK) for fast and accurate nonlinear system identification. The structure of the KCMAC-TSK model is inspired by the neurophysiological aspects of cerebellar learning and development process. By incorporating a fuzzy model in KCMAC-TSK using kernel density estimation, we enhance the modeling capability, accuracy, and interpretability of the system. We applied the proposed KCMAC-TSK model in a challenging highway traffic flow modeling and prediction problem. Experimental results showed that KCMAC-TSK outperformed current modeling techniques, demonstrating the learning accuracy and effectiveness of KCMAC-TSK in handling complex nonlinear dynamic real-world systems.

5. An Adaptive Alert Message Dissemination Protocol for VANET to Improve Road Safety

Kanitsorn Suriyapaiboonwattana, Chotipat Pornavalai, Goutam Chakraborty

Vehicular Ad-hoc Network (VANET) is gaining much attention recently because of its many important applications in transportation, to improve road safety, reduce traffic congestion, to enable efficient traffic management etc. However, there are several technical issues to be addressed for its effective deployment. Stability in communication in VANET is difficult to achieve due to rapid network changes. Restoration is inefficient while using traditional protocols based on broadcast storm. In this paper, we propose a new adaptive protocol to improve performance for on road safety alert application in VANET. It can alleviate the broadcast storm problem using adaptive wait-windows and adaptive probability to transmit. Simulation shows that our proposed approach has better performances in terms of number of collision, success rate, and delay, when compared with other existing protocols.

6. Fuzzy-Genetic Approach for Incorporation of Driver's Requirement for Route Selection in a Car Navigation System

Basabi Chakraborty, Rung Ching Chen

Car navigation systems are now widely used as a component for intelligent transportation systems. Route planning is the most important task of car navigation systems. Though modern car navigation systems incorporate various road information, even dynamic information, to generate optimal route, but they are yet to present routes according to driver's requirements or preferences. Most of the car navigation systems present a single best route or alternate routes according to systems predefined choices which may not satisfy the driver. In this work a fuzzy genetic approach is proposed to generate alternate routes according to driver's requirement and choice with fine tuning by using feed back mechanism. A simple simulation experiment proves the effectiveness and importance of the concept for developing more user friendly car navigation system with an outline of implementation.

Fri 10:30-12:30

Room #303

SS15: Fuzzy Methods for Data Mining and Knowledge Discovery

Chair: Daniel Sanchez, University of Granada

1. Generation of Synthetic Data by Means of Fuzzy C-Regression

Isaac Cano, Vicenc Torra

Problems related to data privacy are studied in the areas of privacy preserving data mining (PPDM) and statistical disclosure control (SDC). Their goal is to avoid the disclosure of sensitive or proprietary information to third parties. In this paper a new synthetic data generation method is proposed and the information loss and disclosure risk are measured. The method is based on fuzzy techniques. Informally, a fuzzy c-regression method is applied to the original data set and synthetic data is released with an appropriate information loss and disclosure risk depending on c . As other data protection methods do, our synthetic data generation procedure allows third parties to do some statistical computations with a limited risk of disclosure. The trade-off between data utility and data safety of our proposed method will be assessed.

2. Hybrid Fuzzy-Rough Rule Induction and Feature Selection

Richard Jensen, Chris Cornelis, Qiang Shen

The automated generation of feature patternbased if-then rules is essential to the success of many intelligent pattern classifiers, especially when their inference results are expected to be directly human-comprehensible. Fuzzy and rough set theory have been applied with much success to this area as well as to feature selection. Since both applications of rough set theory involve the processing of equivalence classes for their successful operation, it is natural to combine them into a single integrated method that generates concise, meaningful and accurate rules. This paper proposes such an approach, based on fuzzy-rough sets. The algorithm is experimentally evaluated against leading classifiers, including fuzzy and rough rule inducers, and shown to be effective.

3. Finding Fuzzy Association Rules via Restriction Levels

Carlos Molina, Daniel Sanchez, Jose-Maria Serrano, Maria-Amparo Vila

Association rule mining is a helpful tool to discover relations between items in transactions. But in some scenarios, it is also interesting to consider not only the presence of items, but the absence of them. In this paper, we introduce a methodology to obtain fuzzy association rules involving absent items. Additionally, our proposal is based on restriction level sets, a recent representation of fuzziness that extends that of fuzzy sets, and introduces some new operators, covering some misleading results obtained from usual fuzzy operators as, for example, negation. In our methodology, we define new measures for fuzzy association rules as RL-numbers, as well as we propose a new way of summarizing the resulting set of fuzzy association rules, distributed in restriction levels.

4. Fuzzy Association Rule Mining Algorithm for Fast and Efficient Performance on Very Large Datasets

Ashish Mangalampalli, Vikram Pudi

Fuzzy association rules use fuzzy logic to convert numerical attributes to fuzzy attributes, like "Income = High", thus maintaining the integrity of information conveyed by such numerical attributes. On the other hand, crisp association rules use sharp partitioning to transform numerical attributes to binary ones like "Income = [100K and above]", and can potentially introduce loss of information due to these sharp ranges. Fuzzy Apriori and its different variations are the only popular fuzzy association rule mining (ARM) algorithms available today. Like the crisp version of Apriori, fuzzy Apriori is a very slow and inefficient algorithm for very large datasets (in the order of millions of transactions). Hence, we have come up with a new fuzzy ARM algorithm meant for fast and efficient performance on very large datasets. As compared to fuzzy Apriori, our algorithm is 8-19 times faster for the very large standard real-life dataset we have used for testing with various mining workloads, both typical and extreme ones.

A novel combination of features like two-phased multiplepartition tidlist-style processing, byte-vector representation of tidlists, and fast compression of tidlists contribute a lot to the efficiency in performance. In addition, unlike most twophased ARM algorithms, the second phase is totally different from the first one in the method of processing (individual itemset processing as opposed to simultaneous itemset processing at each k -level), and is also many times faster. Our algorithm also includes an effective preprocessing technique for converting a crisp dataset to a fuzzy dataset.

5. Improved Method for Linguistic Expression of Time Series with Global Trend and Local Features

Motohide Umamo, Mitsuhiro Okamura, Kazuhisa Seta

We have various kinds of time series such as stock prices. We understand them via their linguistic expressions in a natural language rather than conventional stochastic models. We propose

an improved method to have a linguistic expression with a global trend and local features of time series. A global trend is extracted via aggregated values on the fuzzy intervals in the temporal axis and local features are specified as the positions of locally large differences between the original data and the data representing the global trend. We apply the method to the data of Multimodal Summarization for Trend Information (MuST).

6. Study of Fuzzy Resemblance Measures for DNA Motifs

Fernando Garcia, Francisco J. Lopez, Carlos Cano, Armando Blanco

TFBSs are known as regulatory motifs and can be represented as position frequency matrices (PFMs). The de novo identification of transcription factor binding sites (TFBSs) is a crucial problem in computational biology and includes the issue of comparing putative TFBSs to one another and to already known TFBSs. To date there is no fuzzy approach for this problem. In this work we propose the use of fuzzy measures to deal with motif comparison tasks. We investigate the behavior of different classes of classical measures for fuzzy sets including set-theoretic (Jaccard's method), proximity-based (Minkowsky's r-metric), angular coefficient-based (Bhattacharyya's distance) and a measure defined for the fuzzy polynucleotide space. We show that fuzzy measures provide excellent results when dealing with sets of randomly generated motifs and outperforms other existing measures when facing datasets of real motifs.

Fri 10:30-12:30

Room #401

SS16: Fuzzy Inference Systems - Theory and Applications

Chair: Toshihiko Watanabe, Osaka Electro-Communication University

1. On the Computational Aspects of the BK-Subproduct Inference Mechanism

Martin Št'epnička, Balasubramaniam Jayaram

The compositional rule of inference (CRI) is widely used in approximate reasoning schemes using fuzzy sets. In this work we discuss the suitability of the Bandler-Kohout subproduct for an alternative inference mechanism from the computational point of view.

2. Methods of Interpretation of a Non-Stationary Fuzzy System for the Treatment of Breast Cancer

Xiao-Ying Wang, Jonathan M. Garibaldi, Shang-Ming Zhou, Robert I. John

Recommending appropriate follow-up treatment options to patients after diagnosis and primary (usually surgical) treatment of breast cancer is a complex decision making problem. Often, the decision is reached by consensus from a multi-disciplinary team of oncologists, radiologists, surgeons and pathologists. Non-stationary fuzzy sets have been proposed as a mechanism to represent and reason with the knowledge of such multiple experts. In this paper, we briefly describe the creation of a non-stationary fuzzy inference system to provide decision support in this context, and examine a number of alternative methods for interpreting the output of such a non-stationary inference system. The alternative interpretation methodologies and the experiments carried out to compare these methods are detailed. Results are presented which show that using majority voting ensemble decision making from a non-stationary fuzzy system improves accuracy of the decision making. We conclude that non-stationary systems coupled with ensemble interpretation methods are worthy of further exploration.

3. Analysis and Design of Monotonic Type-2 Fuzzy Inference Systems

Chengdong Li, Jianqiang Yi, Dongbin Zhao

The prior knowledge – monotonicity property – is helpful for system analysis, modeling and design, especially when no specific physical structure knowledge about systems is available. This paper presents how to use interval type-2 fuzzy logic systems (IT2FLSs) to incorporate the monotonicity property into system design. First, we present sufficient conditions on the parameters of IT2FLSs to ensure the monotonicity between the inputs and outputs of IT2FLSs. Then, we transform the design of monotonic IT2FLSs to the least squares problem with linear-inequality constraints. At last, simulations are given to show the usefulness of the monotonicity property and the advantages of monotonic IT2FLSs under noisy circumstances.

4. Comparison of Neuro-Fuzzy Based Techniques in Nasopharyngeal Carcinoma Recurrence Prediction

Orrawan Kumdee, Hirosato Seki, Hiroaki Ishii, Thongchai Bhongmakapat, Panrasee Ritthipravat

This paper aims to compare neuro-fuzzy based techniques for effective prediction of nasopharyngeal carcinoma (NPC) recurrence. The techniques include an artificial neural network (ANN), adaptive neuro-fuzzy inference systems (ANFIS), the functional-type single input rule modules connected fuzzy inference method (F-SIRMs method) and the functional and neural network type SIRMs method (FNN-SIRMs method). All models are produced to predict the presence or absence and timing of the NPC recurrence. Five years predictions are carried out. Validity of each predictive model is assured by 10-fold cross validation. The results show that the F-NN-SIRMs method is superior to the other techniques in a sense that it provides the higher prediction performance.

5. Linguistic Rulesets Extracted from a Quantifier-Based Fuzzy Classification System

Khairul A. Rasmani, Jonathan M. Garibaldi, Qiang Shen, Ian O. Ellis

The use of linguistic rulesets is considered one of the greatest advantages that fuzzy classification systems can offer compared to non-fuzzy classification systems. This paper proposes the use of fuzzy thresholds and fuzzy quantifiers for generating linguistic rulesets from a data-driven fuzzy submethod-based classification system. The proposed technique offers not only simplicity in the design and comprehensibility of the generated rulesets but also practicality in the implementation. Additionally, the use of fuzzy quantifiers makes it easier for the user to understand the classification process and how such classifications were reached. The effectiveness of the proposed method is demonstrated using a medical dataset which provides evidence that rules generated by the proposed system are consistent with the expert-rules created by clinicians.

6. On the Equivalence of SIRMs Connected Fuzzy Inference Method

Hirosato Seki

This paper addresses equivalence of fuzzy inference methods. It first presents fuzzy inference methods: the product-sum-gravity method, fuzzy singleton-type inference method and single input rule modules connected type fuzzy inference method (SIRMs method). Secondly, three fuzzy inference methods of the product-sum-gravity method, fuzzy singleton-type inference method and SIRMs method which are all widely used as fuzzy control methods are shown to be equivalent to each other. Finally, we propose a "fuzzy singleton-type SIRMs method" as weighted SIRMs method, and also shown to be the equivalent between the proposed SIRMs method and above three fuzzy inference methods.

SS08A: Human Symbiotic System I

Chair: Yoichiro Maeda, University of Fukui

1. View Estimation Learning Based on Value System

Yasutake Takahashi, Kouki Shimada, Minoru Asada

Estimation of a caregiver's view is one of the most important capabilities for a child to understand the behavior demonstrated by the caregiver, that is, to infer the intention of behavior and/or to learn the observed behavior efficiently. We hypothesize that the child develops this ability in the same way as behavior learning motivated by an intrinsic reward, that is, he/she updates the model of the estimated view of his/her own during the behavior imitated from the observation of the behavior demonstrated by the caregiver based on minimizing the estimation error of the reward during the behavior. From this view, this paper shows a method for acquiring such a capability based on a value system from which values can be obtained by reinforcement learning. The parameters of the view estimation are updated based on the temporal difference error (hereafter TD error: estimation error of the state value), analogous to the way such that the parameters of the state value of the behavior are updated based on the TD error. Experiments with simple humanoid robots show the validity of the method, and the developmental process parallel to young children's estimation of its own view during the imitation of the observed behavior demonstrated by the caregiver is discussed.

2. Gait Learning Method for Quadrupedal Robot Based on Subjective Human Feeling

Hitoshi Nishi, Hidekazu Suzuki, Koji Taki

In the field of pet robots and robot-assisted therapy (RAT), characterization of animal motion is important for the development of robots resembling various animals. This paper presents a method for the generation of animal gait in quadrupedal robots. In this study, we employed AIBO as an experimental quadrupedal robot and generated the gait of the robot on the basis of an animal's gait. First, we optimized the mono-leg orbit, which can efficiently output a propulsive force, by imitating a dog's gait using a genetic algorithm. Moreover, we generated the quadrupedal gait of AIBO using both the optimum orbit of the mono-leg and an animal's gait, classified as the gait of a walking dog based on zoology. Furthermore, we administered a questionnaire study to determine subjective human feelings to choose the best gait for AIBO from among the various gaits mentioned above. Finally, minor deviation of parameters for each joint was corrected to realize the stable gait on the ground.

3. Fuzzy Contour Tracking of Human Silhouettes

Timothy C. Havens, Gregory L. Alexander, James M. Keller, Marjorie Skubic, Marilyn Rantz

Video-based tracking of contours on the human body has been shown to be useful for many applications, including gait and gesture recognition, posture estimation, and activity analysis. We present a contour tracking method that incorporates a novel edge feature and fuzzy contour template. We apply our method in tracking the motions of older adults exercising in a gym environment. The output of our system is a dynamic fuzzy representation of the spine angle of the subject. We show that the method described in this paper is capable of tracking contours even in cases where human silhouette extraction is poor.

4. Development of RC Helicopter Control Skill Study Support System in Consideration of User Interface

Junichi Kunieda, Yukinobu Hoshino

The purpose of our research is the acquisition of Radio Control helicopter control skill for the beginners. We developed the learning system about both study support and control support. And, we aim at making the system an effective learning system. This system consists of three subsystems of the acquisition of the basic knowledge that considered User Inter-face, and flight simulator, and the control support system is mounted on RC helicopter. The camera and the sensor are mounted on the RC helicopter. The information is overlapped with the camera image and the control support screen on Head Mounted Display. This system supports the easy under-standing of RC helicopter control to the beginners. We per-formed the usability evaluation about a presentation image and we aimed to develop the learning system more efficient.

Fri 11:50-12:30

Room #402

Invited Session**Introduction and Discussion Computer Go**

Chair: Robert John, De Montfort University, UK

Friday, August 21, 14:00-15:40

Fri 14:00-15:20

Samda A

A01: Adaptive, Hierarchical, Evolutionary, Neural and Nature-Inspired Systems I

Chair: Chai Quek, Nanyang Technological University

1. A Hypothalamic and Piagetian Fuzzy Inference System: Htpfis

Eng Yeow Cheu, See Kiong Ng, Chai Quek

This paper presents a new approach to solving model externalization by taking into consideration the imprecise nature of decision makers' judgements on the different tacit models. Knowledge in the form of fuzzy rules are created using a neuro-fuzzy system called the Hypothalamic and Piagetian Fuzzy Inference System (HtPFIS). The structure of HtPFIS is inspired from the simplified neuronal circuitries of the preoptic area and anterior hypothalamus (PO/AH) which are involved in the thermoregulation of body temperature. HtPFIS employs a novel structure learning algorithm that is inspired from the Piaget's constructivist emphasis of action-based cognitive development in human. Results from the experiments show that HtPFIS is able to represent the formulated explicit model using a set of concise fuzzy rules knowledge base, and achieve better or comparable generalization than other models.

2. Robust Adaptive Fuzzy Control for Nonlinear Uncertain Systems with Unknown Dead-Zone and Unknown Upper Bound of Uncertainties

Chih-Lyang Hwang, Chiang-Cheng Chiang, Wei-Yu Chen

In this paper, a robust adaptive fuzzy control for a class of nonlinear uncertain systems preceded by an unknown dead-zone and with unknown upper bound of uncertainties is developed. The dead-zones are quite commonly encountered in many systems (e.g., DC servosystem, robot, and machine tools), are usually poorly known, and may severely limit the performance of control. In addition, the system uncertainties (e.g., parameter variations, or

external load, unmodeled dynamics) often exist. Therefore, the controllers are required to deal with the robust stability and performance of the systems with unknown dead-zone and in the presence of uncertainties, whose upper bound is generally unknown. In the beginning, an adaptive dead-zone compensation is employed to improve system performance. Then the unknown system functions and the unknown upper bound of system uncertainties are respectively approximated by fuzzy logic systems with unknown weights. The unknown bounds caused by the learning error of the slope of dead-zone and the system functions are also tackled by an extra learning law. The above weights are all on-line learned to provide for the controller design. Moreover, the projection terms in these learning laws are designed such that the boundedness of the learning weight can be assured.

3. RSFCMAC: A Novel Rough Set-Based Rule Reduction Approach for Fuzzy CMAC Architecture with Yager-Inference-Scheme

Ngoc Nam Nguyen, Chai Quek

The strength of neuro-fuzzy systems involves two contradictory requirements in neuro-fuzzy modeling: interpretability versus accuracy. The Yager-Inference-Scheme-Based Fuzzy CMAC (FCMAC-Yager) architecture shows advantages such as it exhibits learning and memory capabilities of the human cerebellum through the CMAC (cerebellar model articulation controller) structure and the human way of reasoning through the Yager inference scheme. However, it suffered from an exponential increase in the number of identified fuzzy rules and computational cost arising from high-dimensional data. This diminishes the interpretability of the FCMAC-Yager network in linguistic fuzzy modeling. This paper proposes a novel rough set-based rule reduction (RSFCMAC) approach for the established FCMAC-Yager architecture. RSFCMAC algorithm used in the FCMAC-Yager network can help to provide better generalization, to reduce the number of fuzzy rules and computational cost. The proposed algorithm not only performs reduction of redundant fuzzy rules, but also carries out reduction of redundant input attributes. Experiments using real-world application involving stock movement and highway traffic flow prediction were conducted to evaluate the performance of the proposed RSFCMAC against the FCMAC-Yager network and other published results of cross-architectures using globalized learning as well as similar architectures employing localized learning. The results are encouraging.

4. Categorization of News Articles Using Neural Text Categorizer

Taeho Jo

This research proposes the application of NTC (Neural Text Categorizer) for categorizing news articles. Even if the research on text categorization has been progressed very much, documents should be still encoded into numerical vectors. Encoding so causes the two main problems: huge dimensionality and sparse distribution. The idea of this research as the solution to the problems is to encode documents into string vectors and apply the NTC as a string vector based approach to text categorization. The idea will be described in detail and validated.

Fri 14:00-15:20

Samda B

L: Knowledge Discovery, Learning, Reasoning, Agents, Knowledge Representation

Chair: Bernadette Bouchon-Meunier, Universite Pierre Et Marie Curie - Paris 6

1. Towards Spatial Reasoning in Fuzzy Description Logics

Umberto Straccia

Fuzzy Description Logics are logics which allow to deal with structured knowledge affected by vagueness. Although a relatively important amount of work has been carried out in the last years, fuzzy DLs are open to be extended with several features worked out in the fuzzy logic literature. In this work, we extend fuzzy DLs towards supporting fuzzy spatial reasoning and, thus, offer a framework for modeling spatial relations such as "region a is part of region b, which is connected to region c, a is close to c and b is right over c".

2. Mapping Natural Language to Imagery: Placing Objects Intelligently

Isaac J. Sledge, James M. Keller

Humans are endowed with innate faculties, which allow for reasoning in noisy or uncertain environments, that far surpass the current abilities of computing systems. One such example is the notion of forming a "sketch" of some real-world location or route from a series of linguistic descriptions of regions and surrounding landmarks. While mirroring this functionality might seem like a daunting computational task, it is possible, to a certain degree, to mimic many of the underlying humanistic processes. Out of these, the facet that we consider in this paper is iterative object placement from a set of language extracted spatial relations and dependencies.

3. Interpretable Decisions by Means of Similarities and Modifiers

Bernadette Bouchon-Meunier

The interpretability of decisions on the basis of approximate descriptions of situations is approached by means of the use of linguistic modifiers. The closeness between two descriptions is evaluated by means of the measure of their differences. An analogy-based reasoning method is proposed in compatibility with fuzzy deductive reasoning, using linguistic modifiers.

4. Input Selection in Learning Systems: A Brief Review of Some Important Issues and Recent Developments

Chenglin Hu, Feng Wan

Input selection is a crucial step for learning systems especially when in system modeling and identification the dataset is with a large number of variables, as a redundant input usually impairs the transparency of the underlying model and also increases the complexity of computation. The primary objective of input selection is to select the relevant inputs under the available information. This paper gives a brief review of some important issues and recent developments in the literature.

Fri 14:00-15:20

Room #302

Q: Software and Hardware Applications

Chair: Richard Jensen, Aberystwyth University

1. VLSI Implementation of a Module for Realization of Basic T-Norms on Fuzzy Hardware

Antonio Hernandez Zavala, Oscar Camacho Nieto, Ildar Batyrshin, Luis Villa Vargas

Fuzzy theory applications have been explored and analyzed on fields as pattern recognition, control, data classification, signal processing, expert systems, among others. To accomplish this, more complex calculations and faster processing speed are required, turning fuzzy hardware implementation to be the perfect choice. Fuzzy operations as tnorms and t-conorms are used in fuzzy

systems as conjunction and disjunction operations respectively. Commonly used t-norms for hardware implementation are minimum and algebraic product, first one is cheaper to implement; second consumes more resources. On this work FPGA technology is used to implement basic fuzzy t-norms as minimum, Lukasiewicz and drastic product into an 8 bit single circuit that allows operation selection. Timing, resources and comparative results are presented.

2. Generation of Optimal Trajectories for Ascending and Descending a Stair of a Humanoid Based on uDEAS

Eun-Su Kim, Jo-Hwan Kim, Jong-Wook Kim

In this paper, a humanoid is simulated and implemented to walk up and down a staircase using the blending polynomial and univariate dynamic encoding algorithm for searches (uDEAS). The motivation of this paper is to divide efficient walking step for a commercial humanoid when ascending and descending a stair. Therefore ascending and descending a staircase are each scheduled by four steps. Each step mimics natural gait of human being and is easy to analyze and implement. Optimal trajectories of ten motors in a lower extremity of a humanoid are rigorously computed to simultaneously satisfy stability condition, walking constraints, and energy efficiency requirements. As an optimization method, uDEAS is applied to search optimal trajectory parameters in blending polynomials. The feasibility of this approach will be validated by simulation with a commercial humanoid robot.

3. Textual Information and Correspondence Analysis in Curriculum Analysis

Masaaki Ida

Correspondence analysis has been used in text mining to deepen global understanding on the characteristics of categorized accumulated textual information, and may lead to new knowledge discovery. However, difficulty in category classification for textual information remains. This article presents a new analysis method for higher education curriculum textual information utilizing corresponding analysis with a library classification.

4. Potential Applications of Fuzzy Logic in Music

Asim Egemen Yilmaz, Ziya Telatar

Even though the application spectrum of the fuzzy logic is quite wide, fuzzy based implementations in music are rarely encountered. In this study, we try to give the definitions of the problems in music theory; and we try to adapt fuzzy based reasoning particularly for the counterpoint problem. Despite the fact that this study is currently limited to note-against-note two-voice counterpoint technique, the approach can be extended to more complicated problems of harmonization (either vocal or orchestral), improvisation, and even composition.

the parameters and to improve the performance of the SIRMs based type-2 fuzzy logic controller (SIRM-T2FLC). At last, simulations and comparisons are given to demonstrate the effectiveness, robustness and superiority of the proposed controller under three circumstances: normal case, the disturbance existing case, and the parameter varying case. From the design process and comparisons, it can be seen that: 1) this SIRMs based type-2 fuzzy control scheme can alleviate the difficulty to design conventional type-2 fuzzy logic controllers (T2FLCs) for this multivariable TORA system, 2) the SIRM-T2FLC is much easier to design and understand compared with conventional nonlinear control strategies for the TORA system, 3) better performance can be achieved.

2. Similarity-Based Perceptual Reasoning for Perceptual Computing

Dongrui Wu, Jerry Mendel

Perceptual reasoning (PR) is an approximate reasoning method that can be used as a computing with words (CWW) engine in perceptual computing. There can be different approaches to implement PR, e.g., PR using firing intervals is proposed in [8], [9], [16], and similarity-based PR is proposed in this paper. Both approaches satisfy the constraint on a CWW engine, i.e., the result of combining fired rules should lead to a footprint of uncertainty (FOU) that resembles the three kinds of FOUs in a CWW codebook. A comparative study shows that the output FOU from similarity-based PR more closely resemble the three kinds of FOU in a codebook, and the resulting linguistic descriptions are more intuitive; so, similarity-based PR is a better choice for a CWW engine.

3. Combined Interval Type-2 Fuzzy Kinematic and Dynamic Controls of the Wheeled Mobile Robot with Adaptive Sliding-Mode Technique

Ming-Ying Hsiao, Chih-Yang Chen, Shun-Hung Tsai, Shun-Tsai Liu

In this paper, an interval type-2 fuzzy kinematic control (IT2-FKC) combined with an interval type-2 adaptive fuzzy sliding-mode dynamic control (IT2-AFSMDC) are proposed for controlling the trajectory-tracking of a nonholonomic wheeled mobile robot (WMR). Firstly, an interval type-2 fuzzy logic controller designed for the kinematic model of the WMR is introduced, and then the IT2-AFSMDC is developed for the dynamic part, which is a combination of the interval type-2 fuzzy logic control (IT2-FLC) and the adaptive fuzzy sliding-mode dynamic control (AFSMDC). Adaption law is introduced to cope with the uncertainties and disturbances of the system. The trajectory-tracking stability is proved by the Lyapunov stability analysis. The validity of the proposed method is demonstrated via computer simulations. The simulation results show that the tracking performance of the IT2-AFSMDC is better than that of the AFSMDC.

4. Extension of Fuzzy Adaptive Laws to IT2 Fuzzy Systems

Maowen Nie, Woei Wan Tan

As an extension of T1 FLS, IT2 FLS was proposed to handle a higher level of uncertainties by providing an additional dimension to FSs. This paper investigates IT2 FLSs' advantages over type-1 FLSs in adaptive fuzzy systems. It is shown that the uncertainties existing in consequent sets could not be fully utilized when type-reduction is performed using the uncertainty bounds method, which may limit the potential advantages of adaptive IT2 fuzzy systems. To address this limitation, a type-reduction method based on two of the four boundary embedded type-1 FLSs in the uncertainty bounds method is proposed. Moreover, we also establish the condition when adaptive fuzzy systems using T1 FLSs and IT2 FLSs have the same performance. Lastly, IT2 FLSs using the proposed type-reduction method are demonstrated to have greater approximation ability than type-1 FLSs through numerical experiments.

Fri 14:00-15:20

Room #303

SS0102A: Practical Aspects and Applications of Type 2 Fuzzy Systems / Type-2 Fuzzy Logic Theory I

Chair: Hani Hagra, University of Essex

1. Control of the TORA System Using SIRMs Based Type-2 Fuzzy Logic

Chengdong Li, Jianqiang Yi, Dongbin Zhao

The translational oscillations with a rotational proof-mass actuator (TORA) is a well-known benchmark for examining the advantages and limitations of different nonlinear control design techniques. In this paper, a single-input-rule-modules (SIRMs) based type-2 fuzzy logic control scheme is proposed for this nonlinear multivariable system. And, genetic algorithms (GAs) are adopted to determine

SS06: Fuzzy Robotics

Chair: Naoyuki Kubota, Tokyo Metropolitan University

1. Application of Fuzzy Decision Making in Mobile Robot Navigation in Dynamic Environments

Alireza Babalou, Navid Seifipour

This paper presents a modified sensor-based online method for mobile robot navigation generating paths in dynamic environments. The intelligent part of the algorithm is a Fuzzy Decision Maker (FDM) which enables the robot to do both the guidance-based tracking algorithm and the obstacle avoidance simultaneously. The output of FDM is a weighted combination of velocity vectors generated by velocity obstacle algorithm and guidance based tracking algorithm. The results prove that the robot can track a moving target while maneuvering safely in dynamic environment and avoids stationary and moving obstacles.

2. Fast Estimating Data Dependence Structure via Fuzzy Empirical Copula

Zhaojie Ju, Honghai Liu, Youlun Xiong

As a non-parametric algorithm, Empirical Copula is an effective way to estimate the dependence structure of high-dimension arbitrarily distributed data. However, it suffers from the problem of huge computation time because of its high computational complexity. In this paper, Fuzzy Empirical Copula is proposed to solve this problem by combining the Fuzzy Clustering by Local Approximation of Memberships (FLAME) with Empirical Copula. In the proposed algorithm, FLAME is extended from two-dimension data to high-dimension data and FLAME+ is implemented to identify the highest density objects which represent the original dataset, and then Empirical Copula is used to estimate its independence structure according to the new dataset. Case studies have been carried out to demonstrate the effectiveness of the Fuzzy Empirical Copula. Index Terms—Fuzzy Empirical Copula, FLAME, Dependence Structure, and Computation Cost.

3. An Extended Fuzzy Logic System for Uncertainty Modeling

Jiangtao Cao, Ping Li, Honghai Liu

An extended fuzzy logic system (EFLS) based on interval fuzzy membership functions is proposed for covering more uncertainty in practical applications. With the degree of uncertainty in fuzzy membership functions, interval fuzzy membership functions are self-generated to include uncertainties which occur from understanding linguistic knowledge and fuzzy rules in fuzzy methods. A novel adaptive strategy is designed to self-tune the interval fuzzy membership functions and to deduce the crisp outputs with feedback structure. An inverse kinematics modelling study based on a two-joint robotic arm has demonstrated that proposed EFLS outperforms conventional fuzzy methods.

4. Embedding Fuzzy Controllers into Golog

Alexander Ferrein, Stefan Schiffer, Gerhard Lakemeyer

High-level behaviour specification of an intelligent autonomous agent or robot is a non-trivial task. Various approaches exist some of which try to combine different paradigms like programming and planning. In this paper, we show how to integrate fuzzy logic controllers into the logic-based programming language Golog. Golog already allows for combining programming and planning. By adding the instrument of fuzzy controllers we provide the means to have a natural specification of rules for tasks that require a high amount of reactivity. Since the facilities already present in Golog remain, we add to an already powerful framework thus expanding the applicability of Golog for high-level behaviour specification of a robot or agent.

5. Self-Adaptation in Intelligent Formation Behaviors of Multiple Robots Based on Fuzzy Control

Naoyuki Kubota, Naohide Aizawa

Recently, multi-agent systems have been discussed to realize a large size of distributed autonomous system. This paper proposes an intelligent control method for formation behaviors of multi-robot. First of all, we discuss the current state of researches on formation behaviors in multi-robot. Next, we propose a multi-objective behavior coordination to realize formation behavior based on the integration of the intelligent control from the local viewpoint of individual intelligence and the spring model from the global viewpoint of collective intelligence. Next, we propose a self-adaptation method in complicated environments. Finally, we discuss the effectiveness of the proposed method through computer simulation results.

Invited Session**Human vs. Computer Go Competition #1**

Friday, August 21, 16:00-17:00

Special Invited Lecture (Halla Hall)**Fuzzy Logic and Beyond: A New Perspective**

Lotfi Zadeh, University Of California

Friday, August 21, 17:00-19:20

H: Fuzzy Optimization and Design, Decision Analysis and Support

Chair: Hau San Wong, City University of Hong Kong

1. Robust Portfolio Selection Using Interval Random Programming

Wei Chen, Shaohua Tan

This paper addresses the portfolio selection problem in a robust manner. In practice, it is difficult to collect all information to determine the precise bounds of the box uncertainty set used in robust portfolio optimization. To solve this problem, we introduce a novel uncertainty set: interval random uncertainty. We apply our interval random chanceconstrained programming to robust semi-absolute deviation portfolio selection under interval random uncertainty in the element of mean vector. The method for generating the uncertainty set from historical data is discussed. An hybridintelligent algorithm is applied to solve the robust portfolio model. Finally, we compare the potentially significant economic benefits of investing in portfolios computed using classical model and the model introduced here. And the robustness is achieved at relatively high performance and low cost.

2. Experimental Studies on Timing and Memory Usages of Concurrent Fuzzy Control Applications

Chantana Phongpensri, Krisana Sripanomwan

This paper studies the timing and memory usages of fuzzy control applications on embedded systems. Particularly, we are interested in the timing and memory usages of various fuzzy applications implemented on microcontroller. Our study is based on the PIC microcontroller platform. We develop a fuzzy library used to build a concurrent fuzzy system prototype. Then, we compare the memory usage and the timing property of our prototype concurrent fuzzy systems implemented by interrupt-based scheme and Micro C-based with the baseline one. The results show that implementation using interrupt-based has overheads on the program memory about 11 bytes per system and about 160 bytes for data memory. Timing overhead for the interrupt-based is about 72% compared to the baseline. When compared to using Micro C, which has more data overheads, it has an advantage on real-time features and small task switching overhead. However, implementation of the Micro C and fuzzy systems are limited on PIC due to the data memory size.

3. A Portfolio Selection Problem with Type-2 Fuzzy Return Based on Possibility Measure and Interval Programming

Hasuiki Takashi, Ishii Hiroaki

This paper discusses a portfolio selection problem with type-2 fuzzy future returns involving interval numbers considering the investor's subjectivity. Since this proposed problem is not well-defined due to primary and secondary fuzziness, introducing the possibility measure that the total return is more than the target value, the main problem is transformed into the type-1 fuzzy programming problem with the interval value. Furthermore, using the hybrid solution approach based on the linearity of the deterministic equivalent problem and the interval programming problem, the efficient solution is constructed. In order to compare the proposed model with previous standard models, a numerical example derived from the current stock market is provided.

4. Fuzzy Multi-Objective Portfolio Selection Model with Transaction Costs

Yang Zhang, Xiang Li, Hau San Wong, Lirong Tan

Within the framework of credibility theory, several fuzzy portfolio selection models have been researched such as mean-variance model, chance constrained programming model, entropy optimization model and so on. However, all of them are proposed in the forms of single-objective programming, and there is no investigation on the transaction costs between the new portfolio and the existing one. In this paper, a fuzzy multi-objective mean-variance-skewness model with transaction costs is presented. In order to solve this model, a hybrid intelligent algorithm is designed by integrating simulated annealing algorithm, relevance vector machine and fuzzy simulation techniques, where the relevance vector machine is used to approximate the expected value, variance and skewness of portfolio returns and the fuzzy simulation is used to generate the training data for relevance vector machine.

5. A Discussion on Consistency Test in Fuzzy AHP

Morteza Mahmoudzadeh, Ali Reza Bafandeh

This paper presents that the consistency test with consideration of a tolerance deviation in fuzzy AHP proposed by L. C. Leung and D. Cao (2000) is not efficient and has some errors, hence a new method of fuzzy consistency test by direct fuzzification of (Quick Response) QR algorithm - which is one of numerical methods for calculating eigenvalues of an arbitrary matrix - has been proposed.

6. Fuzzy-State Q-Learning-Based Human Behavior Suggestion System in Intelligent Sweet Home

Sunha Bae, Sang Wan Lee, Yong Soo Kim, Zeungnam Bien

Memory impaired people, e.g., dementia people, requires careful social support. Dementia people are getting increased with very high rate especially. It has been reported that regular daily life can alleviate the symptom of the memory loss. Accordingly, human behavior suggestion is highly expected to help memory impaired people live regularly. In this paper, we propose a human behavior suggestion system based on Fuzzy-state Q-Learning for memory impaired person, and show its possible application in Intelligent Sweet Home. Specifically, we claim that an averaged frequency feature is an important factor. In order to evaluate the validity of the proposed human behavior suggestion system, we conduct experiments with a real world data set, INT DB. The experimental results show that the proposed system with the averaged frequency feature outperforms the existing system.

7. Semi-Supervised OWA Aggregation for Link-Based Similarity Evaluation and Alias Detection

Tossapon Boongoen, Qiang Shen

Within the past decades, many fuzzy aggregation techniques, ordered weighted averaging (OWA) in particular, have proven effective for a wide range of information processing tasks, such as decision making, image analysis, database and machine learning. Despite reported successes, their potentials have yet to be explored for the emerging problem of link analysis, which aims to discover similarity and relations amongst objects through their associations. Recently, several link-based similarity methods have been put forward to identifying similar objects in the Internet and publication domains. However, these techniques only take into account the cardinality property of a link structure that is highly sensitive to noise and causes a great number of false positives. In light of such challenge, this paper presents a novel OWA aggregation model that is capable of efficiently deriving a similarity measure through the integration of multiple link properties. The underlying approach is based on the methodology of stress function by which the aggregation behavior can be easily interpreted and modeled. In addition, a semi-supervised method is introduced to assist a user in designing a stress function, i.e. the weighting scheme of link properties, appropriate for a particular link network. The application of the OWA aggregation approach to alias detection is demonstrated and evaluated, against state-of-art link-based techniques, over datasets specifically related to terrorism, publication and email domains.

Fri 17:00-19:20

Samda B

N02: Fuzzy Set Theory, Fuzzy Measures, Fuzzy Integrals II

Chair: Christer Carlsson, Abo Akademi University

1. Confluence and Related Properties of Fuzzy Relations

Radim Belohlavek, Tomas Kuhr, Vilem Vychodil

Confluence and termination are essential properties of relations connected to the idea of rewriting and substituting which appear in abstract rewriting systems. This paper presents a preliminary study of confluence, termination, and related properties from the point of view of fuzzy logic leaving the ordinary notions a particular case when the underlying structure of truth degrees is the two-valued Boolean algebra. The main motivation of this study is the fact that there are natural examples where the notion of substitutability is inherently fuzzy rather than crisp.

2. Preserving Piece-Wise Linearity in Fuzzy Interpolation

Zhiheng Huang, Qiang Shen

Fuzzy interpolative reasoning plays an important role in fuzzy modelling as it not only helps to reduce the number of rules in a rule base, but also provides an inference mechanism for sparse rule bases. In interpolation, it is desirable to preserve piece-wise linearity as piece-wise linear results can thus be inferred from piece-wise linear rules and observations. This safely ensures the ignorance of non-characteristic points in performing interpolations. However, almost all existing fuzzy interpolative reasoning methods do not preserve piecewise linearity for general polygonal fuzzy sets. This paper, based on the work of [1], proposes a new interpolative method which preserves this property.

3. Fuzzy Strongly (R, S)-Precontinuous Mappings

Seok Jong Lee, Jin Tae Kim

In this paper, we introduce the concepts of fuzzy strongly (r, s)-preopen sets and fuzzy strongly (r, s)-precontinuous mappings on intuitionistic fuzzy topological spaces in Sostak's sense. The relationships among fuzzy (r, s)-continuous, fuzzy strongly (r, s)-semicontinuous, fuzzy (r, s)-precontinuous and fuzzy strongly (r, s)-precontinuous mappings are discussed. The notions of a fuzzy strongly (r, s)-preinterior and a fuzzy strongly (r, s)-preclosure are given. Using these concepts, the characterizations for the fuzzy strongly (r, s)-precontinuous mappings are obtained.

4. Possibilistic Mean Value and Variance of Fuzzy Numbers: Some Examples of Application

Christer Carlsson, Robert Fuller

In 2001 we introduced the notions of possibilistic mean value and variance of fuzzy numbers. In this paper we explain these notions from a pure probabilistic view and show some examples of their application from the literature.

5. A Study on Fuzzy Logic Reasoning with Residual Implications and Frank's t-norm

Yahachiro Tsukamoto

This paper formulates fuzzy reasoning based on residual implications using Frank's t-norm. The most important of the normative criteria for generalized modus ponens is that the conclusion must not be more informative than the consequent used in the fuzzy implication. Following a recent paper on analysis using a universal set as a finite set from the similar point of view[12], we here consider a case in which the universe is an infinite set, providing several examples clarifying the meaning of this.

6. On the Measure of Incoherence in Extended Residuated Logic Programs

Nicolas Madrid, Manuel Ojeda-Aciego

In this paper we continue analyzing the introduction of negation into the framework of residuated logic programming [18], [19]; specifically, we focus on extended programs, in which strong negation is introduced. The classical approach to extended logic programs consists in considering negated literals as new, independent, ones and, then apply the usual monotonic approach (based on the fix-point semantics and the TP operator); if the least fix-point so obtained is inconsistent, then the approach fails and no meaning is attached to the program. This paper introduces several approaches to considering consistence (under the term coherence) into a fuzzy setting, and studies some of their properties.

7. A Characterisation of Bases of Triangular Fuzzy Sets

Pietro Codara, Ottavio M. D'Antona, Vincenzo Marra

Fuzzy sets featuring in applications to fuzzy control systems are often required to satisfy specific conditions such as, e.g., convexity or normality. In the same connection, a widespread choice is to work with fuzzy sets whose graphs have triangular shape. The purpose of this paper is to show that the former conditions may be regarded as attempts at approximating the latter choice. Specifically, as our main result we prove that a reasonable set of such conditions suffices to characterise families of triangular fuzzy sets. A second result provides an additional characterisation of such families in terms of properties of the curve that they parametrise.

Fri 17:00-19:20

Room #302

102: Fuzzy Systems Design, Modeling, Identification, Fault Detection II

Chair: Whye Loon Tung, Nanyang Technological University

1. Elgasir: An Algorithm for Creating Fuzzy Regression Trees

Fathi Gasir, Zuhair Bandar, Keeley Crockett

This paper presents a new fuzzy regression tree algorithm known as Elgasir, which is based on the CHAID regression tree algorithm and Takagi-Sugeno fuzzy inference. The Elgasir algorithm is applied to crisp regression trees to produce fuzzy regression trees in order to soften sharp decision boundaries inherited in crisp trees. Elgasir generates a fuzzy rule base by applying fuzzy techniques to crisp regression trees using Trapezoidal membership functions. Then Takagi-Sugeno fuzzy inference is used to aggregate the final output from the fuzzy implications. The approach is evaluated using two problem sets from the UCI repository. Experiments conducted yield an improvement in the performance of fuzzy regression trees compared with crisp CHAID trees. The generated fuzzy regression trees are more robust and presented in a highly visual format which is easy to understand.

2. Fuzzy Impulsive Control with Application to Chaos Control

Iman Zamani, Masoud Shafie

This paper investigates the stability and stabilization problem for fuzzy impulsive controller in which the fuzzy system is presented by Takagi-Sugeno model. Based on Lyapunov criterion, some conditions are derived under which the whole fuzzy impulsive controller is stabilized asymptotically and exponentially in term of some matrix inequalities. Finally, a chaotic example is given to illustrate the proposed method and its effectiveness.

3. Particle Swarm Optimization with Turbulence (PSOT) Applied to Thermal-Vacuum Modelling

Ernesto Araujo, Fernando P. A. Araujo, Jose C. Becceneri, Haroldo F. Campos Velho

Particle Swarm Optimization with Turbulence (PSOT) is, in this paper, applied to find out fuzzy models to represent dynamic behavior of space systems that lie underneath the space qualification process. In optimization area, each minimal improvement in results may represents a maximal, precious meaning and PSOT improve the performance of the established Particle Swarm Optimization (PSO) by introducing a slight variation, which simulates the action of an atmosphere turbulence to escape from local minima. This paper trades off the results of original PSO presented in a previous paper and PSOT both intertwined with Takagi-Sugeno (TS) fuzzy modeling dealing with experimental results of a thermalvacuum system. Particle Swarm Optimization with turbulence has demonstrated to be a good alternative by taking into account the velocity of convergence to better solution and the total optimization time in generating dynamical models to the proposed system.

4. Single-Input Single-Output Convex Fuzzy System as Universal Approximator of Single-Input Single-Output Convex Function

Jinwook Kim, Jin S. Lee

This paper derives sufficient conditions for a single-input single-output fuzzy system whose output is convex with respect to its input. They are composed of two parts: the constraint on input membership functions and the constraint on the THEN parts of fuzzy rule base. And we prove in a constructive manner that any continuously differentiable singleinput single-output convex function can be approximated with any degree of accuracy by a single-input single-output fuzzy system with the above conditions.

5. Online Identification of a Neuro-Fuzzy Model through Indirect Fuzzy Clustering of Data Space

Ahmad Kalhor, Babak N. Araabi, Caro Lucas

In this paper we propose a new approach to identify a neuro-fuzzy model. In our approach, data space is partitioned indirectly through a fuzzy clustering method. The clusters are not created directly through spatial features of data points. A gradient vector is defined as major feature of clustering in data space. This feature is estimated for each incoming data points. Creating and updating fuzzy membership functions, adding new clusters and removing redundant clusters are performed through it. Correspond with cluster parameters, fuzzy rules are defined and a neuro-fuzzy model is identified recursively. Prediction of monthly sunspots number is considered to demonstrate the capability of the proposed Neuro-Fuzzy Model.

6. Fuzzy Affine Impulsive Controller

Iman Zamani, Masoud Shafie

In this paper a new approach for stability analysis of fuzzy impulsive controller is proposed in which the fuzzy system is presented by Takagi-Sugeno model. An affine impulsive controller has been considered and based on Lyapunov criterion, some sufficient conditions are derived to guarantee asymptotically stability of fuzzy affine impulsive controller. These conditions are shown in term of some matrix inequalities and Bilinear Matrix Inequalities (BMIs). Finally, an example is given to illustrate the proposed method and its effectiveness.

7. A Mamdani-Takagi-Sugeno Based Linguistic Neural-Fuzzy Inference System for Improved Interpretability-Accuracy Representation

Whye Loon Tung, Chai Quek

Existing fuzzy and neural-fuzzy systems in the literature can be classified into three main categories, i.e. Mamdani, Takagi-Sugeno (T-S) or Tsukamoto systems based on their implemented fuzzy rule structures. Furthermore, depending on the intended modeling objective, there are two main approaches to fuzzy and neural-fuzzy modeling; namely: linguistic fuzzy modeling (LFM) and precise fuzzy modeling (PFM). In general, Mamdani fuzzy models are more interpretive but less accurate than T-S fuzzy models, and improving the output accuracy of Mamdani fuzzy models usually implies using a larger rulebase with increased complexity and reduced interpretability. This paper presents a linguistic neural-fuzzy architecture that combines the explanatory trait of Mamdani-typed fuzzy models with the output accuracy of T-S fuzzy systems in a hybrid approach referred to as Mamdani-Tagaki-Sugeno (MTS) fuzzy modeling. The resultant network is named the MTS linguistic neural-fuzzy inference system (MTS-LiNFIS). The improved trade-off between the interpretability and accuracy demands of Mamdani-based fuzzy approximation is demonstrated through the evaluation of the learning and modeling performances of MTS-LiNFIS using a simple benchmark application.

Fri 17:00-19:20

Room #303

SS05: Recent Development of Fuzzy Probabilistic Inference Systems with 3-Dimensional Fuzzy Sets

Chair: Han-Xiong Li, City University of Hong Kong

1. Adaptive Control Using Type-2 Fuzzy Logic

Haibo Zhou, Hao Ying, Ji`An Duan

Type-2 (T2) fuzzy systems have gained increasing attention in the recent years. There have been a number of T2 fuzzy control studies in the literature but only one of them is involved in adaptive control. The objective of this paper is to develop a new and theoretically rigorous interval T2 adaptive fuzzy controller for controlling uncertain systems. Our adaptive controller contains a T2 fuzzy system component that is mathematically proven to be capable of approximating any continuous function to any degree of accuracy (in contrast, the sole work in the literature just assumes the universal approximation ability without showing any proof). Based on the Lyapunov method, we design the adaptive laws with mathematical proofs for stability and convergence of the closed-loop system. The controller updates its parameters online to control an uncertain system and track a reference trajectory. Our simulation study involves a nonlinear inverted pendulum. The simulation results demonstrate that the interval T2 adaptive fuzzy controller can achieve the system stability as designed and maintain good tracking performance. We also use the simulation to study the system performance under noise and disturbance.

2. Boxing Motions Classification through Combining Fuzzy Gaussian Inference with a Context-Aware Rule-Based System

Mehdi Khoury, Honghai Liu

This paper continues to explore the potential of newly introduced Fuzzy Gaussian Inference (FGI) [1]. It aims at constructing fuzzy membership functions by modelling hidden probability distributions underlying human motions. A fuzzy rule-based system has been employed to assist boxing motion classification from natural human Motion Capture data. In this experiment, FGI alone is able to recognise seven different boxing stances simultaneously with an accuracy superior to a GMM-based classifier. Results indicate that adding a Fuzzy Inference Engine on top of FGI improves the accuracy of the classifier in a consistent way.

3. Probabilistic Fuzzy Logic System: A Tool to Process Stochastic and Imprecise Information

Zhi Liu, Han-Xiong Li

In this paper, a probabilistic fuzzy logic system (PFLS) is discussed for modeling the stochastic and imprecise information. The PFLS uses a 3-dimensional probabilistic fuzzy set to capture the imprecise stochastic information. A unique 3-dimensional probabilistic fuzzy logic is designed to perform rule inference under such imprecise and stochastic environment. When the PFLS and neural networks are integrated in a unified framework, it can further adapt to time varying dynamics so as to improve its modeling performance. The paper briefly reviews this unique development and potential power of probabilistic fuzzy logic system.

4. 3-D Fuzzy Logic Controller for Spatially Distributed Dynamic Systems: A Tutorial

Xian-Xia Zhang, Ye Jiang, Han-Xiong Li

Three-dimensional fuzzy logic controller (3-DFLC) is a new fuzzy logic controller for spatially distributed dynamic systems. The goal of this tutorial is to wipe of the magic behind the FLC. This tutorial focuses on building an intuition for how and why 3-D FLC works.

Additionally, recent development on 3-D FLC is presented. The hope is that by addressing both aspects, readers of all levels will be able to gain a better understanding of 3-D FLC as well as the when, the how and the why of applying the techniques.

5. Probabilistic-Constrained Fuzzy Logic for Situation Modeling

Jinhua Xiong, Jianping Fan

How to model situation user-friendly and precisely is a key issue for situation-aware applications. Fuzzy logic is an effective approach to model situation, but one obstacle is how to select the suitable operators between different fuzzy sets. One possibility is to combine the merit of both Fuzzy logic and Probability logic. The paper first introduces a set of constraints on conventional fuzzy logic and its operations, to setup a unified framework so as to combine the merits of the above two approaches. Such probabilistic-constrained fuzzy logic can be used in situation-aware applications. The paper then focuses on how to derive new fuzzy concepts from basic fuzzy partition, and how to compute the relationship between such derived and basic fuzzy concepts according to the probability constraints, which is different from the conventional ones.

6. Refinement Geometric Algorithms for Type-2 Fuzzy Set Operations

Long Thanh Ngo, Long The Pham, Phuong Hoang Nguyen, Kaoru Hirota

The paper deals with an approach to applications of α -approximate representation of type-2 fuzzy sets using triangulated irregular network (TIN). Geometric algorithms are designed for operations of type-2 fuzzy sets without using manner of upper or lower surfaces. Operations involving meet under minimum, join under minimum, negation, inference process of type-2 fuzzy sets are presented as applications of geometric representation to operations of type-2 fuzzy sets.

7. The Space of Fuzzy Set-Valued Square Integrable Martingales

Jungang Li, Shoumei Li, Yanping Xue

In this paper, we shall introduce the concept of a fuzzy set-valued square integrable martingale, define a metric between two fuzzy set-valued square integrable martingales. Then we prove that the family of all right-continuous fuzzy set-valued square integrable martingales with respect to the metric is a complete space and the family of all continuous fuzzy set-valued square integrable martingales is its closed subset. This discussion will be useful in the study of fuzzy set-valued stochastic integrals, stochastic differential equations with applications in finance.

Fri 17:00-19:20

Room #401

SS14: Recent Algorithms in Clustering

Chair: Yasunori Endo, University of Tsukuba

1. A Comparative Study on Cluster Validity Criteria in Linear Fuzzy Clustering and Pareto Optimality Analysis

Katsuhiko Honda, Tomonari Nomaguchi, Akira Notsu, Hidetomo Ichihashi

Cluster validation is an important issue in cluster analysis. In this paper, a comparative study on validity criteria is performed with linear fuzzy clustering that can be identified with a local PCA technique. Besides the standard fuzzification approach, the entropy regularization approach is responsible for fuzzification of data partition and the approach implies a close relation between FCM-

type linear fuzzy clustering and probabilistic PCA models. This comparative study reveals mutual differences between two fuzzification approaches from the view point of cluster validation using several cluster validity criteria. Additional characteristics are shown in a pareto analysis, in which the effect of noise sensitivity is also discussed.

2. Different Sequential Clustering Algorithms and Sequential Regression Models

Sadaaki Miyamoto, Kenta Arai

Three approaches to extract clusters sequentially so that the specification of the number of clusters beforehand is unnecessary are introduced and four algorithms are developed. First is derived from possibilistic clustering while the second is a variation of the mountain clustering using medoids as cluster representatives. Moreover an algorithm based on the idea of noise clustering is developed. The last idea is applied to sequential extraction of regression models and we have the fourth algorithm. We compare these algorithms using numerical examples.

3. Entropy Regularized Fuzzy C-Lines for Data with Tolerance

Yuchi Kanzawa, Yasunori Endo, Sadaaki Miyamoto

This paper presents a new clustering algorithm, which is based on entropy regularized fuzzy c-lines, can treat data with some errors. First, the tolerance is formulated and introduced into optimization problem of clustering. Next, the problem is solved using Karush-Kuhn-Tucker conditions. Last, the algorithm is constructed based on the results of solving the problem. Some numerical examples for the proposed method are shown.

4. On Semi-Supervised Fuzzy C-Means Clustering

ENDO Yasunori, HAMASUNA Yukihiko, YAMASHIRO Makito, MIYAMOTO Sadaaki

We have two methods of pattern classification, one is supervised and the other is unsupervised. Unsupervised classification, which is called clustering and classifies data except external criteria, is very useful in the methods of pattern classification so that it has been applied in many fields. There are two types of clustering, one is hierarchical and the other is non-hierarchical. We often use hard c-means clustering (HCM) or fuzzy c-means clustering (FCM) as typical methods of non-hierarchical clustering. By the way, supervised classification can achieve practical classification results but can't handle a lot of data. On the other hand, unsupervised classification can handle a lot of data but the method is complex and sometimes results look a bit of strange. Therefore recently, study of semi-supervised classification has been studied. This classification has advantages of both of the above-mentioned methods, e.g., practical results, low costs and short calculation time. In this paper, we propose new semi-supervised classification algorithms based on fuzzy c-means clustering in which some membership grades are given as supervised membership grade in advance.

5. On L1-Norm Based Tolerant Fuzzy C-Means Clustering

HAMASUNA Yukihiko, ENDO Yasunori, MIYAMOTO Sadaaki

In this paper, we will propose two types of L1-norm based tolerant fuzzy c-means clustering (TFCM) from the viewpoint of handling data more flexibly. One is based on the constraint for tolerance vector and the other is based on the regularization term. First, the concept of clusterwise tolerance is introduced into optimization problems. In these methods, a tolerance vector attributes not only to each data but also each cluster. First, the concept of clusterwise tolerance is introduced into optimization problems. Second, optimal solutions for these optimization problems are derived. Third, new clustering algorithms are constructed based on the explicit optimal solutions. Finally, effectiveness of proposed algorithms is verified through numerical examples.

6. Cluster Validation in Linear Fuzzy Clustering of Relational Data from Multi-Cluster Principal Coordinate Analysis View Point

Naoki Haga, Katsuhiro Honda, Akira Notsu, Hidetomo Ichihashi

This paper considers a new approach to cluster validation in linear fuzzy clustering of relational data. Considering the close connection between linear fuzzy clustering and local PCA, the relational clustering model can be regarded as a multi-cluster MDS model. In the new cluster validation approach, the quality of fuzzy partitions is measured from the multi-cluster principal coordinate analysis view point, in which the reconstructed low dimensional substructure in each cluster is compared with the result of principal coordinate analysis considering fuzzy membership degrees to the cluster.

7. Benchmarking Parameterized Fuzzy C-Means Classifier

Kazuya Nagaura, Hidetomo Ichihashi, Katsuhiro Honda, Akira Notsu

This paper reports on the performance of the fuzzy c-means based classifier (FCMC). Test set performances optimized by way of several CV procedures and three sets of hyperparameters are thoroughly compared. UCI benchmark datasets are used to evaluate the performance. FCM classifier in combination with standard 10-CV procedure or resubstitution (i.e., 1-CV) procedure for parameter selection achieves good test set performance compared to k-nearest neighbor classifier (k-NN). Randomized test sets performance of the classifier is comparable to that of the support vector machine (SVM) reported in the literature.

Fri 17:00-19:20

Room #402

Invited Session

Human vs. Computer Go Competition #2

Friday, August 21, 19:20-21:00

WCI Meeting (Samda A)

Saturday, August 22, 09:00-11:00

Sat 09:00-11:00

Samda A

SS20: Soft Computing in Image Processing

Chair: Ioannis Vlachos, Aristotle University of Thessaloniki

1. Quasi-Global Oppositional Fuzzy Thresholding

Hamid R. Tizhoosh, Farhang Sahba

Opposition-based computing is the paradigm for incorporating entities along with their opposites within the search, optimization and learning mechanisms. In this work, we introduce the notion of "opposite fuzzy sets" in order to use the entropy difference between a fuzzy set and its opposite to carry out object discrimination in digital images. A quasi-global scheme is used to execute the calculations, which can be employed by any other existing thresholding technique. Results for prostate ultrasound images have been provided to verify the performance whereas expert's markings have been used as gold standard.

2. High Precision PSO and FLS Integrated Method for Facial Landmark Localization

Sohrab Khanmohammadi, Saeed Mahdizadeh Bakhshmand, Hadi Seyedarabi

Automatic finding exact location of facial salient points under translation, rotation and changing lightning illumination is a considerable task in face image processing. This paper presents a multistage procedure for finding landmark points on a rigid object like human face. Gabor filter jets make EBGM, very effective but computationally expensive. In proposed method, searching landmark points using Gabor filter jets is optimized by using particle swarm optimization (PSO) and similarity between model jet and extracted jet as cost function. After locating first landmark, the location of next landmark is estimated and then is refined by local search criteria (FLS) until localizing of all desired 5 landmarks. Model jets are used for accounting pixels and can be extracted manually from landmark points of same identity for more robustness and accuracy. Results based on the proposed approach are included to prove the accuracy and low computational cost of proposed method comparing the exhaustive search.

3. Defining Bidimensional Fuzzy Sets for Visual Coarseness Modelling

Jesus Chamorro-Martinez, Pedro Martinez-Jimenez, Jose Manuel Soto-Hidalgo

In this paper, the texture feature "coarseness" is modelled by means of fuzzy sets, relating representative coarseness measures (our reference set) with the human perception of this type of feature. In our study, a wide variety of measures have been analyzed, defining unidimensional and bidimensional fuzzy set for different combination of measures. The fineness human perception has been collected from polls filled by human subjects, performing an aggregation of their assessments by means of OWA operators. Using as reference set a combination of some measures, the membership function corresponding to the fuzzy set is modelled as the function which provides the best fit of the collected data.

4. Application of Cost-Sensitive Fuzzy Classifiers to Image Understanding Problems

Gerald Schaefer, Tomoharu Nakashima

Image understanding applications often involve a pattern classification stage. In this paper we show how a fuzzy rule-based classifier, extended to incorporate a cost function, can be successfully used in various imaging applications. The antecedent part of fuzzy if-then rules are specified by partitioning each attributes into fuzzy sets while the consequent class and the degree of certainty are determined from compatibility training patterns. Extension to include a cost term is shown to be straightforward and experimental results on several image processing tasks demonstrate the efficacy of our method.

5. Cellular Neural Network Based Algorithms in the Early Detection of Hand Osteoarthritis

Sreeparna Banerjee, Gerald Schaefer, Ioannis K. Vlachos

Cellular Neural Network (CNN) algorithms have been successfully used in a plethora of image processing applications including the medical imaging domain. Analogic CNN algorithms use CNN templates combined with logic operations to perform operations such as blurring and thresholding for image processing. In this paper we apply CNN based techniques incorporating image enhancement, region segmentation and line detection for detecting the manifestations of osteoarthritis, a metabolic disease afflicting the elderly population caused by wear and tear of cartilage surrounding weight bearing bone joints like the human hand. The two main indicators of osteoarthritis that we examine are the cystic regions, and osteophytes or bony spurs in the vicinity of the joints, produced by the rubbing together of bones due to joint space narrowing.

6. Improved SIM Algorithm for Effective Image Retrieval

Kwang-Baek Kim, Young Woon Woo, Doo Heon Song

Contents-based image retrieval methods are in general more objective and effective than text-based image retrieval algorithms since they use color and texture in search and avoid annotating all images for search. SIM (Self-organizing Image browsing Map) is one of contents-based image retrieval algorithms that uses only browsable mapping results obtained by SOM (Self Organizing Map). However, SOM may have an error in selecting the right BMU in learning phase if there are similar nodes with distorted color information due to the intensity of light or objects' movements in the image. Such images may be mapped into other grouping nodes thus the search rate could be decreased by this effect. In this paper, we propose an improved SIM that uses HSV color model in extracting image features with color quantization. In order to avoid unexpected learning error mentioned above, our SOM consists of two layers. In learning phase, SOM layer 1 has the color feature vectors as input. After learning SOM Layer 1, the connection weights of this layer become the input of SOM Layer 2 and re-learning occurs. With this multilayered SOM learning, we can avoid mapping errors among similar nodes of different color information. In search, we put the query image vector into SOM layer 2 and select nodes of SOM layer 1 that connects with chosen BMU of SOM layer 2. In experiment, we verified that the proposed SIM was better than the original SIM and avoid mapping error effectively.

Sat 09:00-10:40

Samda B

SS22A: New Perspective of Fuzzy Approaches to Management Engineering I

Chair: Feng-Tse Lin, Chinese Culture University

1. Value-At-Risk Based Fuzzy Stochastic Optimization Problems

Shuming Wang, Junzo Watada

A new class of fuzzy stochastic optimization models — two-stage fuzzy stochastic programming with Value-at-Risk (VaR) criteria is established in this paper. An approximation algorithm is proposed to compute the VaR by combining discretization method of fuzzy variable, random simulation technique and bisection method. The convergence theorem of the approximation algorithm is also proved. To solve the twostage fuzzy stochastic programming problems with VaR criteria, we integrate the approximation algorithm, neural network (NN) and particle swarm optimization (PSO) algorithm, and hence produce a hybrid PSO algorithm to search for the optimal solution. A numerical example is provided to illustrate the designed hybrid PSO algorithm.

2. Fuzzy Approach for Assignment Problem

Shamshul Bahar Yaakob, Junzo Watada

In workers' evaluation and placement, numerous workers with different skills and expertise may share the same role in an organization, making it hard to select appropriate workers based merely on the assignment relation between role and a job. To bridge the gap between abstract roles and real workers, this paper proposed a workers' placement model capable of evaluating workers' suitability for a specified task according their performance, social and mental factor. For this type of problems, an analysis using a fuzzy number approach promises to be potentially effective. In order to make a more convincing and accurate decision, the relationship among workers is included in the workers' assignment in an industrial environment. Finally candidates are ranked based on their suitability grades to support decision makers in selecting appropriate workers to perform the job.

Numerical examples are also presented to demonstrate that the workers' relationship is an important factor and our method is effective for the decision making process.

3. Reevaluation of the Storage of Numerical Fuzzy Data in Multidimensional Indexes

Marcel Shirvanian, Wolfram Lippe

The performance of a database system significantly depends on the application of suitable indexes. Integrating fuzzy sets in databases requires indexes which can handle that kind of data. One of the few variants concerning an indexing technique for fuzzy data manages the storage of numerical possibility distributions in multidimensional indexes. A subsequent analysis shows that the storage of fuzzy numbers in a B+tree, which is a standard index in most database systems, is the more preferable option. Due to some problematic assumptions in the aforementioned analysis, a reevaluation of that comparison is performed in this paper. In doing so, several modifications of the techniques are proposed and a comparison between B+trees and multidimensional indexes based on these modifications is examined. According to these examinations, a variant of the KDB-tree clearly outperforms the B+tree.

4. Efficiency Increase of Fuzzy Query Languages by Using Indexes for Selected Operations

Marcel Shirvanian, Wolfram Lippe

The relatively weak performance of fuzzy database management systems is a major reason for the clear lack of commercial variants. A very important component of a database management system is the query language whose performance is improved amongst others by using indexes. Consequently, the applicability of indexes, designed for the management of fuzzy data, for several operations of a fuzzy query language, in particular a fuzzy equi-join and a fuzzy projection, is examined in this paper. In doing so, the advantages achieved with the integration of a specific index are compared with the benefits resulting from the utilization of a fuzzy equality indicator which is another approach for the efficiency increase of fuzzy query languages. The results will demonstrate that the use of an index can definitely enhance the performance of a fuzzy query language.

5. Determining Feasible Operating Schedules for a Job Shop Scheduling Problem Based on Bio-Soft Computing

Ikno Kim, Junzo Watada, Don Jyh-Fu Jeng

Meta-heuristic methods, which are often used in order to deal with job shop scheduling problems, are also often applied to combinatorial optimization problems. On another front, bio-soft computing is a new way of computing associated with DNA molecules. It is a new massively parallel computation, compared to micro-soft computing. In this paper, a novel way of determining feasible operating schedules is proposed for a job shop scheduling problem, paying particular attention to machine sequences. This new study shows how the goal of deriving reliable solutions using bio-soft computing can be achieved, for more reliable solutions based on this new bio-soft computing approach. A sample of various types of job shop scheduling problems is selected and its feasible operating schedules are determined using the strengths of our proposed method.

SS23: Interactive Human-Space Design and Intelligence

Chair: Yoshinobu Ando, Shibaura Institute of Technology

1. Domestic Robot Service Based on Ontology Applying Environmental Information

Yusuke Fukusato, Shoichiro Sakurai, Siliang Wang, Eri Sato-Shimokawara, Toru Yamaguchi

In this research, authors suggested one robot service in "Kukanchi". Therefore the authors developed the module which combined image recognition with voice recognition. By this module, the system recognizes movement and the utterance of the person. Furthermore, the system understands the intention of the person by using robot ontology in recognition contents. The service that understood the intention of the person by this system which authors developed is enabled. In this paper shows an example of the service that used the system.

2. Push Communication for Network Robot Services and Rsi/RTM Interoperability

Masahiko Narita, Yoshihiko Murakawa, Chuzo Akiguchi, Yuka Kato, Toru Yamaguchi

We, RSi (Robot Service Initiative) organization, have been developing a common network based robot service platform, named RSNP (Robot Service Network Protocol) since 2004. As spreading actual use of RSNP, strong requirements are raised on the push communication in limited conditions such as fewer operators and/or limited resources, and on the robot service integration with various devices supported by the other robot platform, such as RTM (Robot Technology Middleware), particularly. In this paper, we clarified these requirements and solved them by pseudo PUSH communication method, by introducing multimedia/sensor profile and by building RSi/RTM gateway. Moreover, we evaluate the effectiveness of the proposed scheme through the performance experiments. And also these results have been also reflected in RSNP 2.0, the latest specification.

3. Investigation of User RT-Service Generation System Design

Ken Ukai, Makoto Mizukawa, Yoshinobu Ando

In this research, we propose the robot technology (RT) Ontology for Interactive Human-Space Design and Intelligence to make robot provide appropriate services according to situations. For this, we propose to define that "Main task" as a task that the user requests and "Tsuide task" as an essential task accompanied with the "Main task" to complete it. We focus on the development of the system for identifying and defining "Tsuide task" that is changed by the intention of user and the main task. We name the proposing technique as "RT Ontology" which can be used for the infrastructure technology for structuring space information. In this paper, we describe the outline of RT Ontology and experiments.

4. Home Appliance Components Using RT Middleware - Development of the Interface and an Example System

Toshiyuki Kusumoki, Kazuyoshi Wada, Hayato Takayama

Recently, the development costs for robot software is becoming bigger and bigger. Especially, the robots which works with humans in the home and office environment are expected to have various functions according to its user's demand. Therefore, RT (Robotics Technology) Middleware developed by AIST offers the methods to develop desired robot system by combining RT Components. However, various kinds of RT Components are obviously necessary. In this paper, we introduce RT Components for home

appliances which will achieve seamless integration with robot system. Moreover, in order to control the home appliances and robots easily, we developed "Advanced Appliance for Robot Interface (ACARI)." Bedtime support system was developed as an example for the components and ACARI. The usefulness of home appliance components and ACARI were experimentally confirmed by an example system.

5. Investigation of Service Management System Design of RT-Service

Toshihiro Kato, Ken Ukai, Yuki Kodama, Yousuke Tsukumori, Yoshinobu Ando, Makoto Mizukawa

In this research, we propose the service management system design of robot technology (RT) Service for Interactive Human-Space Design and Intelligence to make robot provide appropriate services according to situations. For this, we propose to define that "Service" as an order that the end user requests and "Task" as elements that compose "Service". We focus on the development of the system that manages services for various robots to work by cooperating. And we systematize RAC (Robot Action Command) for service generation by the system. In this paper, we describe the outline of RT-Service management system and experiments.

6. Perceptual System for Clearing the Table Based on the Perceiving-Acting Cycle

Hiroyuki Masuta, Naoyuki Kubota

This paper discusses a perceptual system for an intelligent service robot based on the Perceiving-Acting Cycle. Recently, various intelligent robots work in real environments such as public facilities, commerce facilities and houses. We are developing an intelligent service robot. The task of this robot is to clear the table in a restaurant. In this environment, the robot must perceive the necessary information from various information to take a flexible action like a human. In this study, we focus on the perceptual system based on perceiving-acting cycle discussed in ecological psychology. First, we propose a retinal model for a 3D-range camera based on human retinal structure, and the information extraction method using a spiking neural network based on perceiving-acting cycle. Next, we apply the proposed method for a task of clearing the table. As an experimental result, we show the proposed method can detect a dish in dynamic environment. We discuss the efficiency of our proposed method.

SS24: Soft Computing: New Trends, Advances, and Applications

Chair: Chen-Sen Ouyang, University of I-Shou

1. 3D Character Creation System Using Kansei Rule with the Fitness Extraction Method

Masaki Ando, Masafumi Hagiwara

In this paper, we propose a 3D character creation system using an extraction method of kansei (sensitivity) rule with fitness value. In the proposed system, a 3D character reflected kansei of the user is expressed with some constitution attributes. The attributes that are necessary to reflect kansei of the user are extracted as if-then rules by kansei rule extraction method. The consequent part of kansei rule has the fitness. By introducing the fitness, extracted kansei rules have priority. Therefore, kansei rules can be used effectively. 3D characters created by the proposed system and the user's evaluation values are stored as data, and kansei rules are extracted by analyzing the data. The extracted kansei rules are applied to create 3D characters. We have confirmed that the proposed system can create 3D characters reflected kansei of the user through experiments.

2. A Comparative Study on Regression Models of GPS GDOP Using Soft-Computing Techniques

Chih-Hung Wu, Wei-Han Su

Global Positioning System (GPS) has been used extensively in various fields. One key to success of using GPS is the positioning accuracy. Geometric Dilution of Precision (GDOP) is an indicator showing how well the constellation of GPS satellites is organized geometrically. It is known that increasing the number of satellites for positioning reduces GDOP. However, the calculation of GDOP is a time- and power-consuming task which can be done by solving measurement equations with complicated matrix transformation and inversion. Previous studies have partially solved this problem with artificial neural network(ANN). Though ANN is a powerful function approximation technique, it needs costly training and the trained model may not be applicable to data deviating too much from the training data. Using the technique of support vector regression (SVR), this paper presents the effectiveness of SVR for GDOP approximation. The experimental results show that SVR needs less training time to generate a precise model for GDOP than ANN does.

3. An Approach for Construction and Learning of Interval Type-2 TSK Neuro-Fuzzy Systems

Chen-Sen Ouyang, Shiu-Ling Liu

In this paper, we propose an approach for construction and learning of interval type-2 TSK neuro-fuzzy systems. In the structure identification phase, we develop a self-constructing rule generation method to group the data into fuzzy clusters and extract initial fuzzy rules for creating an interval type-2 TSK fuzzy system. Then, we construct an interval type-2 TSK fuzzy neural network in the parameter identification phase and propose a hybrid learning algorithm to refine the parameters of initial fuzzy rules for higher precision. The hybrid learning algorithm is composed of the particle swarm optimization and a recursive SVD-based least squares estimator. Finally, we have a set of refined fuzzy rules. Compared with other approaches, experimental results have shown our approach produces smaller root mean squared errors and converges more quickly.

4. The "Final" Model of Granular Computing

Tsau Young Lin

Granular computing(GrC) is a recent label, roughly speaking, jointly coined by Lin and Zadeh in 1996 to denote an emerging technology that is based on the computing/mathematical theory of an ancient concept of granulation. In this paper, we present the "final" GrC model that simplify the earlier version.

5. An Automatic Web Site Menu Structure Evaluation

Haruhiko Takeuchi

The purpose of this paper is to propose a method for automatically evaluating Web site menu structures. The evaluation system requires content data and a menu structure with link names. This approach consists of three stages. First, the system classifies the content data into appropriate links. Second, the system identifies the usability problems for all content data. Third, the system calculates an index that indicates the averaged predicted mouse clicks for the menu structure. As applications, a link name selection problem and a link structure evaluation problem are discussed. This system was also applied to real data, such as Encarta's and Wikipedia's menus. The results confirmed the usefulness of the system.

6. General Type-2 Fuzzy Neural Network with Hybrid Learning for Function Approximation

Wen-Hau Roger Jeng, Chi-Yuan Yeh, Shie-Jue Lee

A novel Takagi-Sugeno-Kang (TSK) type fuzzy neural network which uses general type-2 fuzzy sets in a type-2 fuzzy logic system, called general type-2 fuzzy neural network (GT2FNN), is proposed for function approximation. The problems of constructing a GT2FNN include type reduction, structure identification, and parameter identification. An efficient strategy is proposed by using α -cuts to decompose a general type-2 fuzzy set into several interval type-2 fuzzy sets to solve the type reduction problem. Incremental similarity-based fuzzy clustering and linear least squares regression are combined to solve the structure identification problem. Regarding the parameter identification, a hybrid learning algorithm (HLA) which combines particle swarm optimization (PSO) and recursive least squares (RLS) estimator is proposed for refining the antecedent and consequent parameters, respectively, of fuzzy rules. Simulation results show that the resulting networks obtained are robust against outliers.

Sat 09:00-11:00

Room #401

SS07: Fuzzy Logic in Medical Sciences

Chair: Yutaka Hata, University of Hyogo

1. Biometric Personal Authentication by One Step Foot Pressure Distribution Change by Load Distribution Sensor

Takahiro Takeda, Kazuhiko Taniguchi, Kazunari Asari, Syoji Kobashi, Yutaka Hata

This paper proposes a biometric personal authentication based on the pressure distribution while one step walking. We extract one step from a walk on a mat type load distribution sensor and use it to personal authentication. With this method, features which are based on weight movement and foot shape during walking are calculated, then a classifier is developed on the basis of fuzzy inference. We employed 30 volunteers. All volunteers are ranged from 20 to 85 years old. For each volunteer, we took walk data six times. Then, we evaluated this method by five training data and one test data. We obtained 6.1% EER (Equal Error Rate) and 13.9% FRR (False Rejection Rate) in verification (1:1 collation) and identification (1:N collation), respectively.

2. Fuzzy Logic Approach to Respiration Detection by Air Pressure Sensor

Kiyotaka Ho, Naoki Tsuchiya, Hiroshi Nakajima, Kei Kuramoto, Syoji Kobashi, Yutaka Hata

This paper describes a method for a respiratory rate monitoring system by an air pressure sensor. By using this sensor, we propose a detection method of a respiratory rate for human in bed by fuzzy logic. Our method was examined on four healthy volunteers. We successfully detected the respiratory rate and the time of apnea state. In our method, fuzzy logic plays a primary role in the detection of respiratory points. The experimental results showed that the error ratio of respiratory rate was 1.3 % and the error of time of apnea state was 1.1 seconds. Consequently, this system can noninvasively detect the respiratory rate and the time of apnea state by using an unconstrained device.

3. Calculation Algorithm of Hepatorenal Contrast in Ultrasonic Images Based on Fuzzy Inference

Yutaka Hatakeyama, Hiromi Kataoka, Noriaki Nakajima, Teruaki Watabe, Yoshiyasu Okuhara

A calculation algorithm for hepatorenal contrast from real ultrasonic images is proposed for analysis research of time series change in patient condition by aging. It provides automatic calculation of kidney pelvis position based on fuzzy inference, which detects kidney and liver region for hepatorenal contrast to calculate. Experimental calculation results for 150 ultrasonic images taken in real treatment from Kochi Medical School hospital show that accuracy of kidney pelvis detection is 93% and that correlation coefficient of hepatorenal contrast with normal gamma-GT is 0.82. The proposed algorithm is being considered for use in analysis of condition change in Center of Medical Information Science, Kochi Medical School.

4. Fuzzy Estimation System of Dementia Severity Using Biological Information During Sleep

Hayato Uchida, Hayato Yamaguchi, Shoji Kobashi, Yutaka Hata, Naoki Tsuchiya, Hiroshi Nakajima

Recently, the increase of care burden due to the increase of number of the elderly dementia patients is a matter of concern in Japan. However, dementia of the elderly tends to be wrongly recognized as the effect of aging, and there are many cases in which early detection are difficult. In this paper, we focus on the cognitive impairment as one of the core symptoms of dementia, and propose the fuzzy estimation system to detect the level of dementia through monitoring the participants' sleep using air pressure and ultrasonic sensor systems which were developed by our laboratory. As a result of applying this method to twenty-three women in a nursing home, we could confirm the high correlation between the degree of dementia and the truth value, the score of Revised Hasegawa's dementia scale.

5. Fuzzy Thick Rubber Model for Cerebral Surface Extraction in Neonatal Brain MR Images

Syoji Kobashi, Takuma Oshiba, Kumiko Ando, Reiichi Ishikura, Setsuro Imawaki, Shozo Hirota, Yutaka Hata

Cerebral surface extraction plays a fundamental role of computer aided diagnosis (CAD) for neonatal brain magnetic resonance (MR) images. However, cerebral sulci of the neonatal brains is complexity folded, and it is difficult to extract complete cerebral contour from MR images due to the limitation of spatial resolution and partial volume effect (PVE). This paper proposes a novel method to extract the cerebral contour based on fuzzy thick rubber model (TRM). The TRM is deformed by using fuzzy control schemes so that the digitally synthesized MR images from the deforming TRM are identical to the given MR images. By synthesizing the MR images with respect to PVE, the proposed method is able to extract the cerebral contour with sub-voxel accuracy. The proposed method was applied to 7 subjects whose revised ages were from -17 days to 34 days. The root-mean-squared-error between the extracted contour and the manually delineated contour by two physicians was 1.09 ± 0.48 mm from the truth contour. And, to demonstrate the clinical effective, gyral index was calculated using the extracted cerebral contour.

6. Automated Extraction Method of Bone Tunnel after The Anterior Cruciate Ligament Reconstruction from a Knee MDCT Image by Using Fuzzy Inference

Kouki Nagamune, Daisuke Araki, Yuichi Hoshino, Seiji Kubo, Ryosuke Kuroda, Masahiro Kurosaka

The anterior cruciate ligament (ACL) plays important role as a preventing excessive anterior movement of the knee. When the ACL is injured, ACL reconstruction is often performed. In ACL reconstruction, bone tunnels of the femur and tibia are made for

passing graft to the bone. It is reported that the bone tunnel is usually enlargement. The bone tunnel enlargement affects much knee function. In serious case, ACL reconstruction should be required again. Therefore evaluation of the bone tunnel is important. However, it has not been analyzed in 3D image, because the bone tunnel is unclear at distal region in MDCT image. To overcome this problem, this study proposed extraction method with fuzzy inference. As a result, our proposed method could detect bone tunnel region. Then, the bone tunnel enlargement was examined. A future work is to specify the enlarge part within the extract volume.

Sat 09:00-11:00

Room #402

Invited Session

Human vs. Computer Go Competition #3

Saturday, August 22, 11:20-12:20

Keynote #2 (Halla Hall)

Statistics Powered Conceptual Fuzzy Sets and Word Computing System

Tomohiro Takagi, Meiji University

Saturday, August 22, 14:00-15:40

Sat 14:00-15:40

Samda A

G02: Fuzzy Control and Robotics, Sensors, Fuzzy Hardware, Fuzzy Architectures II

Chair: Ahmed El Hajjaji, University of Picardie Jules Verne

1. Development of an IDS Hardware Unit for Real-Time Learning Applications

Masayuki Murakami, Nakaji Honda

In artificial neural networks (ANNs) and fuzzy inference systems (FISs), hardware implementation is significantly effective in improving real-time performance by utilizing their parallel processing structures. Thus, numerous hardware solutions for ANNs and FISs have been provided for time-critical control applications. The ink drop spread (IDS) method is a modeling technique that has been proposed as a new paradigm of soft computing. The structure of IDS models is similar to that of ANNs: they comprise distributed intermediate units referred to as IDS units. In this paper, the hardware design of the IDS unit is presented and it is demonstrated that the hardware implementation is effective in enhancing the real-time performance of IDS modeling systems.

2. Sum-Of-Squares-Based Stability Analysis of Polynomial Fuzzy-Model-Based Control Systems

H.K. Lam, Mohammad Narimani

This paper presents the stability analysis of polynomial fuzzy-model-based control systems, formed by a polynomial fuzzy model and a fuzzy controller connected in a closed loop, using sum-of-squares (SOS) approach. Based on the Lyapunov stability theory, the stability analysis is generalized by bringing the membership functions as polynomial variables to the stability analysis for relaxation of SOS-based stability conditions. For further relaxation of the stability analysis result, the information of membership

function boundary and operating domain information is considered. It can be shown that the existing SOS and linear-matrix-inequality (LMI)-based stability conditions are a particular case of the proposed SOS-based stability conditions. Simulation examples are given to verify the stability analysis results and demonstrate the effectiveness of the proposed approach.

3. Decentralized Fuzzy Controller for Nonlinear Interconnected Systems with Missing Measurements

Geun Bum Koo, Jin Bae Park, Young Hoon Joo, Se Jin Kim

This paper discusses the decentralized fuzzy control technique for the stochastic stability of nonlinear interconnected systems with missing measurements. We develop the fuzzy subsystem of the interconnected system by using the Takagi–Sugeno (T–S) fuzzy model and design the decentralized fuzzy controller for stochastic stability. To guarantee the sufficient condition of stability, we use Lyapunov stability theorem. Its constructive condition is expressed as the linear matrix inequality (LMI). An example is given to show the verification discussed throughout the paper.

4. Fuzzy Inference Based Subjective Material-Recognition System Employing a Multi-Modal Tactile Sensor

Chikara Sonoda, Tsutomu Miki, Yayoi Tateishi

A multi-modal tactile sensing system for a human-like tactile representation is proposed. The proposed system consists of the multimodal tactile sensor and a texture recognition block employing fuzzy inference. The sensor inspired by structure of human's fingertip detects pressure, thermal conductivity and strain by using a pressure-sensitive conductive rubber, a PVDF film and a strain gauge, respectively. By introducing two active motions which are pressing and tracing on a surface of an object, hardness, warmth, friction and roughness of a material can be recognized. Furthermore subjective material-recognition mechanism can be implemented using fuzzy rules that describe directly a human-like sense of touch in word. We will show material-recognition experiments using several materials found in our daily life and discuss the performance of the system for subjective recognition.

5. H^∞ Sensor Faults Estimation for T-S Models Using Descriptor Techniques: Application to Fault Diagnosis

Bouattour Maha, Chadli Mohammed, El Hajjaji Ahmed, Chaabane Mohamed

This paper deals with the H^∞ estimation of both system state and faults for T-S (Takagi-Sugeno) fuzzy model with bounded input disturbances. Based on the descriptor technique, the sensor faults are considered as an auxiliary state variable. Then a descriptor observer for the obtained augmented system is designed and the observer gains are determined in LMI (Linear Matrix Inequalities) formulation. This method has the advantage to estimate the state variables and the sensor faults simultaneously with H^∞ approach. Numerical example shows the efficiency of the proposed method.

Sat 14:00-15:40

Samda B

B02: Hybrid Systems of Computational Intelligence Techniques II

Chair: Jee-Hyong Lee, Sungkyunkwan University

1. A Novel Adaptive Fuzzy Load Balancer for Heterogeneous LAM/MPI Clusters Applied to Evolutionary Learning in Neuro-Fuzzy Systems

V. Mehar Swarup, Achint Setia, Satish Kumar, Lotika Singh

Load balancing in parallel master-slave implementations on heterogeneous computing clusters is a pressing research problem.

Proper load balancing can lead to dramatic speedups in program run times. This paper introduces a novel adaptive fuzzy load balancer which automatically senses cluster state through measurements of node evaluation times and network delays. Measured data are collected within a time window and then clustered using fuzzy c-means clustering. The optimal number of clusters are decided using the Xie-Beni index. Rule base extraction is facilitated by reverse projection of clusters (for antecedents) and a heuristic function (for consequents). Re-clustering is triggered on outlier point detection, and re-validation of clusters is performed depending on an FCM objective function-based cluster scattering threshold. The load balancer is deployed on the master to balance the load between various slaves. The algorithm is tested extensively on an evolutionary-neuro-fuzzy network learning application and implemented in a LAM/MPI computing environment. Results clearly bring out the efficacy of employing the adaptive load balancer in heterogeneous computing environments. Speedups ranging from 42% to 89% are observed when compared to parallel implementations without the fuzzy load balancer, and up to 448% when compared to the serial implementations.

2. ACPOP: Ambiguity Correction-Based Pseudo-Outer-Product Fuzzy Rule Identification Algorithm

Javan Tan, Chai Quek

Fuzzy rules generated from neuro-fuzzy systems may contain ambiguous rules, due to numerous factors. While contradiction-correction often ensures consistency in fuzzy rulebases, a differing approach should be reserved for problems where the linguistic definitions can be mutually-inclusive. For these cases, the proposed ambiguity-correction approach is a simple procedure that prevents excessive skew towards stronger rules, and still creates consistent fuzzy rule-base. This paper describes a proof-of-concept model, ACPOP-CRI(S), where ambiguity-correction can be adapted to the generic POP-CRI(S) framework. Experimental results on the Nakanishi dataset shows that the ACPOP rule identification algorithm has the potential to perform better, and generate fewer rules than the generic POP algorithm.

3. T2-Hyfis-Yager: Type 2 Hybrid Neural Fuzzy Inference System Realizing Yager Inference

Sau Tung, Chai Quek, Cuntai Guan

The Hybrid neural Fuzzy Inference System (Hy-FIS) is a five layers adaptive neural fuzzy inference system, based on the Compositional Rule of Inference (CRI) scheme, for building and optimizing fuzzy models. To provide the HyFIS architecture with a firmer and more intuitive logical framework that emulates the human reasoning and decision-making mechanism, the fuzzy Yager inference scheme, together with the self-organizing gaussian Discrete Incremental Clustering (gDIC) technique, were integrated into the HyFIS network to produce the HyFIS-Yager-gDIC. This paper presents T2-HyFIS-Yager, a Type-2 Hybrid neural Fuzzy Inference System realizing Yager inference, for learning and reasoning with noise corrupted data. The proposed T2-HyFIS-Yager is used to perform time-series forecasting where a non-stationary timeseries is corrupted by additive white noise of known and unknown SNR to demonstrate its superiority as an effective neuro-fuzzy modeling technique.

4. Learning Flexible Structured Linguistic Fuzzy Rules for Mamdani Fuzzy Systems

Ning Xiong

One significant challenge in building fuzzy systems for complex problems is the "curse of dimensionality". For the sake of a reduced size of the knowledge base, some rules with incomplete premise structures covering larger areas of the input domain are often desirable. This paper presents a genetic algorithm based approach to searching for suitable antecedents of rules under which specific fuzzy consequences can be recommended. The rule premises are

coded in a flexible way allowing for presence as well as absence of an input variable in them, in combination with a certain class of input and output fuzzy sets. On the other hand, a consistency index is introduced to give a numerical evaluation of the coherence among individual rules. This index is incorporated into the fitness function of the genetic algorithm to search for a set of optimal rule premises yielding not only good problem solving performances but also little conflict in the rule base. The effectiveness of our work is demonstrated through experiment results on controlling an inverted pendulum.

5. A Vulnerability Recommendation System in Linux Kernel Variables

Jaekwang Kim, Bo Kyeong Kim, Seunghun Lee, Jee-Hyong Lee

In these days, Linux system is widely used because of its freedom to use and develop. With this trend, to find vulnerabilities in Linux kernel has become more important. Linux kernel is so huge that we need a machine based error detecting approach. There are some former studies about error detection in software code. However, they are not suitable for detecting unknown vulnerabilities related to Linux kernel variables. We suggest a vulnerability recommendation system for Linux kernel variables. First, we propose a methodology by analyzing 368 reported vulnerabilities in Linux kernel. We focus on two elements to find vulnerabilities in Linux kernel variables. Those are the kernel variables which are concerned about privilege escalating and the system call tree information that shows which system calls may modify which kernel variables. We tested our recommendation system with two representative Linux versions. Through experiments, we confirm that our system can find potential vulnerabilities including known ones.

Sat 14:00-15:40

Room #302

E01: Fuzzy Image, Speech and Signal Processing, Vision and Multimedia I

Chair: Hassan Kazemian, London Metropolitan University

1. An Intelligent Video Streaming Technique in ZigBee Wireless

Hassan B Kazemian

This paper is concerned with an intelligent application of Moving Picture Expert Group (MPEG) video transmission over IEEE 802.15.4 – ZigBee. MPEG Variable Bit Rate (VBR) video is data hungry and presents excessive time delay and data loss over a wireless communication. Conventional rate policing such as generic cell rate algorithm is inadequate to sufficiently regulate transmission of VBR data sources over bandwidth limited ZigBee. Therefore, it is impossible to transmit MPEG VBR video over ZigBee channel. A buffer entitled ‘traffic-shaping buffer’ is introduced to prevent excessive overflow of MPEG video data over the ZigBee channel. A new Neural-Fuzzy (NF) scheme is developed to adjust the traffic-shaping buffer output rate to eliminate unacceptable delay or loss of the VBR encoded video and to conform the data to the token-bucket's contract prior entering the ZigBee channel. A Rule-Based Fuzzy (RBF) scheme is developed to monitor the data rate entering the traffic-shaper, in order to prevent either saturation or starvation of the buffer. The simulation results show that the use of the NF scheme and the RBF scheme enables MPEG VBR video to be transmitted over ZigBee.

2. Vacant Parking Space Detector for Outdoor Parking Lot by Using Surveillance Camera and FCM Classifier

Hidetomo Ichihashi, Katsuhiko Honda, Akira Notsu, Tatsuya Katada, Makoto Fujiyoshi

The most prevailing approach now for parking lot vacancy detecting system is to use sensor-based techniques. The main impediments to the camera-based system in applying to parking lots on rooftop and outside building are the glaring sun light and dark shadows in the daytime, and low-light intensity and back-lighting in the nighttime. To date, no camera-based detecting systems for outdoor parking lots have been in practical use. A few engineering firms provide the camera-based system, which is only for underground and indoor parking lots. This paper reports on the new camera based system called ParkLotD for detecting vacancy/occupancy in parking lots. ParkLotD uses a classifier based on fuzzy c-means (FCM) clustering and hyper-parameter tuning by particle swarm optimization (PSO). The test result of the detection error rate for the indoor multi-story parking lot has improved by an order of magnitude compared to the current system based on the edge detection approach. ParkLotD demonstrates high detection performance and enables the camera-based system to achieve the practical use in outdoor parking lots.

3. Fuzzifying Images Using Fuzzy Wavelet Denoising

Giovanni Palma, Isabelle Bloch, Serge Muller, R'Azvan Iordache

Fuzzy connected filters were recently introduced as an extension of connected filters within the fuzzy set framework. They rely on the representation of the image gray levels by fuzzy quantities, which are suitable to represent imprecision usually contained in images. No robust construction method of these fuzzy images has been introduced so far. In this paper we propose a generic method to fuzzify a crisp image in order to explicitly take imprecision on grey levels into account. This method is based on the conversion of statistical noise present in an image, which cannot be directly represented by fuzzy sets, into a denoising imprecision. The detectability of constant gray level structures in these fuzzy images is also discussed.

4. Video Transmission over IEEE 802.15.1 Standard Using Neural-Fuzzy

Guillaume F. Remy, Hassan B. Kazemian

This paper is to present a solution on how to improve Quality of Picture on Moving Picture Expert Group (MPEG-4) video Compression over IEEE 802.15.1 wireless transmission using Artificial Intelligence (AI). IEEE 802.15.1 standard is sensitive to noise and interferences due to other 2.4GHz Industrial, Scientific and Medical (ISM) devices. It is consequently, difficult to predict an accurate transmission rate. MPEG-4 video is an object oriented compression system and it is data hungry. But It is almost impossible to transmit MPEG-4 over IEEE 802.15.1 standard without excessive delay, data loss or degrading of the image quality. In this paper, two neural-fuzzy have been applied to control a buffer at the input and the reception end to monitor and manipulate the flow of MPEG-4 video over the IEEE 802.15.1 standard. This method will leave less data for the IEEE 802.15.1 token bucket, as some of the data is processed at the buffer. The results obtained by simulation confirm that the application of Artificial Intelligence improves the transmission rate and the image quality, as compared with a classical video transmission over IEEE 802.15.1 standard.

5. Vision Based Ego-Motion Estimation for Robot Systems by Type-2 Fuzzy Sets

Tae-Koo Kang, Huazhen Zhang, Gwi-Tae Park

This paper addresses an efficient vision based motion estimation method of robot systems for the ego-motion compensation using type-2 fuzzy Sets. Every intelligent robot system like walking robots, service robots, automatic vehicles should have the ability to

autonomously recognize its surroundings and to make right decisions under unknown environment. To enable a robot system to do this, ego-motion compensation is mandatory. Therefore, we suggest the ego-motion estimation method so that the errors of the environment recognition caused by the egomotion of intelligent robot systems are eliminated. This method uses the disparity map obtained from the stereo-vision and can be divided into three parts - segmentation, feature extraction, estimation. In the segmentation part, a novel type-2 fuzzy sets based segmentation method to extract the objects is used. In the feature extraction module, features are extracted by the wavelet level-set transform. In the estimation part, least square ellipse approximation is used to calculate the displacement for the rotation and translation between image sequences. we can estimate the displacement for the rotation and translation by tracking the least square ellipse and type-2 fuzzy sets based filtering method. From the results of experiments, we can know that the proposed method can be applied to intelligent robot systems effectively.

Sat 14:00-15:40

Room #303

SS29A: Evolutionary Fuzzy Systems I

Chair: Yusuke Nojima, Osaka Prefecture University

1. A Genetic Fuzzy Rule-Based Classifier for Land Cover Image Classification

Dimitris Stavrakoudis, John Theocharis

This paper proposes the use of a Boosted Genetic Fuzzy Classifier (BGFC) for land cover classification from multispectral images. The model's learning algorithm is divided into two stages. The first stage iteratively generates fuzzy rules, employing a boosting algorithm that localizes new rules in uncovered subspaces of the feature space. Each rule is obtained through an efficient genetic rule extraction method, which both adapts the parameters of the fuzzy sets in the premise space and determines the required features of the rule, further improving the interpretability of the obtained model. The second stage fine-tunes the obtained rule base through an evolutionary algorithm (EA), improving the cooperation among the fuzzy rules and, thus, increasing the classification performance attained after the first stage. The BGFC is tested using an IKONOS multispectral VHR image, in the agricultural area surrounding a lake-wetland ecosystem in northern Greece. The results indicate that the proposed system is able to handle multi-dimensional feature spaces, effectively exploiting information from different feature sources.

2. Co-Evolving Fuzzy Rule Sets for Job Exchange in Computational Grids

Alexander Foelling, Christian Grimme, Joachim Lepping, Alexander Papaspyrou

In our work, we utilize a competitive Coevolutionary Algorithm in order to optimize the parameter set of a Fuzzy System for job exchange in Computational Grids. In this domain, the providers of High Performance Computing (HPC) centers strive for minimizing the response time for their own customers by trying to distribute workload to other sites in the Grid environment. The Fuzzy System is used for steering each site's decisions whether to distribute or accept workload in a beneficial, yet egoistic direction. This scenario is particularly suited for the application of a competitive CA: Grid sites' Fuzzy Systems are modeled as species, which evolve in different populations. While each species tries to minimize the response time for locally submitted jobs, their individuals' fitness is determined within the commonly shared ecosystem. Using real workload traces and Grid setups, we show that the opportunistic cooperation leads to significant improvements for both each Grid site and the overall system.

3. A Genetic Learning of the Fuzzy Rule-Based Classification System Granularity for Highly Imbalanced Data-Sets

Pedro Villar, Alberto Fernandez, Francisco Herrera

In this contribution we analyse the significance of the granularity level (number of labels) in Fuzzy Rule-Based Classification Systems in the scenario of data-sets with a high imbalance degree. We refer to imbalanced data-sets when the class distribution is not uniform, a situation that it is present in many real application areas. The aim of this work is to adapt the number of fuzzy labels for each problem, applying a fine granularity in those variables which have a higher dispersion of values and a thick granularity in the variables where an excessive number of labels may result irrelevant. We compare this methodology with the use of a fixed number of labels and with the C4.5 decision tree.

4. Speeding up Genetic-Fuzzy Mining by Fuzzy Clustering

Chun-Hao Chen, Tzung-Pei Hong, Vincent S. Tseng

In the past, we proposed an algorithm for extracting appropriate multiple minimum support values, membership functions and fuzzy association rules from quantitative transactions. In this paper, an enhanced approach, called the fuzzy cluster-based genetic-fuzzy mining approach for items with multiple minimum supports (FCGFMMMS), is proposed to speed up the evaluation process and keep nearly the same quality of solutions as the previous one. It divides the chromosomes in a population into several clusters by the fuzzy k-means clustering approach and evaluates each individual according to both their cluster and their own information. Experimental results also show the effectiveness and the efficiency of the proposed approach.

5. Parallel Evolutionary Multiobjective Methodology for Granularity and Rule Base Learning in Linguistic Fuzzy Systems

Juan M. Bardallo, Miguel A. De Vega, Francisco A. Marquez, Antonio Peregrin

In this paper we present a parallel evolutionary multi-objective methodology for granularity and rule-based learning for Mamdani Fuzzy Systems. The proposed methodology produces a set of solutions with different trade-off between accuracy and interpretability, based on searching the number of labels and the fuzzy rules, and also makes a variable selection. This process is achieved by exploiting present parallel computer systems allowing it to deal with more complex models.

Sat 14:00-15:40

Room #401

J04: Fuzzy Data Analysis - Clustering and Classifiers, Pattern Recognition, Bio-Informatics IV

Chair: Tsaipei Wang, National Chiao Tung University

1. A Unified Approach to C-Means Clustering Models

Laszlo Szilagyi, Sandor Szilagyi, Zoltan Benyo

In order to improve the accuracy, robustness, and computational load of c-means clustering models, a series of hybrid solutions have been proposed. Mixtures of fuzzy (FCM) and possibilistic c-means (PCM) clustering generally attempted to avoid the noise sensitivity of the former and the coincident clusters of the latter. On the other hand, mixtures of fuzzy and hard c-means (HCM) have been proposed to speed up fuzzy clustering without losing the quality of its partitions. In this paper, a novel hybrid c-means algorithmic scheme is proposed that unifies the objective functions of all three conventional clustering models. The strength of each component within the mixture is controlled by two tradeoff parameters. The optimization of the proposed objective function is achieved using

the alternating optimization derived from zero gradient conditions and Lagrange multipliers. The novel hybrid's behavior is evaluated in terms of classification accuracy, cluster validity and execution time, using the IRIS data set. Suitably chosen tradeoff parameters enable the proposed algorithm to achieve better accuracy than previous models, while performing less computations.

2. A Fuzzy Modeling Approach to Cluster Validity

Hoel Le Capitaine, Carl Frelicot

This paper presents a new approach to find the optimal number of clusters of a fuzzy partition. It is based on a fuzzy modeling approach which combines measures of clusters' separation and overlap. These measures are based on triangular norms and a discrete Sugeno integral. Results on artificial and real data sets prove its efficiency compared to indexes from the literature.

3. Comparing Hard and Fuzzy C-Means for Evidence-Accumulation Clustering

Tsaipei Wang

There exist a multitude of fuzzy clustering algorithms with well understood properties and benefits in various applications. However, there has been very little analysis on using fuzzy clustering algorithms to generate the base clusterings in cluster ensembles. This paper focuses on the comparison of using hard and fuzzy c-means algorithms in the well known evidence-accumulation framework of cluster ensembles. Our new findings include the observations that the fuzzy c-means requires much fewer base clusterings for the cluster ensemble to converge, and is more tolerant of outliers in the data. Some insights are provided regarding the observed phenomena in our experiments.

4. User Adaptive Hand Gesture Recognition Using Multivariate Fuzzy Decision Tree and Fuzzy Garbage Model

Moon-Jin Jeon, Seung-Eun Yang, Zeungnam Bien

Recently, the natural signal of human such as voice or gesture has been applied to the system for assisting disabled and the elderly people. As an example of such kind of system, the Soft Remote Control System has been developed by HWRS-ERC in KAIST [1]. This system is a vision-based hand gesture recognition system for controlling home appliances such as television, lamp and curtain. One of the most important technologies of the system is the hand gesture recognition algorithm. The frequently occurred problems which lower the recognition rate of hand gesture are inter-person variation and wrong recognition of similar gestures. In this paper, we propose multivariate fuzzy decision tree (MFDT) learning and classification algorithm for hand gesture recognition. The similar meaningless gestures are rejected using fuzzy garbage model. To recognize hand gesture of a new user, the most proper recognition model among several well trained models is selected using model selection algorithm and incrementally adapted to the user's hand gesture. For the general performance of MFDT as a classifier, we show classification rate using the benchmark data of the UCI repository. The experimental results show the classification and user adaptation performance of proposed algorithm is better than traditional fuzzy decision tree. Also the meaningless gestures are well rejected.

5. An Interval Type-2 Fuzzy PCM Algorithm for Pattern Recognition

Frank Chung-Hoon Rhee, Ji-Hee Min, Eun-A Shim

The Possibilistic C-means (PCM) was proposed to overcome some of the drawbacks associated with the Fuzzy C-means (FCM) such as improved performance for noise data. However, PCM possesses some drawbacks such as sensitivity in the initial parameter values and to patterns that have relatively short distances between the prototypes. To overcome these drawbacks, we propose an interval type-2 fuzzy approach to PCM by considering uncertainty in the fuzzy parameter m in the PCM algorithm.

Sat 14:00-15:40

Room #402

Invited Session

Human vs. Computer Go Competition #4

Saturday, August 22, 16:00-17:00

Plenary Lecture (Halla Hall)

Perceptual Computing: One Implementation of Zadeh's Computing with Words Paradigm

Jerry Mendel, University Of Southern California

Saturday, August 22, 17:00-19:00

Sat 17:00-19:00

Main Lobby, 3rd Fl.

Poster Session

1. On the Use of Fuzzy Rule Interpolation Techniques for Monotonic Multi-Input Fuzzy Rule Base Models

Kai Meng Tay, Chee Peng Lim

Constructing a monotonicity relating function is important, as many engineering problems revolve around a monotonicity relationship between input(s) and output(s). In this paper, we investigate the use of fuzzy rule interpolation techniques for monotonicity relating fuzzy inference system (FIS). A mathematical derivation on the conditions of an FIS to be monotone is provided. From the derivation, two conditions are necessary. The derivation suggests that the mapped consequence fuzzy set of an FIS to be of a monotonicity order. We further evaluate the use of fuzzy rule interpolation techniques in predicting a consequent associated with an observation according to the monotonicity order. There are several findings in this article. We point out the importance of an ordering criterion in rule selection for a multi-input FIS before the interpolation process; and hence, the practice of choosing the nearest rules may not be true in this case. To fulfill the monotonicity order, we argue with an example that conventional fuzzy rule interpolation techniques that predict each consequence separately is not suitable in this case. We further suggest another class of interpolation techniques that predicts the consequence of a set of observations simultaneously, instead of separately. This can be accomplished with the use of a search algorithm, such as the brute force, genetic algorithm or etc.

2. F.C.A: Designing a Fuzzy Clustering Algorithm for Haplotype Assembly

Ehsan Asgarian, M-Hossein Moeinzadeh, Sarah Sharifian-R, Morteza Mohammad Noori, Mehdi Sadeghi

Error Correction) model is an important clustering problem which focuses on inferring two haplotypes from SNP fragments (Single Nucleotide Polymorphism) containing gaps and errors. Mutated form of human genome is responsible for genetic diseases which mostly occur in SNP sites. In this paper, a fuzzy clustering approach is performed for haplotype reconstruction or haplotype assembly from a given sample Single Nucleotide Polymorphism (SNP). In the best previous approach based on reconstruction rate (Wang 2007[2]), all SNP-fragments are considered with equal values. In our proposed method the value of the fragments are based on the degree of membership between SNP fragments and centers of clusters. Finally, these two approaches are executed on four standard datasets (ACE, Daly, SIM0 and SIM50) and the results show the efficiency of our proposed approach.

3. A Novel Control Scheme for a Class of Nonlinear Systems with Time Delays Based on Fuzzy Hyperbolic Model

Jun Yang, Huaguang Zhang, Derong Liu

This paper concerns the problem of mixed H_2/H_∞ control of a class of nonlinear continuous-time systems with time delays, which can be represented by a delayed fuzzy hyperbolic model (DFHM). The main advantage of using DFHM over T-S fuzzy model is that no premise structure identification is needed and no completeness design of premise variables space is needed. In addition, a DFHM is not only a kind of valid global description but also a kind of nonlinear model essentially. Based on delay-independent Lyapunov functional approach, some sufficient conditions for the existence of such a DFHM-based mixed H_2/H_∞ controller are provided, which are given in terms of the feasibility of a set of linear matrix inequalities (LMIs). Simulation results show the validity of the proposed method.

4. Study on Water Resource Risk Using the Interior-Outer Set Model

Lihua Feng

There is a transition from a fuzzy set to crisp set. Therefore, we can obtain a conservative risk value, a venture risk value and a maximum probability risk value. Under such an α level, three risk values can be calculated. As α adopts all values throughout the set $[0, 1]$, it is possible to obtain a series of risk values. Therefore, the fuzzy risk may be a multi-valued risk or set-valued risk. Calculation of the fuzzy expected value of Yiwu city's water resource risk has been performed based on the interior-outer set model. Selection of an α value depends on the confidence in different groups of people, while selection of a conservative risk value or venture risk value depends on the risk preference of these people.

5. Experimental Analysis on Objective Weights with Intuitionistic Fuzzy Entropy Measures in Multi-Attribute Decision Problems

Ting-Yu Chen, Chia-Hang Li, Che-Wei Choi

In the multiple attribute decision making (MADM) problem, it is crucial to properly assess the weights of attribute because the changes in the attribute weights would affect the ranking of alternatives. In addition, although the intuitionistic fuzzy (IF) set is widely extended to MADM problems, it turns out that the data and decision matrix get more complex and uncertain. Therefore, it is important to pay much attention to the credibility of data itself. However, there is little investigation on MADM with the credibility of data being explicitly taken into account. In this research, we propose a new objective weighting method by using IF entropy measures for MADM under the intuitionistic fuzzy environment. In terms of the nature of IF entropy, the attribute weights are assessed by the credibility of data. Moreover, several IF entropy measures are used and examined to figure out the difference between them with a series of simulation experiments. Four indices are employed to compare the ranking results by objective weights, including the contradiction rate, the inversion rate, the consistency rate and Spearman correlation coefficients. The experimental results indicate that different IF entropy measures would cause a totally different ranking result for attributes. In addition, when the numbers of alternative and attributes become large, the difference between rankings of attributes expands gradually.

6. Multiple Attribute Decision Making Based on Induced OWA Operator

Chunfu Wei, Zheng Pei, Bo Li

Aggregation operators are crucial to multiple attribute decision makers when they make decisions. While minimum and maximum can only represent optimistic and pessimistic extremes, an Ordered Weighted Aggregation (OWA) operator is able to reflect varied human attitudes lying between the two extremes by using distinct weight vectors. However, the OWA operator has a disadvantage of overlooking the importance of given argument itself. By combining the given argument itself with the ordered position argument and considering their importance, the authors of this paper first present an induced ordered weighted geometric averaging (IOWGA) operator for aggregating data information, and then give an IOWGA operator-based method applying to multiple attribute decision making (MADM) problems. Both the theoretical analysis and the numerical results show that IOWGA can better reflect the real situations in practical applications, and finally an illustrative example is given.

7. A New All-Neighbor Fuzzy Association Technique for Multitarget Tracking in a Cluttered Environment

Ashraf M. Aziz

Multitarget tracking in a cluttered environment is a significant problem in a wide variety of applications. A typical approach to deal with such problem is the joint probabilistic data association filter. The joint probabilistic data association filter determines the joint probabilities over all targets and hits and updates the predicted target state estimate using a probability weighted sum of residuals. This paper proposes a new all-neighbor fuzzy association technique. Unlike the joint probabilistic data association filter, in which the similarity measures are determined in terms of the conditional probability for all feasible data association hypothesis, the proposed allneighbor approach determines the similarity measures between measurements and tracks in terms of fuzzy weights. It associates measurements into tracks using fuzzy scores and updates the predicted target state estimate using a fuzzy weighted sum of residuals. The proposed technique performs data association based on a single possibility matrix between measurements and tracks; thus it highly reduces the computational complexity compared to other all-neighbor fuzzy techniques reported in the literature. The proposed technique can be applied to non-maneuvering targets as well as maneuvering targets in a cluttered environment. Its performance is compared to the joint probabilistic data association technique, the nearest-neighbor standard filter, and perfect data association. The results showed the efficiency of the proposed technique.

8. Extended T-S Fuzzy Model Based on Interval Arithmetic and Its Application to Interval Nonlinear Regression Analysis

Sun Changping, Xu Zhengguang

In this paper, a new fuzzy system model structure –Interval T-S Fuzzy Model (ITSFM) is proposed. Inspired from interval regression analysis, the interval arithmetic is incorporated with classical T-S fuzzy model and the parameters in consequent part of the ITSFM model become to be interval numbers. Thus, the outputs of the proposed ITSFM are interval numbers. In our ITSFM model, the membership functions are the same as the ones of the classical type. Finally, the proposed ITSFM is applied to interval nonlinear regression analysis with crisp inputs and interval outputs. Experimental results are then presented that indicate the validity and applicability of the proposed ITSFM.

9. Exploring the Effects of Intuitionistic Fuzzy Separation Measures on TOPSIS Rankings

Ting-Yu Chen, Yi-Wen Li, Che-Wei Choi

The purpose of this study is to extend the TOPSIS method for solving multiple attribute decision analysis problems with intuitionistic fuzzy data. Intuitionistic fuzzy sets are capable of coping with imprecise information due to the fact that exact data may be difficult to be precisely determined since human judgments are often vague under many conditions. In this paper, a proposed intuitionistic fuzzy version of the TOPSIS method is presented and further deals with a comparative analysis of separation measures. For the sake of the comparison of intuitionistic fuzzy TOPSIS rankings yielded by different separation measures, a simulation experiment of different sizes was generated and examined. The consistency rate, the contradiction rate of the best alternative, and average Spearman correlation coefficients are utilized to conduct a pairwise comparison for all separation measures. The results which are inclusive of one hundred combinations of ten different categories of number for each alternatives and attributes indicate that the preference orders are hardly identical using different separation measures in the intuitionistic fuzzy TOPSIS method. The experimental analysis showed that the different definitions of IFS separations indeed significantly affect the final results by means of the intuitionistic fuzzy TOPSIS method. The comparative results presented in our experimental analysis indicate differentiations in a number of important aspects with some comparative indices.

10. An Analysis of Partition Index Maximization Algorithm

Kuo-Lung Wu

In the traditional fuzzy c-means clustering algorithm, nearly no data points have a membership value one. Ozdemir __ and Akarum proposed a partition index maximization (PIM) algorithm which allows the data points can whole belonging to one cluster. This modification can form a core for each cluster and data points inside the core will have membership value $\{0,1\}$. In this paper, we will discuss the parameter selection problems and robust properties of the PIM algorithm.

11. Adaptive fuzzy Sliding Mode Control for a Class of Underactuated Systems

Chung-Chun Kung, Ti-Hung Chen, Liang-Chih Huang

This paper proposes an adaptive fuzzy sliding-mode controller for a class of underactuated systems. Here, the underactuated system is decoupled into two subsystems, and respectively define a sliding surface for each subsystem. The fuzzy models are applied to estimate the unknown functions of the controlled underactuated system. Then, we will propose the adaptive fuzzy sliding model controller to guarantee the tracking performance. Finally, computer simulations are given to demonstrate the tracking performance of the proposed control strategy.

12. Virtual Presence e-Learning Using Learning History Database of Collective Intelligence

Chang Suk Kim, Sung Shin Park

Web-based e-Learning is free from time and space to learn. It is very convenient to study without going to school. But web-based e-Learning has a merit and demerits. Most of web-based e-Learning learners used to study alone in isolated space. This is major shortcoming of the web-based e-Learning. Virtual presence e-Learning method using learning record of collective intelligence has a facility to study concurrent learning. It uses study records of other students to support e-Learning student to use the study history such as questions, comment etc. This approach has an effect virtual presence of lots students.

13. Hybrid Intelligent Modeling and Prediction of Texture Segmented Lesion from 4DCT Scans of Thorax

Kakar Manish, Olsen Rune Dag

In this study, modeling and prediction from four dimensional computed tomography images of texture delineated sub-lesion region by using hybrid intelligent algorithm (adaptive neural fuzzy inference system) is presented. Texture segmented sub-lesion region was segmented by fuzzy C means clustering and deformation maps between segmented regions are computed by using an expectation minimization approach. Both rigid (global) and non-rigid (local) registration was performed on the data. The data consisted of 4 phases of respiratory cycle totalling 36 images containing sub-lesion regions. Parameters extracted from the maps were fed to the hybrid intelligent algorithm for training and validation. The root mean square error for modeling and prediction was 10.7 for rigid parameter modeling and 46.06 for non-rigid modeling, respectively. The artificial sequence of sublesion regions was warped by using predicted parameters from the hybrid intelligent algorithm. The artificially generated warped images and true segmented images were then compared. The registration error was determined by the correlation coefficient and was found to be 0.603.

14. Estimation of Distribution Algorithms Making Use of Both High Quality and Low Quality Individuals

Yi Hong, Guopu Zhu, Sam Kwong, Qingsheng Ren

Most estimation of distribution algorithms only make use of some high quality individuals and neglect other low quality individuals. However like high quality individuals, these neglected low quality individuals also contain some important information that may be useful for guiding the search of estimation of distribution algorithms. This paper proposes a novel kind of estimation of distribution algorithms, where both high quality and low quality individuals in the old population are employed for reproducing new candidate individuals at the next generation. In particular, both the density $PH(X)$ of high quality individuals and the density $PL(X)$ of low quality individuals are estimated; then the new population G is obtained with the following steps employed: 1) a new candidate individual x is reproduced through sampling from the density $PH(X)$; 2) to let $PH(X = x)$ and $PL(X = x)$ compare and the individual x will be stored into the new population G if and only if $PH(X = x) \geq PL(X = x)$; 3) the above steps repeat until M new individuals have been successfully generated where M is the population size. To demonstrate the usefulness of low quality individuals for estimation of distribution algorithms, estimation of distribution algorithms using both high quality and low quality individuals are tested on several benchmark problems and their results are compared with those obtained by estimation of distribution algorithms where only high quality individuals are used. The usefulness of low quality individuals for speeding up the search of estimation of distribution algorithms is confirmed by the experimental results.

15. Buckley-Feuring Solutions for Non-Polynomial Fuzzy Partial Differential Equations. Application to Utility Theory

David Galvez, Jose Luis Pino

This paper presents the natural extension of Buckley-Feuring method proposed in [2] for solving fuzzy partial differential equations (FPDE) in a nonpolynomial relation, such as the operator (Dx_1, Dx_2) , which maps to the quotient between both partials. The new assumptions and conditions proceedings from this consideration, have been developed for a concrete application: a new method for building consumer fuzzy utility functions from marginal rates of substitution (MRS). Finally, the consumer decision problem is tackled in its fuzzy mathematical programming form.

16. GMM-QNT Hybrid Framework for Vision-based Human Motion Analysis

Chee Seng Chan, Honghai Liu

The understanding of human behaviour in video is a challenging task in that the same behaviour might have several different meanings depending upon the scene and task context in which it is performed. While human seem to perform scene interpretations without effort, this is a formidable and yet unsolved task for artificial vision systems. One of the main reasons is that there exists a gap between low-level vision at signal level and high-level representation of activities at symbolic level. In this paper, we present an intelligent connection framework using Gaussian Mixture Model-based clustering (GMM) to bridge the low-level vision data and the Qualitative Normalised Templates (QNT) - a symbolic representation for human motion based on fuzzy qualitative robot kinematics, which could link the former with domain-independent scenarios. The proposed method has been applied to the recognition of eight types of human motions and an empirical comparison with fuzzy hidden Markov-based human motion recognition system.

17. Triplet of FCM Classifiers

Hidetomo Ichihashi, Katsuhiko Honda, Akira Notsu

This paper proposes an additional version of the fuzzy *c*-means based classifier (FCMC). The classifier FCMC-R treats relational data instead of object data. FCMCs use covariance structures to represent flexible shapes of clusters. Despite its effectiveness, the intense computation of covariance matrices is an impediment for classifying a set of high-dimensional feature data. In order to tackle with this problem, we proposed a way of directly handling highdimensional data, i.e., FCMC-H. The third type of the FCM classifier is the relational classifier FCMC-R, which is derived from FCMC-H. The relational data represented by a relational matrix are based on dissimilarities or distances between object data. The triplets, i.e., FCMC, FCMC-H, and FCMC-R are equivalent when the dimensionality of feature vectors is not very high and the dissimilarity is represented by Euclidean distances. The randomized test set performance of FCMC on the sets of object data from UCI repository is comparable to that of the support vector machine (SVM) classifier. The performances of the triplet in terms of 100 times three way data splits (3-WDS) procedure are compared. The triplet surpasses the *k*-nearest neighbor (*k*-NN) classifier, which is a well established and very popular relational classifier.

18. A Novel Multi-Level Quantization Scheme for Discrete Particle Swarm Optimization

Hwachang Song, Ryan Diolata, Young Hoon Joo

This paper presents a novel multi-level quantization scheme which best approximates the sigmoid function for multi-value discrete variable transformation in PSO. We define the set of multi-level quantization as integer multiples of powers-of-two terms to efficiently approximate the sigmoid function in transforming particle's position into multilevel discrete values. In this paper, the feasibility of the proposed technique was tested in photovoltaic (PV) system allocation problem, and a comparison study with genetic algorithm (GA) is performed to show the quality of the solutions obtained.

19. Effects of Fuzzy Membership Function Shapes on Clustering Performance in Multisensor-Multitarget Data Fusion Systems

Ashraf M. Aziz

Fuzzy systems have been proven very successfully in many important applications and are rapidly growing to become a powerful technique for multisensor-multitarget data fusion. The functional paradigm for fuzzy multisensormultitarget data fusion

consists of fuzzification, fuzzy knowledge-base, fuzzy inference mechanism, and defuzzification. In fuzzy system design, users start with some fuzzy rules, which are chosen heuristically based on their experience, and membership functions, which in many cases are chosen subjectively based on understanding the problem, and they use the developed system to tune these rules and membership functions. Constructing membership function is the most important step in the fuzzy system design. This paper addresses the problem of constructing the optimal membership functions from input data in a multisensor-multitarget environment. This analysis has been applied to clustering of multisensor information in a two-dimensional multisensormultitarget data fusion system. Clustering performance using optimal membership functions is compared to that of clustering using non-optimal membership functions. The results show that there is a significant performance improvement when using optimal membership functions.

20. Multi-criteria Decision-making and Extracting Fuzzy Linguistic Summaries Based on Intuitionistic Fuzzy Sets

Bo Li, Zheng Pei, Chengjie Li, Chunfu Wei

In this paper, we used Chen and Tan's method for handling multi-criteria fuzzy decision-making problems, where the characteristic of the alternatives are represented by intuitionistic fuzzy sets. The method allows the degrees of membership and non-membership of each alternative with respect to a set of criteria to be represented by intuitionistic fuzzy sets, respectively. Based on the structure of a fuzzy statement, a new method to extract Q; S and T of a linguistic data summary is discussed. The proposed method uses a new function weighting "real degree", which not only due to the fact that it use intuitionistic fuzzy set theory rather fuzzy set theory, but also due to the fact that the function can deal with the uncertainty well. Some patterns, which can conduct the decision-making, can be obtained from the linguistic summaries. Two example are given to illustrate the process.

21. Design of Collision Avoidance System for a Chicken Robot Based on Fuzzy Relation Equations

Alexey Gribovskiy, Francesco Mondada

Design and study of mixed animal-robot societies are the fields of scientific exploration that can bring new opportunities for research into the group behavior of social animals. Our goal is to develop a Chicken Robot – an autonomous mobile robot, socially acceptable by a group of chicks and able to interact with them using appropriate communication channels. One of the basic requirements to such a robot is the safety of its motion with respect to the chicks, so it has to be endowed with an efficient real-time collision avoidance system. In this paper we present a fuzzy obstacle avoidance system that was designed for the Chicken Robot using the theory of fuzzy relation equations. This approach allows to easily check a consistency of a used rule base and provides a more systematic approach to design of fuzzy control systems comparing with the classical techniques. The experimental results demonstrate that a mobile robot equipped with the presented system is able to successfully avoid obstacles and safely navigate on an experimental arena.

22. A Comparison of Type-1 and Type-2 Fuzzy Controllers in a Micro-Robot Context

Philip A.S. Birkin, Jonathan M. Garibaldi

In this paper we compare the differences between type-1 and interval type-2 fuzzy logic controllers, with seven, five and two three term membership functions. The controllers were used to control a DC motor model in a closed loop simulation. The performance of each controller to a step change and a change in motor inertia with and without added noise was recorded. The results showed that there was no statistical difference between the type-1 and type-2 controllers. It was also found that a type-1 three term controller was as good as a type-1 or type-2 seven term controller, in controlling the micro robot DC motor model.

23. The Multi-Audiences Intelligent Online Presentation System

Sandy W. K. Wong, Hillman W. K. Tam, Edward H. Y. Lim, James N. K. Liu, Raymond S. T. Lee

Office web application is a hot topic in nowadays commercial society. Many office application development companies try to put the traditional document software to the Internet. However, there are difficulties of putting presentation software on the Internet, especially the activeness in the global business environment for presentation of manufacturers' favorite documentation software (e.g. Microsoft Power Point). Thus, the presenter and audiences must stay in the same physical location. That constitutes another problem which the presenter is difficult to invite all the audiences. This paper presents an intelligent appointment approach for implementing a multi-audiences online presentation system. The presentation system integrates three main approaches - online presentation materials preparation, presentation with group video conferencing and agent-based appointment services.

24. A Fuzzy-Based Design Procedure for a Single-Stage Sampling Plan

S. Ajorlou, A. Ajorlou

In a single-stage sampling plan, the decision to accept or reject a lot is made based on inspecting a random sample of certain size from the lot. There are two possible errors in any sampling plan; a good lot may get rejected (known as the producer's risk), or a bad lot may get accepted (known as the consumer's risk). Conventional designs may result in needlessly large sample size. The sample size n can be reduced by relaxing the conditions on the producer's and consumer's risks. In this paper, we propose a method for constructing the membership function of the grade of satisfaction for the sample size n based on the shape of the sampling cost function. Based on that, we find a reasonable solution to the trade-off between relaxing the conditions on the actual risks and the sample size n . The membership function of the grade of satisfaction for the sample size is derived for three general sampling cost functions, and the advantages of the proposed methodology over the existing methods is illustrated via a numerical example.

25. An SVD-Based Watermarking Scheme Using Improved Micro-Genetic Algorithm

Chih-Chin Lai, Cheng-Chih Tsai, Shing-Tai Pan

In this paper, we introduce an image watermarking scheme using singular value decomposition (SVD) and improved micro-genetic algorithm (micro-GA). In an SVDbased watermarking scheme, the singular values of a cover image are modified by multiple scaling factors to embed the watermark image. Determining proper values of scaling factors to reduce visual artifacts is viewed as an optimization problem and we use the improved micro-GA to search the feasible solution. Experimental results are provided to illustrate the proposed approach is robust to common signal processing attacks.

26. A Comparison and Analysis of Genetic Algorithm and Particle Swarm Optimization Using Neural Network Models for High Efficiency Solar Cell Fabrication Processes

Hyun-Soo Kim, Sang Jeon Hong, Seung-Soo Han

In this paper, statistical experimental design is used to characterize the surface texturing and emitter diffusion formation processes for high-performance silicon solar cells. The output characteristics considered are reflectance, sheet resistance, diffusion depth, and cell efficiency. The influence of each parameters affected to efficiency is investigated through the main effect and interaction analysis. Sequential neural network process models are constructed to characterize the entire 3-step process. In the sequential scheme, each work cell sub-process is modeled individually, and each sub-process model is linked to previous sub-process outputs and

subsequent sub-process inputs. These neural network models are used for process optimization using both genetic algorithms and particle swarm optimization to maximize cell efficiency. The optimized efficiency found via particle swarm optimization showed better performance than optimized efficiency found via genetic algorithms.

27. A Novel Cluster Validity Criterion for Fuzzy C-Regression Models

Chung-Chun Kung, Jui-Yiao Su, Yi-Fen Nieh

This paper proposed a novel cluster validity criterion for fuzzy c -regression models (FCRM) clustering algorithm with hyper-plane-shaped clusters. We combined the concept of fuzzy hypervolume with the compactness validity function in the cluster validity criterion. The proposed cluster validity criterion determined the appropriate number of clusters by calculating the overall compactness and separateness of the FCRM partition. The simulation results demonstrated the validness and effectiveness of the proposed method.

28. Modeling Based on Multi Objective Decision Making for Determining of Goals' Appropriate Selection

Javad Jassbi, Reza Radfar, Rasool Babaali

Resources limitations and requirements and representing a lot of objectives, have made inevitable the necessity of applying optimal and efficient available capabilities in each organization. For this reason, ranking of goals along with organizational goals in each organization cannot be avoided and also most of successful companies pay more attention to this point. But in achieving this objective considering goals and the decision maker conditions is mandatory. Therefore, presenting a scientific solution and appropriate model that can satisfy the relations between goals and limitations seems to be necessary. In the complicated situation, considering all components and factors in decision-making obliges us to create a balance between goals and effective factors in achieving them. In this condition, not only all of the components and environmental variables cannot be considered one dimensionally, but also the best solution is considering all conditions and goals and making a decision in order to succeed in the desired utility of them. These problems have caused the nature of decision making include so many ambiguities, from the simplest to the most complicated affairs, and caused decisions to be taken in a fuzzy environment. As fuzzy logic has several applications in making decision in uncertain and fuzzy environments, this paper intends to model one of the strict and sophisticated decisions of managers using a mathematical model based on fuzzy inference system, that is, analysis and determining ranking of goals, from the available list in which the maximum use of available resources, considering the existing limitations, can be reached.

29. Human Activity Recognition Using a Fuzzy Inference System

Mohammad Helmi, Seyed Mohammad Taghi AlModarresi

This paper presents a fuzzy inference system (FIS) for recognizing human activities using a triaxial accelerometer. The accelerometer is used to collect human motion acceleration data for classifying four different activities: moving forward, jumping, going upstairs, and going downstairs. Three different features including peak to peak amplitude, standard deviation, and correlation between axes are extracted from each axis of the accelerometer as inputs to the fuzzy system. The fuzzy rules and the membership functions of this fuzzy system are defined based on the experimental values of these features. The experiments show that the proposed fuzzy inference system recognizes moving forward, jumping, going upstairs, and going downstairs with accuracy of 100%, 96.7%, 93.3%, and 93.3%, respectively.

30. A Self-Adaptive Control Algorithm of the Artificial Fish Formation

Xiaojuan Ban, Yunmei Yang, Shurong Ning, Xiaolong Lv, Jin Qin

With the deep study of swarm intelligence, biologists found that fish swarm changes in formation gradually in time during their movement. This formation change leads to a better and more effective access to evade predator and opportunity to capture food, so that the group's overall performance is improved. The architecture of artificial fish formation is established based on the behavioral model of artificial fish swarm. The mechanism of formation change is analyzed. A self-adaptive control algorithm of formation is proposed in this paper. The parameters optimized PSO algorithm is used to simulate the process of keeping its balance during the formation change. Thus, the problem on relative bad adaptability and large systematic traffic in existing algorithms of formation is resolved.

31. A Fuzzy Approach for Mining High Utility Quantitative Itemsets

Chia-Ming Wang, Shyh-Huei Chen, Yin-Fu Huang

Studies on frequent pattern mining have often considered the existence of an item in a transaction but ignored its profit and purchase quantity. As a result, utility mining has been introduced to resolve this issue. However, the resulting patterns simply show the correlation among high utility items without quantity information of such items. In this study, a novel method is proposed to discover high utility fuzzy itemsets from quantitative databases which considers both profits and quantities of items. The quantities are fuzzified into linguistic regions, thus the quantitative concept is consistent with human cognition and easy to interpret. In addition, we provide theoretical and empirical analysis of the proposed method. The simulation results demonstrated that our method can efficiently and effectively mine high utility fuzzy itemsets from quantitative databases.

32. Design of Adaptive Prediction Systems Based on Rough Sets

Young-Keun Bang, Chul-Heui Lee

In this paper, a multiple prediction system using T-S fuzzy model is presented for time series forecasting. To design predictors with better performance especially for chaos or nonlinear time series, difference data were used as their input, because they reveal the statistical patterns and the regularities concealed in time series more effectively than the original data can. The proposed method consists of three major procedures. First, multiple model fuzzy predictors (MMFPs) are constructed based on the optimal difference candidates. Next, an adaptive drive mechanism (ADM) based on rough sets is designed for the selection of the best one among the multiple predictors according to each input data. Finally, an error compensation mechanism (ECM) based on the cross-correlation analysis is suggested in order to enhance further the prediction performances. Also we show the effectiveness of the proposed method by computer simulation for the various typical time series.

33. A Novel Approach to Discovering the Pattern of Customer

Tao Zhang, Xu Xu

Practicing customer (owner) retention in construction management is very important. Despite existing the importance of owner retention in many projects, there is a lack of a comprehensive and effective approach to realize it fully. According to these conditions, intuitionistic fuzzy set theory, α -cuts, expert domain knowledge are employed to discover the pattern of owner retention under the context of domain-driven data mining methodology in this paper. The proposed approach is not only expatiated by an example, but also is proved by the experiments. In short, the approach provides a route to guide the further research concerning owner retention.

34. Mining Pattern of Supplier with the Methodology of Domain-Driven Data Mining

Xu Xu, Jie Lin, Dongming Xu

Supplier selection has a critical effect on the competitiveness of the entire supply chain network. It is not only a significant work in supply chain management but also a complex decision making problem which includes both qualitative and quantitative factors. Research results indicate that the supplier selection process appears to satisfy different evaluation criteria and business model in deciding the success of the supply chain. Supplier selection problem related to organization strategy and it needs more critical analysis. This paper proposes a novel approach that combines expert domain knowledge with Apriori algorithm of data mining to discover the pattern of supplier under the methodology of Domain-Driven Data Mining (D3M). Apriori algorithm of data mining with the help of Intuitionistic Fuzzy Set Theory (IFST) is employed during the process of mining. The overall patterns obtained help in deciding the final selection of suppliers. Finally, AHP is used to efficiently tackle both quantitative and qualitative decision factors involved in ranking of suppliers with the help of pattern achieved. An example searching for pattern of supplier is used to demonstrate the effective implementation procedure of proposed method. The proposed method can provide the guidelines for the decision makers to effectively select their suppliers in the current competitive business scenario.

35. Fuzzy Image Restoration for Noise Reduction Based on Dempster-Shafer Theory

Tzu-Chao Lin

A novel decision-based fuzzy averaging filter consisting of a new Dempster-Shafer (D-S) noise detector and a two-pass noise filtering mechanism is proposed. Bodies of evidence are extracted, and the basic belief assignment is developed, avoiding the counter-intuitive problem of Dempster's combination rule. The combination belief value can be the decision rule for the D-S noise detector. A fuzzy averaging method where the weights are constructed using a predefined fuzzy set is developed to achieve noise cancellation. Besides that, a simple second-pass filter is also employed to improve the final filtering performance. Experimental results have confirmed the proposed filter outperforms other decision-based filters in terms of both noise suppression and detail preservation.

36. Efficient Adaptive Filter Design to the Active Noise Control System

Cheng-Yuan Chang, Fuh-Hsin Hwang, I-Ling Chung, Chang-Min Chou

This paper presents an intelligent filter design method with a fixed-point digital signal processor (DSP) and illustrates its performance on the application of active noise cancellation (ANC) system. The proposed designing method uses magnitude and phase compensation techniques to eliminate the errors associated with the nonlinear distortion of analog devices in the application, and hence, to improve the ANC performance. The quantization and rounding errors associated with the fixed-point DSP are also compensated for. Several experiments verify the enhancement.

37. Research of Fault-characteristic Extractive technology Based on Particle Swarm Optimization

Pan Hongxia, Huang Jinying, Mao Hongwei

In the work process of gearbox, because the responding signal is very complex, it is difficult to extract its sensitive fault attributive information. The sensitivity of the fault degree, fault position and fault type is very different, so the characteristic parameter set constructed by the traditional characteristic extraction and analysis method is voluminous. Therefore, how to define the reliable and effective fault characteristic parameter set and how to optimize the

parameter set by the sensitive degree are the await solved problems to realize real time and online fault diagnosis. In this paper, the characteristic extractive method base on particle swarm optimization (PSO) is presented for the problem of gearbox failure characteristic selection. Then the technology is applied to analyze and process the vibration responding signal of gearbox, extract and optimize the fault characteristic parameter set. Finally the parameter set nearly related to the gearbox's fault is constructed and it is used to the fault diagnosis. It proves validity of the diagnosis result that PSO algorithm has good effectiveness, higher diagnosis precision and fast optimal speed than the traditional genetic algorithm, The experimental result indicates that the wavelet neural network training method based on the PSO algorithm is an effective training algorithm, and meanwhile it is also an available approach to solve fault diagnosis problems.

38. Financial Trend Forecasting with Fuzzy Chaotic Oscillatory-Based Neural Networks (CONN)

K. M. Kwong, Max H. Y. Wong, Raymond S. T. Lee, James N. K. Liu, Jane You

This paper describes a methodology for financial prediction by using an advanced paradigm from computational intelligence - Chaotic Oscillatory-based Neural Networks (CONN) and aid with fuzzy membership function. The method uses financial market data to predict market trends over a certain period of time. This approach may have a wide variety of applications but from financial forecasting perspective, it can be used to identify and forecast market patterns for providing valuable and useful advices to investors for making investment decisions.

39. Assessing Similarity Between Cases by Means of Fuzzy Rules

Ning Xiong

The concept of similarity plays a fundamental role in case-based reasoning. However, the meaning of "similarity" can vary in different situations and remains an issue. This paper proposes a novel similarity model consisting of fuzzy rules to represent the semantics and evaluation criteria for similarity. We believe that fuzzy if-then rules present a more powerful and flexible means to capture domain knowledge for utility oriented similarity modeling than traditional similarity measures based on feature weighting. Fuzzy rule-based reasoning is utilized as a case matching mechanism to determine whether and to which extent a known case in the case library is similar to a given problem in query. Further, we explain that such fuzzy rules for similarity assessment can be learned from the case library. The key to achieving this is pairwise comparisons of cases with known solutions in the case library such that sufficient training samples can be derived for fuzzy rule learning. The evaluations conducted have shown that the proposed method yields more precise similarity values to approximate case utility than conventional ways of similarity modeling and that fuzzy similarity rules can be learned from a rather small case base without the risk of over-fitting.

40. Multi-Camera Tracking System in a Large Area Case

Zalili Binti Musa, Junzo Watada

A video tracking system raises a wide range of possibilities in today's society, particularly in security, monitoring, and robotics. The most important research in tracking systems is to discover and develop an available method and algorithm for tracking an object's motion. The objective of this paper is to propose a new method that combines a prediction method and particle filter to manage problems in a wide area of observation. The comparative study of the method is provided and its capabilities are evaluated.

41. Chemical Vapor Deposition Quality Prediction System Based on Support Vector Regression and Fuzzy Learning Mechanism

Jui-Yiao Su, Ching-Shun Chen

In advanced semiconductor manufacturing, the in-process wafers need to be monitored periodically in order to obtain high stability and high yield rate. However, the actual measurement is usually obtained after all the work-pieces of the same lot have been processed. The parameter drift or shift of the production equipment could not be detected in real-time thereby increasing the production cost. We proposed a quality prediction system (QPS) based on support vector regression (SVR) and fuzzy learning mechanism (FLM) to overcome this problem. The SVR provided good generalization performance for prediction, and the embedded FLM implied a continuous improvement or at least non-degradation of the system performance in an ever changing environment. The effectiveness of the proposed QPS was validated by test on chemical vapor deposition (CVD) process in practical 12-inch wafer fabrication. The results show that the proposed QPS not only fulfills real-time quality measurement of each wafer, but also detects the performance degradation of the corresponding machines from the information of manufacturing process.

42. The Geometric Interval Type-2 Fuzzy Logic Approach in Robotic Mobile Issue

Nesrine Baklouti, Adel M. Alimi

Recently type-2 Fuzzy logic systems (FLSs) have demonstrated their competence in treating vagueness in real world dynamic systems. But, in the last few years, new trends and theory in Fuzzy Logic have been appeared, proposing the geometric type-2 Fuzzy logic approach. The main idea of this approach was to model fuzzy logic sets using computational geometry providing by this more accurate results and better performance in treating vagueness. Throughout this paper, we study the effect of the geometric approach in robotic mobile issue. We propose two controllers: a geometric interval type-2 fuzzy logic local avoiding obstacles controller and a geometric interval type-2 fuzzy logic wall following controller. The obtained results are presented and are discussed. The geometric type-2 FLSs provide good results...

43. Investigation of Effective Region for Data Dissemination in Road Networks Using Vehicular Ad hoc Network

Fatemeh Rezaei, Kshirasagar Naik, Amiya Nayak

Dissemination of data related to dynamic and timely traffic / road condition, and any unexpected events can significantly improve the quality of driving with respect to time, distance, and safety. Although extending region of data dissemination in the network constructed among vehicles informs more vehicles on road network, it increases communication cost and imposes delay on the network. The imposed delay has an undesirable impact on vehicle safety applications which require very low message latencies. This research investigates how communication cost and additional travel cost are affected while the region of dissemination is increased. Moreover, this research aims at studying the effective region for data dissemination in an ad-hoc network among vehicles. The simulation results indicate that extending the region of data dissemination increases the communication cost and decreases the additional travel cost. Also, there is an optimal region for data dissemination so that effective propagation of data to a certain area reduces the additional travel cost.

44. Application of Incomplete Linguistic Preference Relations in Predicting the Success of ERP Implementation

Shu-Chen Hsu, Tien-Chin Wang, Tsung-Han Chang, Juifang Chang

This study applies an analytic hierarchical prediction model based on Multi-Criteria Decision Making with Incomplete Linguistic Preference Relations (InLinPreRa) to help the organizations become aware of the essential factors affecting the Enterprise Resource Planning (ERP), as well as identify the actions necessary before implementing ERP. The subjectivity and vagueness in the prediction procedures are dealt with using linguistic terms quantified in an interval scale $[-t, t]$. Then predicted success/failure values are obtained to enable organizations to decide whether to initiate ERP, inhibit adoption or take remedial actions to increase the possibility of successful ERP. The empirical results not only demonstrate the senior manager support degree, organizational and coordination are the three most important influential factors in the ERP initiative process, but also reveal the applicability and feasibility of reciprocal Incomplete Linguistic Preference Relation (InLinPreRa) for solving complicated hierarchical multiple attribute prediction problems. Keywords: InLinPreRa, Incomplete Linguistic Preference Relations, ERP, Multi-Criteria Decision Making, Analytical Hierarchy process.

45. Delay-Dependent Fuzzy Controller Design for Stabilization of Nonlinear Systems with Multiple Non-Commensurate Time Delays

Rong-Jyue Wang

In this paper, the T-S fuzzy model approach is extended to design fuzzy controllers for the stabilizability of nonlinear systems with multiple non-commensurate time delays. Three types of fuzzy controllers are state feedback, observer-based state feedback, and output feedback fuzzy controller with time delay information. Based on the concept of the parallel distributed compensation (PDC) and the delay-dependent Lyapunov functional approach, some control design methods are proposed to stabilize the whole fuzzy time-delay system asymptotically. These design approaches are all dependent on time delays. By Schur complement, these sufficient conditions can be easily transformed into the problem of LMI's. The practical example based on the CSTR (continuous stirred tank reactor) model is given to illustrate the control designs and their effectiveness.

46. The Multiple-Function Intelligent Robotic Arms

Rong-Jyue Wang, Jun-Wei Zhang, Jia-Ming Xu, Hsin-Yu Liu

This paper details the design, production, and programming methodology of a multiple-function robotic arm. All of the hardware and software of this robotic arm were designed and produced by the authors. This robotic arm won the championship of the first competition of HIWIN intelligent robotic arms on Aug. 22, 2008 in Taiwan. The main design goal of this robotic arm was to present the following functions: fancy dancing, weightlifting, Chinese calligraphy, and color classification. Another design goal was to minimize cost and maximize performance. On the other hand, a set of the robotic arms are also applied to show martial arts and play the rock-scissors-paper game with modifying and mimetic hands. The characteristics of the robotic arms include: 1. The shoulder of robotic arm includes a pair of motor structures to enhance the ability to life weight. 2. The stability and accurateness of the robotic arm are optimized for the requirement of high performance throughout the whole structural design. 3. In order to increase the moving ability of the robot, the robotic arm was designed with a four-wheeled transmission structure and track. 4. Two mimetic robotic arms work in concert to present the fancy shows. 5. Five kinds of machine hands were designed to meet the requirements of the six appointed functions.

47. Human Activities of Daily Living Recognition Using Fuzzy Logic for Elderly Home Monitoring

Hamid Medjahed, Dan Istrate, Jerome Boudy, Bernadette Dorizzi

Learning and recognizing human activities of daily living (ADL), is very useful and essential to build a pervasive home monitoring system. These monitoring technologies are indispensable for developing the next generation of smart houses. In this paper we describe a fuzzy logic system for recognizing activities in home environment using a set of sensors: physiological sensors (cardiac frequency, activity or agitation, posture and fall detection sensor), microphones, infrared sensors, debit sensors and state-change sensors. Motivated by the fact that Fuzzy controllers have been successfully embedded within billions of dollars in commercial products, plus the characteristic of data providing from each sensor, the fusion of the different sensors has been performed by using fuzzy logic. This fuzzy logic approach allowed us to recognize several Activities of Daily Living (ADLs) for Ubiquitous Healthcare.

48. Parameter Tuning of Membership Functions of a Fuzzy Logic Controller for an Autonomous Wheeled Mobile Robot Using Ant Colony Optimization

Ricardo Martinez-Marroquin, Oscar Castillo, Jose Soria

In this paper we describe the application of a Simple ACO (S-ACO) as a method of optimization for the membership functions' parameters of a fuzzy logic controller (FLC) in order to find the optimal intelligent controller for an Autonomous Wheeled Mobile Robot. Simulation results show that ACO outperforms a GA in the optimization of FLCs for an autonomous mobile robot.

49. Design of Interval Type-2 Fuzzy Neural Networks and Their Optimization Using Real-coded Genetic Algorithms

Keon-Jun Park, Sung-Kwun Oh, Witold Pedrycz

In this paper, we introduce the design methodology of interval type-2 fuzzy neural networks (IT2FNN). And to optimize the network we use a real-coded genetic algorithm. IT2FNN is the network of combination between the fuzzy neural network (FNN) and interval type-2 fuzzy set with uncertainty. The antecedent part of the network is composed of the fuzzy division of input space and the consequence part of the network is represented by polynomial functions. The parameters such as the apexes of membership function, uncertainty parameter, the learning rate and the momentum coefficient are optimized using genetic algorithm (GA). The proposed network is evaluated with the performance between the approximation and the generalization abilities.

50. On the Effectiveness of Fuzzy Clustering as a Data Discretization Technique for Large-scale Classification of Solar Images

Juan M. Banda, Rafal A. Angryk

This paper presents experimental results on the utilization of fuzzy clustering as a discretization technique for purpose of solar images recognition. By extracting texture features from our solar images, and consequently applying fuzzy clustering techniques on these features, we were able to determine what clustering algorithm and what algorithm's initialization parameters produced the best data discretization. Based on these results we discretized some of our texture features and ran them on two different classifiers comparing how well the classifiers performed on our original data versus the discretized data. Our experimental results demonstrate that discretization of our data via fuzzy clustering carries significant potential since on our classifiers produced similar results on the original and the discretized data, and the reduction of storage space achieved through cluster-based discretization has been very significant.

51. Performance Assessment of Nonlinear Control Systems Based on Fuzzy Modeling

Zhi Zhang, Li-Sheng Hu, Xue-Lian Zhang

This note concerns with performance assessment problem for nonlinear control systems. Because of the difficulty finding a suitable benchmark performance for the nonlinear control systems, this problem is still open by now. With the help of the so called Takagi-Sugeno fuzzy model, the benchmark controller and its associated benchmark performance are proposed based on linear time-variant model transformed by the nonlinear system. Final simulation result well shows the effectiveness of the proposed assessment procedure.

52. Data Reduction Algorithm for Remote Monitoring System Base on Ubiquitous Sensor Network

Cong yi Zhang, Eysu Yook, Su jin Kim, Sung-ho Kim

In the modern life, machines are used for various areas in industries as the advance of science and industrial development has proceeded. In many machines, the rotating machines play an important role in many processes. Therefore, the development of monitoring system for rotating machines is required. The ubiquitous sensor network is drawing a lot of attention as a method for realizing a ubiquitous society. It collects environmental information to realize a variety of functions, through a countless number of compact wireless nodes that are located everywhere to form an ad-hoc arrangement, which does not require a communication infrastructure. In this work, a data reduction algorithm for remote wireless monitoring system based on USN which can be easily applied to previously built factories is proposed. To verify the feasibility of the proposed scheme, some simulation studies are executed.

53. Fuzzy Semi-active Control of MR Damper for Structural Base Isolation

Han Wang, Heidar Malki, Gangbing Song

This paper presents four types of semi-active control on Magnetorheological (MR) Damper in an experimental base isolation structure model with three degree-of-freedom. The semi-active control methods include proportional-derivative (PD) control, and three fuzzy control methods: rule-based fuzzy logic control, auto-tuning fuzzy PD control, and discrete fuzzy PD control. The main purpose is to compare the response effect between passive control methods and semi-active control methods, and also compare within semi-active controls. The results of both passive controls and semi-active controls in experiments are presented. From the results, semi-active controls are shown more adaptive than passive control for this model when the earthquake type is unknown. Moreover, auto-tuning fuzzy PD control is proved to have relatively best performance among all control methods.

54. A Study on Multi-Agent Reinforcement Learning Problem Based on Hierarchical Modular Fuzzy Model

Toshihiko Watanabe

Reinforcement learning is a promising approach to realize intelligent agent such as autonomous mobile robots. In order to apply the reinforcement learning to actual sized problem, the "curse of dimensionality" problem in partition of sensory states should be avoided maintaining computational efficiency. The paper describes a hierarchical modular reinforcement learning that Profit Sharing learning algorithm is combined with Q-Learning reinforcement learning algorithm hierarchically in multi-agent pursuit environment. As the model structure for such huge problem, I propose a modular fuzzy model extending SIRMs architecture. Through numerical experiments, I found that the proposed method has good convergence property of learning compared with the conventional algorithms.

55. A Genetic Algorithm with Utilizing Lethal Chromosomes

Yalong Zhang, Xuan Ma, Jousuke Kuroiwa, Tomohiro Odaka, Hisakazu Ogura

Many unsatisfied solutions being produced in applying GA to solve the constrained combinatorial optimization problems due to genetic operations. The unsatisfied solutions are regarded as lethal chromosomes in GA. Large numbers of lethal chromosomes might lead to that implementing and searching performance of GA comes to degrade. The usual means dealing with the lethal chromosomes is to eliminate it from population, however, evolved lethal chromosomes containing some fruits of evolution, abandoning lethal chromosomes is as same as abandoning available information, and leads to waste of evolving resources. We propose a new method to revive and utilize the lethal chromosomes based on immune theory, and apply it as a double islands algorithm model. To Multidimensional Knapsack Problem (MKP), simulating experiment shows that proposed method could effectively improve the performance of GA.

56. Refining Classifier from Unsampled Data

Donghai Guan, Yongkoo Han, Young-Koo Lee, Sungyoung Lee, Chongkug Park

For a learning task with a huge number of training instances, we sample some informative/important instances, which are then used for learning. Obtaining accurately labeling data is always difficult thus noise detection is required to filter out noises from sampled instances since the noises will degrade the learning performance. In this work, we propose to utilize unsampled instances to improve the performance of noise detection in sampled instances. Empirical study validates our idea that refined classifier can be achieved from noisy sampled instances by utilizing unsampled instances.

57. Fuzzy Objective Functions for Robust Pattern Recognition

Tai-Ning Yang, Chih-Jen Lee, Shi-Jim Yen

In this paper, we consider the issue of fuzzy objective functions when outliers exist. The outlier set is defined as the complement of the data set. Following this concept, a specially designed fuzzy membership weighted objective function is proposed and the corresponding optimal membership is derived. Based on the proposed robust objective functions, algorithms for clustering are implemented. Artificially generated data are used for comparison.

58. Development of the Facial Feature Extraction and Emotion Recognition Method based on ASM and Bayesian Network

Kwang-Eun Ko, Kwee-Bo Sim

In the facial image, emotions are most widely represented with eye and mouth expressions. If we want to recognize the human's emotion via the facial image, we need to extract features of the facial image. Active Shape Model (ASM) is one of the most popular methods for facial feature extraction. Regarding the traditional ASM depends on the setting of the initial parameters of the model, in this paper we propose a facial emotion recognizing method based on ASM and Bayesian Network. Firstly, we obtain the reconstructive parameters of the new gray-scale image by sample-based learning and use them to reconstruct the shape of the new image and calculate the initial parameters of the ASM by the reconstructed facial shape. Then reduce the distance error between the model and the target contour by adjusting the parameters of the model. Finally get the model which is matched with the facial feature outline after several iterations and use them to recognize the facial emotion by using Bayesian Network.

59. Develop Simulation and Trial Test Q-Learning System for Soccer Robot System

Takeshi Kiyoto, Yukinobu Hoshino

Purpose of my research is to make an automatic control system for soccer robots by the Reinforcement Learning [1]. We would like to use the radio controller soccer robots for our research. We have a program agent for trying to movement many times in the simple soccer problem. But this simulation takes very long time for learning by Q-Learning [2]. In this paper, we propose a small simulation field and try to Reinforcement Learning. Finally, we would like to control soccer robots by this result.

60. Development of Fuzzy Controller for the Steering Angle and the Motor Power Control Application to the Line Trace Car

Hiroshi Takimoto, Yukinobu Hoshino

In this research, the simplified reasoning method is used for the steering angle and the motor control of the line trace car. We tried to make smoothly controller without car-rying out a zigzag run. About line tracer system, the car calculates a steering angle from the value of the sensor read during the run. Then, the line trace car calculates a motor output from the outputted steering angle. In this paper, we designed the fuzzy reasoning of 1 input 3 output 9 rules.

61. Dynamic System Identification Using Recurrent Neural Network with Multi-Valued Connection Weights

Arit Thammano, Phongthep Ruxpakawong

This paper introduces a new concept of the connection weight to the standard recurrent neural networks – Elman and Jordan networks. The architecture of the modified networks is the same as that of the original recurrent neural networks. However, in the modified networks the weight of each connection is multi-valued, depending on the value of the input data involved. The backpropagation learning algorithm is also modified to suit the proposed concept. The modified networks have been benchmarked against their original counterparts. The results on eleven benchmark problems are very encouraging.

62. An Auto-Mated Network Management Using Artificial Intelligent Techniques

Hayoung Oh, Chong-kwon Kim

An Auto-mated Network management has been not only critical but also difficult in the network research area. Among the artificial intelligent techniques, traditional supervised learning techniques are not appropriate for an auto-mated network management and specially to detect temporal changes in network intrusion patterns and characteristics. The reason is that supervised learning needs the manager. Therefore, unsupervised learning techniques such as SOM (Self-Organizing Map) are more appropriate for an auto-mated network management such as configuration, performance and anomaly detection. In this paper, we propose an auto-mated network management based on hierarchical SOM that groups similar data and visualize their clusters. Our system labels the map produced by SOM using correlations between features for an auto-mated network management. We experiments our system with KDD Cup 1999 data set. Our system yields the reasonable misclassification rates and takes 0.5 seconds to decide whether a behavior is normal or attack.

63. Implication-Based and Cardinality-Based Inclusions in Information Retrieval

Patrick Bosc, Laurent Ughetto, Olivier Pivert, Vincent Claveau

This paper investigates the use of fuzzy logic mechanisms coming from the database community, namely graded inclusions, to model the information retrieval process. Two kinds of graded inclusions are considered. In this framework, documents and queries are

represented by fuzzy sets, which are paired with operations like fuzzy implications and T-norms. Through different experiments, it is shown that only some among the wide range of fuzzy operations are relevant for information retrieval. When appropriate settings are chosen, it is possible to mimic classical systems, thus yielding results rivaling those of state-of-the-art systems. These positive results validate the proposed approach, while negative ones give some insights on the properties needed by such a model. Moreover, this paper shows the added-value of this graded inclusion-based model, which gives new and theoretically grounded ways for a user to easily weight his query terms, to include negative information in his queries, or to expand them with related terms.

64. A Fuzzy Cognitive Map Based Tool for Prediction of Infectious Diseases

Elpiniki I. Papageorgiou, Nikolaos I. Papandrianos, Georgia Karagianni, George C. Kyriazopoulos, Dimitrios Sfyras

The prediction of pulmonary infections in intensive care unit is a complex medical task where a large number of parameters, tests, clinical symptoms and laboratory results are present. The knowledge of physicians according to the physical examination and clinical measurements are the main point to succeed a diagnosis and monitoring patient status. This paper presents the results of our investigation of the problem of representing knowledge for medical diagnosis systems concentrated on the pulmonary infections. The main topic of the presented effort is the representation of the cause effect relationships within medical data by the application of the soft computing technique of fuzzy cognitive maps. The fuzzy cognitive map is a knowledge based technique for modeling and representing experts' knowledge. It can handle efficiently with complex modeling problems to assess medical decision making tasks. Due to its easy graphical representation the proposed FCM can be used to make the medical knowledge widely available through computer consultation systems.

65. Collision Avoidance Algorithm Based on Fuzzy Expert Systems for Multi-Path Planning

Sungyoung Jung, Jungmin Kim, Sungshin Kim

In the multi-path planning, every autonomous vehicle normally receives her path from the server and sends her position to the server. If server estimates collision between two vehicles, then the path should be re-planned by an algorithm in the server. Path could be compensated by fuzzy expert systems (FESs) that is designed using heuristic method for collision avoidance in multi-path planning. The server calculates the assistance via point and send to each vehicle. The algorithm was evaluated it's stability by simulation test, and then experimented by real autonomous vehicle. The experimental result proved this collision avoidance algorithm is good for multi-path planning.

66. State Feedback Fuzzy-Model-Based Control for Discrete-time Markovian Jump Nonlinear Systems with Time-Varying Delays

Min Kook Song, Jin Bae Park, Young Hoon Joo, Jin Kyu Kim

In this paper, the stability analysis and stabilization problem for a discrete-time Markovian jump nonlinear systems (MJLNS) with time-varying delays are investigated. The timedelay is considered to be time-varying and has a upper bound. The transition probabilities of the mode jumps are considered to be completely known. Sufficient conditions for stochastic stability of the markovian jump fuzzy systems (MJFS) are derived via the linear matrix inequality (LMI) formulation, and the design of the stabilizing controller is further given. A numerical example is used to illustrate the developed theory.

67. Output-Feedback Sampled-data Control for Uncertain Nonlinear System

Hwa Chang Sung, Jin Bae Park, Young Hoon Joo

In this paper, we concern an intelligent digital redesign (IDR) method for a fuzzy observer-based output-feedback control system which includes parametric uncertainties. The term IDR is to convert an existing analog control into an equivalent digital counterpart via state-matching. The considered IDR problem is viewed as convex minimization problem of the norm distances between linear operators to be matched and its constructive condition is formulated in terms of linear matrix inequalities (LMIs). The main features of the proposed method are that the state estimation error in the plant dynamics is considered in the IDR condition that plays a crucial role in the performance improvement; the uncertainties in the plant dynamics is shown in the IDR condition by virtue of the bilinear and inverse-bilinear approximation method; finally, the stability property is preserved by the proposed IDR method.

68. Evolutionary Method Combining Particle Swarm Optimization and Genetic Algorithms Using Fuzzy Logic for Decision Making

Fevrier Valdez, Patricia Melin, Oscar Castillo

We describe in this paper a new hybrid approach for mathematical function optimization combining Particle Swarm Optimization (PSO) and Genetic Algorithms (GAs) using Fuzzy Logic to integrate the results. The new evolutionary method combines the advantages of PSO and GA to give us an improved PSO+GA hybrid method. Fuzzy Logic is used to combine the results of the PSO and GA in the best way possible. The new hybrid PSO+GA approach is compared with the PSO and GA methods with a set of benchmark mathematical functions. The new hybrid PSO+GA method is shown to be superior that the individual evolutionary methods. The mathematical functions were evaluated with 2, 4, 8 and 32 variables to validate this approach.

69. Application of Interval Type-2 Fuzzy Logic for Estimating Module Relevance in Sugeno Integration of Modular Neural Networks

Olivia Mendoza, Patricia Melin, Oscar Castillo

In this work we describe a Fuzzy Inference System to determine the relevance of each module in Modular Neural Networks for images recognition. The tests were made with Type 1 and Interval Type-2 Fuzzy Inference System, to compare the performance. In both cases the fusion operator for the modules is the Sugeno Integral, and the parameters to estimate are the fuzzy densities.

70. Fuzzy CMAC Structures

Kamran Mohajeri, Manijeh Zakizadeh, Bijan Moaveni, Mohammad Teshmehlab

Cerebellum Model Articulation Controller (CMAC) is known as a feedforward Neural Network (NN) with fast learning and performance. Many improvements have been introduced to it which fuzzy CMAC (FCMAC) is the most important one. Fuzzy CMAC as a neuro fuzzy system increases precision, reduces memory size and makes CMAC differentiable. In addition FCMAC converts CMAC NN as a black box to a white box that its operation is interpretable using fuzzy rules. Fuzzy CMAC has not a unique structure in literature and there are differences in many aspects as membership function, memory layered structure, defuzzification and the fuzzy system applied. Discussing these, this paper reviews fuzzy CMAC different structures in literature.

71. A Preprocessing of Outlier Using Kernel PCA and Factor Scores in Regression Model

Kyung-Whan Oh, Sunghae Jun, Yong-Jun Kim

Data analysis including outlier is more difficult to the analysis without outlier. The outlier has a chance to increase the misclassification rate and the variance of estimate in the supervised learning like classification and regression. Also the outlier becomes a cluster in the clustering as unsupervised learning. So we are hard to represent the clustering result. Because of the previous problems, it is removed generally for constructing model in data mining. But when the outlier has some information on given data, we must not remove it from training data set. In this paper, using kernel PCA (principal component analysis) and factor scores, we propose a preprocessing method to contain the outlier in the modeling. The outlier effect of given training data set is reduced by the values of kernel PCA and factor scores. We verify improved performance of our work by the experimental results using simulation data sets in regression model.

72. Intelligent Multi-agent Based Convergence Systems

Young Im Cho

We will discuss about the intelligent multi-agent based convergence system in AI. The multi-agent concept is varied from 2 or 3 agents to many agents. Therefore, to construct the appropriate concept which you want to implement is more important. In this paper, we will discuss the concept of multi-agent, and discuss some application areas of fuzzy logic based multi-agent, especially in bioinformatics and digital library etc. And finally we will discuss about the future research areas of multi-agent in AI.

73. On Hybrid Genetic Models for Hard Problems

Marco Carpentieri, Alessandro Pappalardo, Domenica Sileo, Gianvito Summa

We review some main theoretical results about genetic algorithms. We shall take into account some central open problems related with the combinatorial optimization and neural networks theory. We exhibit experimental evidence suggesting that several crossover techniques are not, by themselves, effective in solving hard problems if compared with traditional combinatorial optimization techniques. Eventually, we propose a hybrid approach based on the idea of combining the action of crossover, rotation operators and short deterministic simulations of nondeterministic searches that are promising to be effective for hard problems (according to the polynomial reduction theory).

74. Abductive Reasoning with Type 2 Fuzzy Sets

Debasish Datta, Amit Konar, Ananda Sankar Chowdhury, Swagatam Das, A. K. Nagar

In fuzzy abduction, one needs to evaluate the membership distribution of the premise (antecedent clause), when the membership distribution of the consequent clause, and the fuzzy implication relations between the antecedent and the consequent clauses are provided. The paper formulates and solves the problem of fuzzy abduction by using type-2 fuzzy sets. It presumes background knowledge about the primary and the secondary antecedent to consequent implication relations to uniquely determine the type-2 fuzzy set corresponding to the antecedent clause, when the same for the consequent clause is provided. The proposed methodology of abduction would serve many interesting applications on predictions, forecasting, and diagnosis, where the environmental factor can be modeled with type-2 secondary distributions.

75. Improved Observer-Based Adaptive Fuzzy Tracking Control for MIMO Nonlinear Systems

Sinda Aloui, Olivier Pages, Ahmed El hajjaji, Abdessattar Chaari, Yassine Koubaa

In this paper, a stable observer-based adaptive fuzzy controller which combines a sliding mode and an adaptive Proportional Integral (PI) controllers is developed for a class of nonlinear Multiple Input Multiple Output (MIMO) systems with unknown parameters and in presence of external disturbances. The free parameters of the adaptive fuzzy controller are tuned on-line based on the Lyapunov approach. The overall adaptive fuzzy scheme guarantees the uniform ultimate boundedness of all the closed-loop signals as well as the tracking errors. The validity of the proposed approach is shown by computer simulations of a two-link robotic manipulator.

76. Improving Plan about Lifetime Prediction of Gas Turbine throughout Image Processing

Seung Jun Mok, Moon Soo Chang, Sun Mee Kang

In this paper, a stable observer-based adaptive fuzzy controller which combines a sliding mode and an adaptive Proportional Integral (PI) controllers is developed for a class of nonlinear Multiple Input Multiple Output (MIMO) systems with unknown parameters and in presence of external disturbances. The free parameters of the adaptive fuzzy controller are tuned on-line based on the Lyapunov approach. The overall adaptive fuzzy scheme guarantees the uniform ultimate boundedness of all the closed-loop signals as well as the tracking errors. The validity of the proposed approach is shown by computer simulations of a two-link robotic manipulator.

77. Pattern Based Object Segmentation Using Split and Merge

Ziaul Karim, Nafize Rabbani Paiker, Ameer Ali Mohammad, Golam Sorwar, M. M. Islam

Split and Merge (SM) algorithm is a well recognized algorithm for segmenting homogeneous regions in an image. Though SM algorithm is simple and easy, this algorithm is unable to segment all type objects in an image successfully due to huge variations among the objects in size, shape, color and intensity. Moreover, the SM algorithm is also highly dependent on threshold values used for split and merge stages. Addressing these issues, a new algorithm namely pattern based object segmentation using split and merge (PSM) considering the basic SM algorithm, the region stability, and the patterns for object extraction. The experimental results prove the superior segmentation performance of the PSM algorithm in comparison with the basic SM algorithm, suppressed fuzzy c-means (SFCM), and object based image segmentation using fuzzy clustering (FISG).

78. Segmentation of the Liver in CT Images Using Pseudocolorization and Labeling Methods

Kyung-Hoon Hwang, Jin-Woo Jung

The fast segmentation of the liver in the CT images is the important but difficult procedure for subsequent image processing and analysis. We applied the pseudocolorization and connected component labeling methods to segment the upper dome area of the liver in the tranverse CT slice images. Arterial phase tranverse CT slice images including the upper dome area of the liver was used for segmentation by the methods. The original transverse slice CT images were pseudocolored and the color component images including the liver were separated. And the connected component labeling algorithm was performed and the upper dome area of the liver was segmented. The segmentation of the remaining portion of the liver in the neighboring CT slice images can be done effectively with active contouring or region growing with interslice reference to the previously segmented liver CT image.

79. The Improved Particle Filter for Motion Estimation

Cheol-hun Han, Kwee-Bo Sim

In this paper, we used particle filter to motion estimation algorithm on real-time for mobile surveillance robot. Particle filter based on the Monte Carlo's sampling method, be used Bayesian conditional probability model which having prior distribution probability and posterior distribution probability. By using particle filter, it can be possible to tracking and estimating robustly for object's motion and movement. Also most of the initial probability density was set to define or random manually. Proposed method in this paper, however, using the Sum of Absolute Differences (SAD) is to take the initial probability density. Therefore, by using a particle filter to the object tracking system, it can be configured more efficient.

80. A Genetic Algorithms for On-line Calculation with Application to System Theory

Hong-Gi Lee, Jin-Man Hong, Hoon Kang, Kwee-Bo Sim

Even though the genetic algorithm is known to be a very effective method to solve the global minimization problem, it needs much time (a large population size and a large number of generations) for a reliable answer and thus it seems to be inadequate for on-line performance. We propose a population feedback GA scheme. We show the effectiveness of our scheme by finding an observer for the discrete-time nonlinear autonomous systems with simulations.

81. A Dependent-Chance Programming Model for Fuzzy Time-Cost Trade-off Problem

Hua Ke, Weimin Ma

In real projects, both the trade-off between the project cost and the project completion time, and the uncertainty of the environment are considerable aspects for decision-makers. However, the research on the time-cost tradeoff problem seldom concerns fuzzy environments. In this paper, a new fuzzy time-cost trade-off model with the philosophy of dependent-chance programming is proposed, in which credibility theory is applied to describe the uncertainty of activity durations. A searching method as a hybrid intelligent algorithm integrating fuzzy simulation and genetic algorithm is produced to search the optimal schedule under the given decision-making rule. The purpose of the paper is to reveal how to obtain the optimal balance of the project completion time and the project cost in fuzzy environment.

Sat 17:00-19:00

Room #401

R: Fuzzy Competition

Chair: Hao Ying, Wayne State University

1. Design and Simulation of a Hybrid Controller for a Multi-Input Multi-Output Magnetic Suspension System

Sherif M. Abuelenin

In this paper we present a Fuzzy Logic control approach designed to stabilize a multi-input multi-output magnetic suspension system. The system has four cubic floaters and four actuators that apply magnetic forces on the floaters, the suspension is performed by changing the voltages applied on the actuators, hence changing their currents, producing vertical magnetic forces that balance with the gravitational force. A fuzzy logic controller is used to control each actuator; the system is nonlinear and sensitive to initial conditions. Another fuzzy logic controller is used as a supervisory controller in order to increase the dynamic range of the system, enabling it to stabilize the floaters when the initial displacements are relatively big. Another design consideration was to keep the four floaters in the same plane as much as possible, to perform that task, a PD controller was set to modulate the currents of the four

actuators in order to minimize an error signal measuring the relative vertical displacement of all the four floaters. Simulation results show that the designed control scheme stabilized the system for the design constrains.

2. A Simple Fuzzy Controller for the Magnetic Suspension System

Hok Lam Wong, Chenglin Hu, Feng Wan

This year, the competition challenge is to develop a fuzzy controller for a nonlinear multi-input multi-output (MIMO) magnetic suspension system with satisfactory performance under different initial conditions. This paper aims at developing a concise but effective fuzzy controller, for the reason that the MIMO system can be divided into four physically independent single-input single-output (SISO) magnetic suspension systems which can be successfully controlled by a fuzzy controller with simple structure that is easy to be created, modified and understood. More specifically, a two-stage control strategy is adopted, consisting of an individual control stage that each SISO subsystem is controlled by a simple Mamdani-type fuzzy controller with intuitive rules, and a coordination stage to balance the four subsystems for the overall performance requirement. Simulation results are provided to show the performance for the required tasks.

3. A Switching Fuzzy Control Method for the Magnetic Active Suspension System

Jiangtao Cao, Zhaojie Ju, Xiaofei Ji, Honghai Liu

A switching fuzzy control system is proposed for dealing with the non-linear dynamics of electromagnetic suspension system. With two fuzzy sub-controllers and a switch engine, the switching fuzzy control system is flexible to cover changeable initial conditions with less computational cost. For satisfying the coupling constraint on positions of four floaters, a global self-supervisor with feedback structure is designed to control all four fuzzy subsystems. Simulations on the magnetic suspension with three different initial position settings demonstrated the efficiency of proposed method.

Sat 17:00-19:00

Room #402

Panel Session

Emergent Technologies for Computer Go

Saturday, August 22, 19:30-22:00

Banquet (Tamna Hall B)

Sunday, August 23, 09:00-10:40

Sun 09:00-10:40

Samda A

A02: Adaptive, Hierarchical, Evolutionary, Neural and Nature-Inspired Systems II

Chair: Myung Geun Chun, Chungbuk National University

1. An Adaptive History Network Method to Improve the Genetic Optimization of Pattern Recognition Systems

Dequan Ko, Richard J. Oentaryo, Michel Pasquier

The existence of many pattern recognition systems (PRSs) and

their relative merits and drawbacks highlights the need for a metalearning framework that can find the best PRS method for a given task. To address this issue, a hyperparameter evolutionary optimization (HPEO) framework was previously devised, initially using a genetic algorithm to tune external PRS parameters in a modular fashion, decoupled from its internal components. To further improve the effectiveness of HPEO and improve the diversity of the hyperparameter solutions found, this paper presents an extension that realizes cross-generation learning with an adaptive history network (AHN), which promotes exploring new regions in the search space while avoiding regions that have been searched extensively. The proposed approach, termed HPEO-AHN, is particularly suitable for tuning powerful but complex PRSs such as neuro-fuzzy systems (NFS). Preliminary experiments with two state-of-the-art NFSs optimized using the new approach have shown encouraging results.

2. Bacterial Foraging with Quorum Sensing Based Optimization Algorithm

Jae Hoon Cho, Jin il Park, Ji Seok Jeong, Myung Geun Chun

Optimization methods have been developed by many researchers. Especially, the methods based on Evolutionary Algorithms (EAs) have received increased attention from diversity fields. Recently, bacterial foraging algorithm mimicked bacterial behavior has been introduced by Passino. However, his work did not implement an important bacterial behavior regulating division so-called 'quorum-sensing'. The quorum-sensing is a chemical communication including producing, releasing, detecting, and responding to small hormone-like molecules termed autoinducers. This communication allows bacteria to coordinate the behavior of the group. This paper proposes an optimization algorithm based on the bacterial quorum sensing. In order to estimate the performance of the algorithm, we use a multimodal Gaussian having several minima and maxima, and also four benchmark functions. Experimental results show that this proposed method can achieve better performance than conventional bacterial foraging algorithm

3. On Multivariate Genetic Systems

Marco Carpentieri

We take into account the problem of extending the Univariate Marginal Distribution Genetic Algorithm (UMDGA) modeling and analysis to the multivariate framework. In particular, we introduce the basic general concepts and mathematical formalism to devise genetic algorithms useful to solve problems involving dependencies among genes. We state the relationships between the natural component attractors of the (numerous or infinite population) multivariate marginal distribution genetic systems and the equilibrium points of associated neural networks so rephrasing the problem of solving an evolutionary task in terms of the analysis of its properties through suitably designed neural networks.

4. Gender Classification with Cortical Thickness Measurement from Magnetic Resonance Imaging by Using Feature Selection Method Based on Evolving Hypernetwork

Jung-Woo Ha, Joon Hwan Jang, Do-Hyung Kang, Wi Hoon Jung, Jun Soo Kwon, Byoung-Tak Zhang

Hypernetworks are a weighted hypergraph where evolutionary methods are learning the model structure and parameters. The evolutionary methods enable the hypernetwork model to conserve significant features implicitly during the learning process. In this study, we propose a novel feature selection method based on occurrence frequencies of attributes in hyperedges by analyzing the structure of a hypernetwork. We also apply the evolutionary hypernetwork with the proposed feature selection method to the gender classification based on cortical thickness measurement on healthy young adults from Magnetic Resonance Imaging (MRI). The experimental results show that the proposed selection method improves the classification accuracy by approximately 20%. Also,

a comparative study on four classification algorithms and three feature selection methods shows that the hypernetwork model with the proposed feature selection method achieves a competitive classification performance.

5. Evolutionary Hypernetworks for Learning to Generate Music from Examples

Hyun-Woo Kim, Byoung-Hee Kim, Byoung-Tak Zhang

Evolutionary hypernetworks (EHNs) are recently introduced models for learning higher-order probabilistic relations of data by an evolutionary self-organizing process. We present a method that enables EHNs to learn and generate music from examples. Short-term and long-term sequential patterns can be extracted and combined to generate music with various styles by our method. Based on a music corpus consisting of several genres and artists, an EHN generates genre-specific or artist-dependent music fragments when a fraction of score is given as a cue. Our method shows about 88% of success rate in partial music completion task. By inspecting hyperedges in the trained hypernetworks, we can extract a set of arguments that constitutes melodic structures in music.

Sun 09:00-10:40

Samda B

SS04A: Advances in Fuzzy Control Using Takagi-Sugeno Fuzzy Models I

Chair: Jun Yoneyama, Aoyama Gakuin University

1. Non-common P Stability/Stabilization Analysis via Multiconvexity Approach

Ji-Chang Lo, YuChi Wang

A new stability condition in terms of LMIs is studied in this paper. Based on a premise-dependent Lyapunov function and multiconvexity, we release the conservatism that commonly exists in the common P approach. Comparison studies for common P and non-common P methods are demonstrated, showing relaxation is achieved via the proposed approach.

2. A Way to Escape from the Quadratic Framework

Thierry-Marie Guerra, Miguel Bernal

The results offered in this paper constitute a way to overcome infeasible global quadratic conditions for stability of continuous-time Takagi-Sugeno (TS) models. It is shown that reducing global stability goals to something less restrictive will give a nice solution by providing an estimation of the stability domain (local asymptotic conditions), as it is usually the case for nonlinear models for which stability and/or stabilization cannot be reached globally. Conditions under the novel approach can be expressed as linear matrix inequalities (LMIs) which are efficiently solved by convex optimization techniques. Some examples are provided to illustrate how the proposed technique actually broadens stability analysis by leaving the quadratic framework.

3. Quadratic Stability Analysis of Fuzzy Control Systems Using Stepwise Membership Functions

H.K. Lam, Mohammad Narimani, L.D. Seneviratne

This paper presents the stability analysis of fuzzy-model-based control systems. Stepwise membership functions are introduced to facilitate the stability analysis. Through the stepwise membership functions approximating those of the fuzzy model and fuzzy controller, the information of the membership functions can be brought into the stability analysis. Based on the Lyapunov stability theory, stability conditions in terms of linear matrix inequalities are derived in a simple and easy-to-understand manner to guarantee the system stability. The proposed stability analysis approach offers a

nice property to include the membership functions of both fuzzy model and fuzzy controller in the LMI-based stability conditions for a dedicated fuzzy-model-based control system. Furthermore, the proposed stability analysis approach can be applied to the fuzzy-model-based control systems of which the membership functions of both fuzzy model and fuzzy controller are not necessarily the same. Greater design flexibility is allowed by choosing the membership functions during the design of fuzzy controllers. By employing membership functions with simple structure, it is possible to lower the structural complexity and the implementation cost. Simulation example is given to illustrate the merits of the proposed approach.

4. LMI-Based Fuzzy Control for a Class of Time-Delay Discrete Fuzzy Bilinear System

Shun-Hung Tsai, Ming-Ying Hsiao, Kun-Lin Tsai

This paper presents robust fuzzy controllers for a class of T-S time-delay discrete fuzzy bilinear systems (DFBSs) with disturbance which ensures the robust asymptotic stability of the closed-loop system and guarantees an H^∞ norm bound constraint on disturbance attenuation. Firstly, we proposed a H^∞ fuzzy controller to stabilize the T-S DFBS with disturbance. Secondly, based on the Schur complement and some variable transformation, the stability conditions of the overall fuzzy control system are formulated by linear matrix inequalities (LMIs). Finally, the validity and applicability of the proposed schemes are demonstrated by simulations.

5. Output Feedback Control for Fuzzy Systems with Immeasurable Premise Variables

Jun Yoneyama

This paper is concerned with the output feedback control for fuzzy systems with immeasurable premise variables. When we consider a fuzzy system, the selection of the premise variable is important. If it is the state of the system, a fuzzy system describes a wide class of nonlinear systems. However, the state is not measurable in the output feedback control problem. Hence, the premise variable is not unknown. In this case, the separation principle, in general, does not hold. This causes a difficulty in control design. In order to overcome this difficulty, a new approach to the output feedback control is introduced. Our approach converts the output feedback stabilization into the H^∞ control problem where the terms related to the premise variable is considered an unknown signal. The method does not only stabilizes the system but also takes care of the control performance. A numerical example is given to show the effectiveness of our output feedback control.

Sun 09:00-10:40

Room #302

SS12: Fuzzy Approaches for Ontology Applications and Adaptive Web Services

Chair: Chang-Shing Lee, National University Of Tainan

1. Towards an Automatic Fuzzy Ontology Generation

Vincenzo Loia, Carmen De Maio, Giuseppe Fenza, Sabrina Senatore

In recent years, the success of Semantic Web is strongly related to the diffusion of numerous distributed ontologies enabling shared machine readable contents. Ontologies vary in size, semantic, application domain, but often do not foresee the representation and manipulation of uncertain information. Here we describe an approach for automatic fuzzy ontology elicitation by the analysis of web resources collection. The approach exploits a fuzzy extension of Formal Concept Analysis theory and defines a methodological process to generate an OWL-based representation of concepts, properties and individuals. A simple case study in the Web domain validates the applicability and the flexibility of this approach.

2. Collaborative Content and User-based Web Ontology Learning System

Edward H. Y. Lim, Hillman W. K. Tam, Sandy W. K. Wong, James N. K. Liu, Raymond S. T. Lee

This paper presents a Collaborative Ontology Learning Approach for the implementation of an Ontology-based Web Content Management System (OWCMS). The proposal system integrates two supervised learning approach - Content-based Learning and User-based Learning Approach. The Content-based Learning Approach applies text mining methods to extract ontology concepts, and to build an Ontology Graph (OG) through the automatic learning of web documents. The User-based Learning Approach applies features analysis methods to extract the subset of the Ontology Graphs, in order to build a personalized ontology by using intelligent agent approach to capture user reading habit and preference through their semantic navigation and search over the ontology-based web content. This system combines the two methods to create collaborative ontology learning through an ontology matching and refinement process on the ontology created from content-based learning and user-based learning. The proposed method improves the validness of the classical ontology learning outcome by user-based learning refinement and validation.

3. A Novel Ontology for Computer Go Knowledge Management

Chang-Shing Lee, Mei-Hui Wang, Tzung-Pei Hong, Guillaume Chaslot, Jean-Baptiste Hooek, Arpad Rimmel, Olivier Teytaud, Yau-Hwang Kuo

In order to stimulate the development and research in computer Go, several Taiwanese Go players, including three professional Go players and four amateur Go players, were invited to play against the famous computer Go program, MoGo, in the Taiwan Open 2009. The MoGo program combines the online game values, offline values extracted from databases, and expert rules defined by Go expert that shows an excellent performance in the games. The results reveal that MoGo can reach the level of 3 Dan in Taiwan amateur Go environment. But there are still some drawbacks for MoGo that should be solved, for example, the weaknesses in semeai and how to flexibly practice the human knowledge through the embedded opening books. In this paper, a new game record ontology for computer Go knowledge management is proposed to solve the problems that MoGo is facing. It is hoped that the advances in intelligent agent and ontology model can provide much more knowledge to make a progress in computer Go and achieve as much as computer chess or Chinese chess in the future.

4. Updating User Profile Using Ontology-based Semantic Similarity

Marek Reformat, Sayed Koosha Golmohammadi

The endless amount of information on the web, known as "lost-in-hyper-space syndrome", easily overwhelms users. User profiles are used as a means to support extracting relevant information by indicating user interests. In this paper, we propose a new method to develop and maintain a user profile by analyzing user's web access behavior. We propose an ontology-based semantic similarity measure and combine it with an importance measure to identify items that are of highest relevance to user interests. The proposed approach is used in a system for updating a user profile in music domain.

5. Fuzzy Data Mining Based on the Compressed Fuzzy FP-trees

Chun-Wei Lin, Tzung-Pei Hong, Wen-Hsiang Lu

In this paper, we design the compressed fuzzy FP-tree structure to mine fuzzy frequent itemsets from the transactions with quantitative values. It consists of two phases. In the first phase, a compressed fuzzy frequent pattern tree (CFFP tree) is constructed from the given quantitative transactions. In the second phase, a

fuzzy mining approach is then proposed to mine the fuzzy frequent itemsets from the CFFP tree constructed. Experiments are also made to show the performance of the proposed approach.

Sun 09:00-10:40

Room #303

SS17A: Hybrid Learning in Fuzzy Control I

Chair: Shun-Feng Su, National Taiwan University of Science and Technology

1. Nonlinear Parameter Fuzzy Control for Uncertain Systems with Only System Output Measurement

Yih-Guang Leu, Chun-Yao Chen, Chin-Ming Hong

In this paper, a nonlinear parameter fuzzy control scheme is proposed for a class of uncertain systems without all states measurement. In the control scheme, a fuzzy identifier without prior knowledge on membership functions is merged into direct adaptive control by means of a linear state estimator. Since the structure of the fuzzy identifier is nonlinear in the adjusted parameters, the fuzzy identifier uses a mean method to develop adaptive laws. Finally, an example is provided to demonstrate the effectiveness of the proposed control scheme.

2. Design of Ball-Beam Balance Control System Using Neural-Fuzzy Algorithm

Huan-Wen Tzeng, Sheng-Kai Hung

This paper proposes a success control application using a Neural-Fuzzy System (NFS) algorithm to control the Ball-Beam balance system, through learning, simulation, and implementation. First, the control system requires control measurement input, enabling it to generate fuzzy control rules automatically, and then the neural-fuzzy system undergoes a series of learning processes to achieve the best simulation results. Finally, the prototype of a control system is realized with good performance.

3. Adaptive Fuzzy Sliding Controller Design with Approximate Error Feedback

Yao-Chu Hsueh, Shun-Feng Su

The research about sliding based approaches is a widely studied topic to the adaptive fuzzy control system designs. In this paper, a novel state error feedback sliding controller is proposed. An optimal feedback gain is required and in this study it is assumed to be unknown. Usually, a rudimentary feedback gain is used. Besides, in order to approximate the state error feedback sliding controller with the optimal feedback gain, an adaptive fuzzy system is employed. Thus, the proposed control scheme consists of an adaptive fuzzy system and a state error feedback sliding controller with a rudimentary feedback gain. In the system framework, the rudimentary state error feedback sliding controller can be viewed as the approximate error estimator of the adaptive fuzzy system. Therefore, such an estimated error can be fed back to the learning of the fuzzy system through a modified adaptive law. With such an approximate error feedback, it is clearly evident from our simulation that the learning speed of the proposed learning scheme is faster than that of the original scheme. Also, with the proposed controller, the system stability not only is guaranteed, but also becomes more stable.

4. Robust Clustering Algorithm for the Symbolic Interval-Values Data with Outliers

Chen-Chia Chuang, Chin-Wang Tao, Jin-Tsong Jeng

In this study, the novel robust clustering algorithm, robust interval competitive agglomeration (RICA) clustering algorithm, is proposed to overcome the problems of the outliers and the numbers

of cluster in the competitive agglomeration clustering algorithm for the symbolic interval-values data. The Euclidean distance measure is considered in the proposed RICA clustering algorithm. Moreover, the RICA clustering algorithm can be fast converges in a few iterations regardless of the initial number of clusters. Additionally, the RICA clustering algorithm is also converges to the same optimal partition regardless of its initialization. Experimentally results show the merits and usefulness of the RICA clustering algorithm for the symbolic interval-values data.

5. Networked Control Systems Design via Fuzzy Logic Method

Song-Shyong Chen

This paper addresses the problem of designing robust static output-feedback controllers for nonlinear network based controller design for the given T-S fuzzy model. The effects of both network-induced delays and data packet dropout will be investigated. Based on an integral inequality and a matrix inequality, a delay-dependent sufficient condition for the existence of a network-based controller is formulated in terms of a linear matrix inequality by adjusting effective parameter matrices. In the approach, we do not directly employ the Lyapunov approach, as do in most of traditional fuzzy control design approaches. Instead, sufficient conditions for guaranteeing the robust stability for the considered networked systems are derived in terms of the matrix spectral norm of the closed-loop fuzzy system. The sufficient conditions are further formulated into linear matrix inequalities so that the desired controller can be easily obtained by using the Matlab LMI toolbox. An illustrative numerical example is also given to show the effectiveness of the proposed design method.

Sun 09:00-10:40

Room #401

J02: Fuzzy Data Analysis - Clustering and Classifiers, Pattern Recognition, Bio-Informatics II

Chair: Woei-Wan Tan, National University of Singapore

1. Improvement of the Fuzzy C-Means Clustering Algorithm with Adaptive Learning of the Dissimilarities among Categorical Feature Values

Mahnhoon Lee

In [1], recently we proposed a generalization of the frequency-based cluster prototype [2-4], in the same framework of the Fuzzy C-Means clustering algorithm, for the objects of mixed features. In the generalization, a general dissimilarity measure, not the simple matching dissimilarity, is assumed for each categorical feature. In this paper we develop an adaptive method to learn dissimilarity measures for categorical features. We include the method into the framework of the Fuzzy C-Means algorithm so that the clustering algorithm can use the dissimilarity measures rather than the simple matching dissimilarity measure for categorical features. Through the experiments over real object sets, we show the clustering quality becomes better.

2. A Generalized Spatial Fuzzy C-Means Algorithm for Medical Image Segmentation

Huynh Luong, Jong-Myon Kim

Medical image segmentation is an indispensable process in viewing and measuring various structures in the brain. However, medical images are inherently low contrast, vague boundaries, and high correlative. The traditional fuzzy c-means (FCM) clustering algorithm considers only the pixel attributes. This leads to accuracy degradation with image segmentation. To solve this problem, this paper proposes a robust segmentation technique, called a Generalized Spatial Fuzzy C-Means (GSFCM) algorithm, that utilizes both given pixel attributes and the spatial local information

which is weighted correspondingly to neighbor elements based on their distance attributes. This improves the segmentation performance dramatically. Experimental results with several magnetic resonance (MR) images show that the proposed GSFCM algorithm outperforms the traditional FCM algorithms in the various cluster validity functions.

3. A New Fuzzy Rule-Based Initialization Method for K-Nearest Neighbor Classifier

Teck Wee Chua, Woei Wan Tan

The performances of conventional crisp and fuzzy K-Nearest neighbor (K-NN) algorithms trained using finite samples tends to be poor [1], [2]. With "holes" in the training data, it is unlikely that the decision area formed can actually represent the underlying data distribution. There is a need to capture more useful information from the limited training samples, therefore we propose a new fuzzy rule-based KNN algorithm. A fuzzy rule-based initialization procedure differentiates our proposed algorithm from the conventional fuzzy K-NN algorithm. The new initialization procedure allows us to handle the imprecise inputs (neighborhood density and distance) through the natural framework of fuzzy logic system. Unlike conventional K-NN algorithms, the ability to fine tune the membership functions can lead to a highly versatile decision boundary. Thus, the new algorithm can be specifically tuned for different problems to achieve better results. The advantage is demonstrated on a synthetic data set in two-dimensional space. In addition, we also adopt weighted Euclidean distance measurement to overcome the curse of dimensionality [3]. The Euclidean distance weights and the parameters of the fuzzy rule-based system are then optimized with Genetic Algorithm (GA) simultaneously. The practical applicability of the proposed algorithm is verified on four UCI data sets (Bupa liver disorders, Glass, Pima Indians diabetes and Wisconsin breast cancer) and Ford automotive data set with an improvement of 3.42% in classification rate on average.

4. Generalized Kernel Fuzzy Clustering Model

Mika Sato-Ilic, Shota Ito, Shota Takahashi

This paper proposes a generalized kernel fuzzy clustering model and investigates the features of the proposed model. An additive clustering model has been proposed that considers the overlapping of clusters whose target data is similarity data. In addition, by introducing the concept of a fuzzy cluster to the additive clustering model, an additive fuzzy clustering model has been proposed. In these models, sharing common properties of clusters combine "additively" and the given similarity between a pair of objects is estimated as the sum of the shared common properties. Therefore, in these models, the effects of the interaction of different clusters can not be considered. In order to solve this problem, we propose a generalized kernel fuzzy clustering model which is an extension of the additive fuzzy clustering model to a nonlinear fuzzy clustering model through the use of kernel functions. In this new model, the degree of objects to clusters is estimated in a mapped higher dimensional space using kernel functions. We show a better performance of the proposed model through several numerical examples.

5. Segmentation in MRI of Ophthalmology Using a Robust-Type Clustering Algorithm

Wen-Liang Hung, Miin-Shen Yang, De-Hua Chen

In this paper we propose a robust-type clustering algorithm that has more accuracy than the alternative FCM (AFCM) proposed by Wu and Yang [7]. Moreover, to speed up the proposed algorithm, we use the suppressed idea to modify it. The modified robust-type clustering algorithm presents fast convergence speed and also robustness. Finally, this algorithm is applied in the segmentation of the magnetic resonance image (MRI) of an ophthalmic patient. In our comparisons of the proposed algorithm with the AFCM for these MRI segmentation results, we find that the proposed algorithm provides better detection of abnormal tissue than AFCM.

Sunday, August 23, 11:00-12:00

Keynote #3 (Halla Hall)
Fuzzy-Based Learning of Human Behavior Patterns
Zenn Bien, KAIST

Sunday, August 23, 13:30-15:10

Sun 13:30-15:10

Samda A

SS03: Intelligent Agents

Chair: Hani Hagra, University of Essex

1. A Neuro-Fuzzy Based Agent for Group Decision Support in Applicant Ranking within Human Resources Systems
Faiyaz Doctor, Hani Hagra, Dewi Roberts, Victor Callaghan

Applicant selection and ranking methods for job roles within Human Resources (HR) systems involve high levels of uncertainty. This is due to the requirement to allow for the varying opinions and preferences of the different occupation domain experts in the decision making process. Hence, there is a need to develop novel systems that will enable HR departments to determine the most important requirements criteria (experience, skills etc) for a given job, based on the preferences of different domain experts, while ensuring that the experts decisions are unbiased and correctly weighted according to their knowledge and experience. This will enable a more effective way to short list submitted candidate CVs from a large number of applicants providing a consistent and fair CV ranking policy, which can be legally justified. This paper presents a novel system using a neuro-fuzzy based agent approach for automatically determining the key skill characteristics defining each expert's preferences and ranking decisions, while handling the uncertainties and inconsistencies in group decisions of a panel of experts. The presented system automates the processes of requirements specification and applicant's ranking. Experiments have been performed within the residential care sector where the proposed system has been shown to produce ranking decisions that were relatively highly consistent with those of the human experts.

2. Intelligent Ontological Multi-Agent for Healthy Diet Planning
Mei-Hui Wang, Chang-Shing Lee, Kuang-Liang Hsieh, Chin-Yuan Hsu, Chong-Ching Chang

Good eating habits can make human beings to live in a healthy lifestyle. When a person constantly eats too much or too little, it will have a high risk of causing a disease for him. Therefore, developing healthy and balanced eating habits is important for most people to stay away from diseases. This study proposes an intelligent healthy diet planning multi-agent (IHDPMA), including a personal profile agent, a nutrition facts analysis agent, a knowledge analysis agent, a discovery agent, a fuzzy inference agent, and a semantic generation agent for healthy diet planning. The IHDPMA provides a semantic analysis of healthy diet status for people based on the pre-constructed ontology by domains experts and results of fuzzy inference. With the generated semantic analysis, people can get healthy information about what they eat and make it easier to eat a balanced and healthy diet. The experimental platform has been constructed to test the performance of the IHDPMA. The results indicate that the IHDPMA can effectively work for healthy diet planning.

3. Evaluation of Trust in an eCommerce Multi-agent System Using Fuzzy Reasoning

Simone A. Ludwig, Andriy Hnativ

Trust is a fundamental concern in large-scale open distributed systems such as multi-agent systems. It lies at the core of all interactions between the entities that have to operate in such uncertain and constantly changing environments. In this paper, an approach is developed for the evaluation of trust using fuzzy reasoning. The approach takes different trust sources into account, thereby minimizing the effect of wrong evaluations. It also incorporates a time factor for the evaluations of trust to address the different weightings of old versus new evaluations. Furthermore, the overall trust calculation consists of a non-linear weighted fuzzy calculation. A case study outlines different steps of the trust evaluation and shows, how the system computes the overall trust value, the reliability of the company, and the reliability of the results.

4. Reducing the Effort in the Creation of New Patients Using the Virtual Simulated Patient Framework

Víctor López Salazar, Juan L. Castro Peña, Javier Vazquez Granada

The use of Embodied Conversational Agents (ECAs) in the primary health care educational field is rare, although it has been demonstrated that it has advantages over traditional learning processes. This is due to the high production and maintenance costs of creating a specific ECA for some domain. In this paper we describe a methodology to reduce the effort of creating virtual patients inside the Virtual Simulated Patient Framework. This framework is an ECA adapted to simulate a sick patient during an appointment with a primary health care doctor. In order to do it, the system separates patient's physical conditions and personal features, i.e. with the diseases they have, their personality or cultural level from the patient's behaviour. The modeling of physical conditions makes use of fuzzy aggregation functions and the behaviour of the patient employ a fuzzy rule based system to control the subjectivity associated to their personality. The advantage of this approach is that many different patients can be created without effort just creating the physical models that represent them and their behaviour are in accordance with the illnesses they suffer from and their personality.

5. A Dynamical Cognitive Multi-Agent System for Enhancing Ambient Intelligence Scenarios

Giovanni Acampora, Vincenzo Loia

Ambient Intelligence (AmI) is born as a computer paradigm that deals with a new world where computing devices are spread everywhere in order to make wider the interaction between human beings and information technology and put together a dynamic computational-ecosystem capable of satisfying the users requirements. However, the AmI systems are more than a simple integration among computer technologies, indeed, their design can strongly depend upon psychology and social sciences aspects able to describe and analyze the human being status during the system's decision making. Consequently, from a computational point of view, an AmI system can be considered as a distributed cognitive framework composed by a collection of intelligent entities capable of modifying their behaviours by taking into account the user's cognitive status in a given time. This paper introduces a novel methodology of AmI systems' design that exploits multi-agent paradigm and a novel extension of Fuzzy Cognitive Maps theory benefiting on the theory of Timed Automata in order to create a collection of dynamical intelligent agents that use cognitive computing to define actions' patterns able to maximize environmental parameters as, for instance, user's comfort or energy saving.

SS04B: Advances in Fuzzy Control Using Takagi-Sugeno Fuzzy Models II

Chair: Hiroshi Ohtake, University of Electro-Communications

1. Switching Fuzzy Model Construction Based on Optimal Dividing Planes

Hiroshi Ohtake, Kazuo Tanaka, Hua Wang

This paper presents switching fuzzy model construction based on optimal dividing planes. In our previous papers, we proposed the switching fuzzy model with arbitrary dividing planes. However, dividing planes have been selected by controller designers before constructing the switching fuzzy model. Unfortunately, it is difficult to find suitable dividing planes for complicated nonlinear systems. Moreover, the switching fuzzy models constructed from different dividing planes are different. Therefore, the model construction affects the stability analysis results. In this paper, we propose switching fuzzy model construction method using multi-dimensional sector nonlinearity concept based on optimal dividing planes. The linear consequent parts of the switching fuzzy model based on optimal dividing planes are constructed from sectors which have minimum distance between a nonlinear system and sectors, and have richer information of the nonlinear system than the consequent parts of the ordinary Takagi-Sugeno fuzzy model. Two examples are provided to illustrate the validity of this approach.

2. Some Results about Stabilization of Periodic Takagi-Sugeno Models

Hichem Kerkeni, Jimmy Lauber, Thierry-Marie Guerra

A class of non linear discrete time models with periodic parameters is considered in a Takagi-Sugeno (TS) form. The main objective of this paper is to show the potential improvement in the area of nonlinear periodic system control and observation using TS models. In order to achieve this goal, two problems are developed in this paper. The first part is dedicated to the design of a periodic TS fuzzy observer, where stability conditions are provided. In the second part, some results about the stabilization of periodic TS models with time varying delay are given. The adopted framework is based on Lyapunov's theory and uses linear matrix inequalities. In each case, a simulation example is provided to show the efficiency of the method.

3. T-S Fuzzy Controllers for a Class of Nonlinear Systems with Uncertainties and Input Delay

Hugang Han

This paper deals with stability analysis and control designs for a class of delay-dependent nonlinear systems with input constraint when using the T-S fuzzy model in consideration of the uncertainties in the system. As a result, it arrives at two kinds of feedback controllers in terms of the LMIs, in which the latter tries to use less information about the delay. In order to make the LMIs less conservative, another two derived corollaries from the above controllers are provided, trying to make the so-called ellipsoids, in the insides of which the closedloop system stability is guaranteed, as large as possible.

4. Development Method for a Robust PID Fuzzy Controller of LPV Systems

Joabe A. Silva, Ginalber L. O. Serra, Carlos Cesar T. Ferreira

This paper proposes the analysis and design of robust fuzzy control to nonlinear systems with time delay. The nonlinear system to be controlled, is studied in the context of Linear Parameters Varying

(LPV) systems, it is partitioned into several linear sub-models of second order with time delay, in terms of transfer function, forming a convex polytope. Once defined the linear sub-models of the plant, these are organized into fuzzy Takagi-Sugeno (TS) structure. From the Parallel Distributed Compensation (PDC) strategy, a mathematical formulation is defined in the frequency domain, based on the gain and phase margins specifications, to obtain robust PID subcontrollers in accordance to the Takagi-Sugeno fuzzy model of the plant. Results for the robust stability conditions with the proposal of one Axiom and two Theorems are also presented.

5. Further Studies on Stabilization Conditions for Discrete-Time Takagi-Sugeno Fuzzy Systems

Dong Hwan Lee, Jin Bae Park, Young Hoon Joo, Hyun Soo Moon

This paper is an attempt to pursue the relaxed stabilization conditions for discrete-time Takagi-Sugeno (T-S) fuzzy systems. The main results given here concern their stabilization using extended non-quadratic Lyapunov functions, a non-parallel distributed compensations (non-PDC). New sufficient conditions in the terms of linear matrix inequalities (LMIs) have been proposed. The conditions are shown to be less conservative than some previous results in the literature. Two examples are given to illustrate the advantage of the proposed methods.

SS18A: Fuzzy System and Control I

Chair: Wen-June Wang, National Central University

1. Relaxation Analysis via Line Integral

Ji-Chang Lo, Chen-Mou Zhang

In this paper, sufficient LMI conditions for the H^∞ state feedback control synthesis of fuzzy control systems consisting of Takagi-Sugeno fuzzy models are proposed for continuous fuzzy systems. Based on a premise-dependent Lyapunov function, we release the conservatism that commonly exists in the common P approach. Particularly, the restriction embedded in continuous-time systems on derivative of μ is removed by introducing Lie derivative to the Lyapunov approach. It is shown that the slack variables employed in this paper provide additional feasibility in solving the H^∞ stabilization problem of fuzzy control systems. Consequently, the stabilization conditions are shown to be more relaxed than others in the existing literature. Numerical simulations appear promising for the proposed method and illuminate the reduction of conservatism clearly.

2. Fuzzy Systems for Slippage Control of a Pruning Robot

Winai Chonnaparamutt, Haruhisa Kawasaki

For a mobile robot using an encoder to measure the travel distance, a critical cause inducing the error is the slip of the wheel. The slippage not only causes the distance error, but also increases the overall energy consumption and decreases the locomotion performance. To cope with these effects without spending extra sensors or high processing load, the slippage control system composed of two fuzzy modules, namely the trajectory estimator and velocity controller, has been developed based on experimental data collected from encoders and a motion capture system. The control system applied the crosscoupling control technique by employing the estimated velocity from the estimator as a part of an input for the velocity controller of four wheels. This way, the simple yet effective slippage control system is feasible. Promising results verify the potential of the system. Thus, this initial research provides the framework to develop the competent slippage control system for our pruning robot.

3. Relaxed Stabilization Conditions of T-S Fuzzy Systems Using Piecewise Lyapunov Function Based Switching Fuzzy Controller

Ying-Jen Chen, Hiroshi Ohtake, Kazuo Tanaka, Wen-June Wang, Hua O. Wang

Based on the piecewise Lyapunov function, this study proposes a switching fuzzy controller, which switches depending on the Lyapunov function, to get relaxed stabilization conditions for the continuous T-S fuzzy system. The relaxed conditions are bilinear with the s-procedure parameters, therefore the particle swarm optimization (PSO) algorithm is utilized with the LMI tool to solve the relaxed conditions. Two simulation examples are given to show the relaxation and effectiveness of the proposed method.

4. Adaptive Evolutionary Active Noise Control System without Secondary Path Measurement

Deng-Rui Chen, Cheng-Yuan Chang

This paper proposes an adaptive evolutionary system for active noise control (ANC). The conventional ANC system often utilized filtered-X LMS (FXLMS) algorithm to update the coefficients of the linear finite impulse response (FIR) filter for its simplicity; while the FXLMS algorithm may converge to local minima. This paper uses evolutionary idea, substituting FXLMS algorithm, to prevent the local minima problem. In addition, it does not require identifying the secondary path for the ANC by using the proposed method; therefore, there is no plant information is necessary for designing an ANC system. Computer simulations results show that the proposed method can control the nonlinear noise under several situations very well, without identifying secondary path effectively.

5. A Descriptor System Approach to Fuzzy Guaranteed Cost Control System Design

Chung-Hsun Sun, Wen-June Wang, Ying-Jen Chen

This paper studies the problem of guaranteed cost control for a Takagi-Sugeno (T-S) fuzzy system by descriptor system method. The redundancy property of a T-S descriptor system is utilized to simplify the control design issue. Furthermore, a linear quadratic cost function is considered as the performance index of the T-S fuzzy control system. According to the redundancy property, the control design of a descriptor system often leads to fewer stability conditions. Consequently, the T-S fuzzy system herein is presented as the descriptor system form. Then, the guaranteed cost fuzzy control for the descriptor subsystem is synthesized by parallel distributed compensation (PDC). Based on the Lyapunov stability criterion and linear matrix inequalities (LMIs) method, some sufficient conditions are derived to obtain the local state feedback gains of the PDC such that the whole fuzzy descriptor system is not only asymptotically stable but also cost guaranteed. Finally, a practical example is given to illustrate the effectiveness of the proposed criterion.

the quality measures more adapted to the evolutionary algorithms for Subgroup Discovery developed so far. The adaptation of the NMEF-SD algorithm to extract disjunctive formal norm rules is also presented.

2. Efficient Multi-Objective Genetic Tuning of Fuzzy Models for Large-Scale Regression Problems

Jorge Casillas

A new algorithm for tuning fuzzy partitions with a high interpretability degree is proposed. The set of input variables, the number of linguistic terms per variable, and the type (triangular or trapezoidal) and parameters of the membership functions is tuned by an efficient process that endows the algorithm with capability to deal with large-scale regression problems. Interpretability constrains and advanced genetic operators are considered. A multi-objective optimization approach is used to generate different interpretability-accuracy tradeoffs. The algorithm is tested in a set of real-world regression problems with successful results compared to other methods.

3. Generating Single Granularity Based Fuzzy Classification Rules for Multiobjective Genetic Fuzzy Rule Selection

Rafael Alcala, Yusuke Nojima, Francisco Herrera, Hisao Ishibuchi

Recently, multiobjective evolutionary algorithms have been applied to improve the difficult tradeoff between interpretability and accuracy of fuzzy rule-based systems. It is known that both requirements are usually contradictory, however, these kinds of algorithms can obtain a set of solutions with different trade-offs. The application of multiobjective evolutionary algorithms to fuzzy rule-based systems is often referred to as multiobjective genetic fuzzy systems. The first study on multiobjective genetic fuzzy systems was multiobjective genetic fuzzy rule selection in order to simultaneously achieve accuracy maximization and complexity minimization. This approach is based on the generation of a set of candidate fuzzy classification rules by considering a previously fixed granularity or multiple fuzzy partitions with different granularities for each attribute. Then, a multiobjective evolutionary optimization algorithm is applied to perform fuzzy rule selection. Although the multiple granularity approach is one of the most promising approaches, its interpretability loss has often been pointed out. In this work, we propose a mechanism to generate single granularity-based fuzzy classification rules for multiobjective genetic fuzzy rule selection. This mechanism is able to specify appropriate single granularities for fuzzy rule extraction before performing multiobjective genetic fuzzy rule selection. The results show that the performance of the obtained classifiers can be even improved by avoiding multiple granularities, which increases the linguistic interpretability of the obtained models.

4. Search Ability of Evolutionary Multiobjective Optimization Algorithms for Multiobjective Fuzzy Genetics-Based Machine Learning

Hisao Ishibuchi, Yusuke Nakashima, Yusuke Nojima

Recently evolutionary multiobjective optimization (EMO) algorithms have been actively used for the design of accurate and interpretable fuzzy rule-based systems. This research area is often referred to as multiobjective genetic fuzzy systems where EMO algorithms are used to search for a number of non-dominated fuzzy rule-based systems with respect to their accuracy and interpretability. The main advantage of the use of EMO algorithms for fuzzy system design over single-objective optimizers is that multiple alternative fuzzy rule-based systems with different accuracy-interpretability tradeoffs are obtained by their single run. The decision maker can choose a single fuzzy rule-based system according to their preference. There still exist several important issues to be discussed in this research area such as the definition of interpretability, the formulation of interpretability measures, the visualization of tradeoff relations, and the interpretability of the

Sun 13:30-15:10

Room #303

SS29B: Evolutionary Fuzzy Systems II

Chair: Yusuke Nojima, Osaka Prefecture University

1. An Analysis of Evolutionary Algorithms with Different Types of Fuzzy Rules in Subgroup Discovery

Cristobal Jose Carmona, Pedro Gonzalez, Maria Jose del Jesus, Francisco Herrera

The interpretability of the results obtained and the quality measures used both to extract and evaluate the rules are two key aspects of Subgroup Discovery. In this study, we analyse the influence of the type of rule used to extract knowledge in Subgroup Discovery, and

explanation of fuzzy reasoning results. In this paper, we discuss the ability of EMO algorithms as multiobjective optimizers to search for Pareto optimal or near Pareto optimal fuzzy rule-based systems. More specifically, we examine whether EMO algorithms can find non-dominated fuzzy rule-based systems that approximate the entire Pareto fronts of multiobjective fuzzy system design problems.

5. Complexity, Interpretability and Explanation Capability of Fuzzy Rule-Based Classifiers

Hisao Ishibuchi, Yutaka Kaisho, Yusuke Nojima

Recently fuzzy system design has been frequently formulated as multiobjective optimization problems with two conflicting goals: maximization of accuracy and interpretability. Whereas the formulation of accuracy maximization is usually straightforward in each application task, it is not easy to define the interpretability of fuzzy rule-based systems. As a result, interpretability maximization is often handled as complexity minimization. In this paper, we discuss whether the complexity minimization leads to the interpretability maximization in the design of fuzzy rule-based systems for pattern classification problems. Using very simple artificial test problems, we show that the complexity minimization does not always lead to the interpretability maximization. We also discuss the explanation capability of fuzzy rule-based systems to explain their reasoning results to human users in an understandable manner. We show that the interpretability maximization is closely related to but different from the explanation capability maximization.

Sun 13:30-15:10

Room #401

J03: Fuzzy Data Analysis - Clustering and Classifiers, Pattern Recognition, Bio-Informatics III

Chair: Keon Myung Lee, Chungbuk National University

1. Fuzzy SVM for Noisy Data: A Robust Membership Calculation Method

Gyeongyong Heo, Paul Gader

Support vector machine (SVM) is a theoretically well motivated algorithm developed from statistical learning theory, that have shown good performance in many fields. In spite of its success, it still suffers from a noise sensitivity problem. To relax this problem, the SVM was extended by the introduction of fuzzy memberships to the fuzzy SVM (FSVM). The FSVM also has been extended further in two ways: by adopting a different objective function with the help of domain-specific knowledge and by employing a different membership calculation method. In this paper, we propose a new membership calculation method, that belongs to the second group. It is different from previous ones in that it does not assume any simple data distribution and does not need any prior knowledge. The proposed method is based on reconstruction error, which measures the agreement between the overall data structure and a data point. Thus the reconstruction error can represent the degree of outlier-ness and help in achieving noise robustness. Experimental results with synthetic and real data sets also support this.

2. Fuzzy Set-Based Microarray Data Analysis Techniques for Interesting Block Identification

Keon Myung Lee, Kyung Soon Hwang, Chan Hee Lee

Microarrays are one of biotechnology products which enable to measure the expression level of thousands of genes simultaneously. It is sometimes crucial to identify some interesting blocks from microarray data for further investigation. Due to the massive volume of data, it is desirable to get assistance of software tools to handle this task. This paper introduces three fuzzy set-based microarray data analysis techniques used to find local cluster, to locate contrasting group, and to filter group with specific pattern.

3. Permutation Clustering Using the Proximity Matrix

Roelof Brouwer

Clustering is fundamental to extracting knowledge from data and is one of the front line attacks. It is classification without comparing to known classes. There are many clustering algorithms. This paper is a treatise on the validation of clustering through visualization of the re-ordered proximity matrix. The paper also proposes a method for extracting clusters automatically from the re-ordered proximity matrix whose density graph representation shows the clusters visually. The method does not at any stage require the specification of the number of clusters. Through simulations and comparisons the method is shown to be quite effective.

4. A New Design Method for Linguistically Understandable Fuzzy Classifier

Heesung Lee, Sanghun Jang, Euntai Kim, Ho Gi Jung

Many classification methods have been reported and the most popular ones among them are multilayer perceptron (MLP), nearest neighbor (NN), and support vector machine (SVM), etc. All of them have the weakness that they are not transparent or not clearly understandable to human beings. Sometimes, however, linguistically understandable classifiers could be preferred to the nontransparent models. Especially, when we are given a large set of data and we have to draw concise but interpretable hypothesis or conclusion, linguistically understandable classifiers should be required. In this paper, a linguistically understandable fuzzy classifier is presented and a new training method is proposed. To handle the uncertainties stemming from the problem or the measurement, the fuzzy classifier, the consequent part outputs the degree of truth for the assignment of each fuzzy set to the classes.

5. A Generalized C-Means Clustering Model Using Optimized Via Evolutionary Computation

Laszlo Szilagyi, David Iclanzan, S'andor M. Szil'agyi, Dan Dumitrescu, Beat Hirsbrunner

Although all three conventional c-means clustering algorithms, namely hard c-means (HCM), fuzzy c-means (FCM), and possibilistic c-means (PCM), had their merits in the development of clustering theory, none of them are generally good solutions for unsupervised classification. Several hybrid solutions have been proposed to produce mixture algorithms. Possibilistic-fuzzy hybrids generally attempt to get rid of the FCM's sensitivity to outliers and PCM's coincident cluster prototypes, while hard-fuzzy mixtures usually aim at quicker convergence while preserving FCM's accurate partitions. This paper presents a unifying approach to c-means clustering: the novel clustering model is considered as a linear combination of the FCM, PCM, and HCM objective functions. The optimal solution is obtained via evolutionary computation. Our main goal is to reveal the properties of such mixtures and to formulate some rules that yield accurate partitions.

Sunday, August 23, 15:30-16:50

Sun 15:30-16:50

Samda A

SS0102B: Practical Aspects and Applications of Type 2 Fuzzy Systems / Type-2 Fuzzy Logic Theory II

Chair: Christian Wagner, University of Essex

1. zSlices Based General Type-2 FLC for the Control of Autonomous Mobile Robots in Real World Environments

Christian Wagner, Hani Hagrass

Fuzzy Logic Control is generally credited with being an adequate methodology for real world control applications which are subject to large amounts of uncertainties. Recent work has shown that interval type-2 Fuzzy Logic Controllers (FLCs) can outperform type-1 FLCs in applications which encompass large amounts of uncertainty. However, the application of general type-2 FLCs and investigations of their performance have been very limited. This paper employs the recently introduced concept of zSlices based general type-2 fuzzy sets to implement a zSlices based general type-2 FLC (zFLC). We will present an overview of the implementation and operations of the zFLC for a two-wheel mobile robot navigating in real world outdoor environments. Furthermore, we present a performance analysis of the zFLC which is compared to the type-1 and interval type-2 FLCs.

2. Interval Type-2 Fuzzy Logic System to Simulate the Environment Resources Stochasticity Affecting the Growth of a Population

Cecilia Leal-Ramírez, Oscar Castillo, Antonio Rodríguez-Díaz

There exist several ways to model population growth at present time, which are mainly based on mathematics. However we present a new model based on fuzzy cellular theory. An interval type-2 fuzzy logic system (IT2-FLS) is designed to evaluate the population growth parameters based on the environment resources stochasticity, in time and space. Interval type-2 fuzzy sets are used to measure the uncertainties of the environment resources. The main goal of this work is to demonstrate how the IT2-FLS integrated into a population growth model can make a suitable evaluation of the parameters required to make that the population size reach a stable equilibrium level on which it fluctuates into a time interval and after that, population size goes down as consequence of insufficient resources. This behaviour is the fundamental basis of the majority of the mathematical models made through the years in Ecology to study the population dynamics.

3. Non-Specificity Measures for Type-2 Fuzzy Sets

Hussam Hamrawi, Simon Coupland

This paper defines non-specificity measures for interval and type-2 fuzzy sets. It relies heavily on alphacuts and alpha-planes. Some observations about this measure are discussed and analysed. An example of calculating these measures is presented.

4. Type-Reduction of the Discretised Interval Type-2 Fuzzy Set

Sarah Greenfield, Francisco Chiclana, Robert John

We begin by surveying the available strategies for type-reducing a discretised type-2 fuzzy set to a type-1 fuzzy set, namely the exhaustive method, the Karnik-Mendel Iterative Procedure, the sampling method, the Greenfield-Chiclana Collapsing Defuzzifier and the Nie-Tan method. We go on to investigate mathematically what happens to the Representative Embedded Set Approximation

as the domain discretisation becomes finer. This leads into a discussion of the relationship between the collapsing and Nie-Tan methods. An experimental comparison is made between the collapsing and Nie-Tan methods, with respect to both efficiency and accuracy.

Sun 15:30-16:50

Samda B

SS10: Fuzzy Systems in Bioinformatics

Chair: Mihail Popescu, University of Missouri

1. eCCV: A New Fuzzy Cluster Validity Measure for Large Relational Bioinformatics Datasets

Mihail Popescu, James C. Bezdek, James M. Keller

The existence of BLAST sequence comparison algorithm and microarray technology are among the reasons that make bioinformatics the domain with the most abundant large relational datasets. For example, by BLAST-ing the genes of the human genome (around 30,000 genes) we obtain a 30,000 by 30,000 distance matrix. This matrix can not be currently stored in the memory of a typical desktop PC. In the same time, clustering the resulting matrix using a fuzzy relational clustering algorithm such as Non-Euclidean Fuzzy C-means (NERFCM) requires prior knowledge of the number of clusters existent in the data set. The question is, how can we evaluate the number of clusters if we can't even load the matrix in the memory our PC? To address this problem, we propose to extend the correlation cluster validity (CCV) that we introduced in a previous paper, denoting the new validity measure as eCCV. eCCV consists of two steps: first sampling of the large matrix followed by the estimation of the number of cluster employing CCV of the sampled data. The sampling strategy produces also a significant processing speedup. We illustrate eCCV properties on a large synthetic dataset and on a large subset of human genes obtained from the RefSeq database.

2. Designing of a Novel GA Based on Fuzzy System for Prediction of CpG Islands in the Human Genome

Li-Yeh Chuang, Yu-Jung Chen, Cheng-Hong Yang

In this paper we proposed a novel Genetic Algorithm based on Fuzzy system for identification CpG islands in human genome, called FGA-CGI (Fuzzy GA-CpG Island). CpG islands play a fundamental role in genome analysis and annotation and contribute to increase the accuracy of promoter prediction. Recently, some approaches rely on large parameter space algorithms of predicting the CpG islands have been proposed in the literature. The goal of our proposed method was that using the evolutionary algorithms with fuzzy system and machine learning to identify CpG islands. A fuzzy expert system was implemented to dynamically adapt the crossover rate and mutation rate in GA for identify significant of CpG islands in human genome, and reinforcement learning sever as extend operation for combined the best subset of islands. In this study, three public tools for identification CpG islands were used to compare with FGA-CGI for the assessment of five prediction performance and statistically analysis. Experimental results reveal that our method can adjust the two variables to escape local optimal by fuzzy system and identify more number of CpG islands. In addition, FGA-CGI had capable of higher performance and precisely predicting statistically significant CpG islands in target sequences than these previous tools.

3. Fuzzy Guided BPSO Method for Haplotype Tag SNP Selection

Li-Yeh Chuang, Yu-Jen Hou, Cheng-Hong Yang

In the current researches of disease-gene association, Single Nucleotide Polymorphism (SNP) is the most interested topic. However, genotyping all existing SNPs for a large number of samples is still challenging even though SNP arrays have been developed to facilitate the task. Therefore, it is essential to select only informative SNPs (tag SNP) representing the rest SNPs for genome-wide association studies. Accordingly, the cost of genotyping is expected to be largely reduced. In this study, the fuzzy guided binary particle swarm optimization (FBPSO) based approach make it possible to select tag SNPs with higher accuracy. The fuzzy logic is employed to tuning the inertia weight (w) of BPSO. Three publicly data sets from the literature have been used for testing the performance of FBPSO. The experimental results indicated that the fuzzy logic will reinforce the search capability of BPSO, which is more accurate than the state-of-the-art methods. On the average of testing results, it also outperforms SVM/STSA method about 3.7%.

4. Fuzzy Adaptive Particle Swarm Optimization for a Specific Primer Design Problem

Cheng-Hong Yang, Yu-Huei Cheng, Hsueh-Wei Chang, Li-Yeh Chuang

A fuzzy system with dynamically adapt the inertia weight of the particle swarm optimization (FAPSO) had been implemented to select a specific feasible primer pair for PCR experiments. Overall, fifty accession nucleotide sequences between 1900 bps and 2100 bps were sampled for primer design with specific PCR product lengths of 150~300 bps and 500~800 bps. Total five hundred runs of the proposed primer design approaches were performed for each accession nucleotide sequence to calculate the optimum accuracy. The proposed approach is compared to standard PSO primer design method. The results generated in a dry dock experiment showed that the FAPSO primer design yielded approximately optimal primer sets and had a relatively short CPU-time than standard PSO. Related materials are available online at <http://bio.kuas.edu.tw/fapso-pd/>.

Sun 15:30-16:50

Room #302

SS18B: Fuzzy System and Control II

Chair: Wei-Yen Wang, National Taiwan Normal University

1. Robust Controllability of TS Fuzzy Descriptor Systems with Structured Parametric Uncertainties

Shinn-Horng Chen, Wen-Hsien Ho, Jyh-Horng Chou

The robust completely controllability problem for the Takagi-Sugeno (TS) fuzzy descriptor systems is studied in this paper. The proposed sufficient condition can provide the explicit relationship of the bounds on parameter uncertainties for preserving the assumed properties.

2. On-Line Adaptive T-S Fuzzy Neural Control for Active Suspension Systems

Wei-Yen Wang, Ming-Chang Chen, Yi-Hsing Chien, Tsu-Tian Lee

Vehicles are not always driven on smooth roads. If parts of the suspension system fail, it becomes an uncertain system. Thus we need an approximator to remodel this uncertain system to maintain good control. In this paper, we propose a new method to on-line identify the uncertain suspension system and design a T-S fuzzy-neural controller to control it. We first use the mean value theorem to transform the active suspension system into a virtual linearized

system. In addition, an on-line adaptive T-S fuzzy-neural modeling approach to the design of robust tracking controllers is developed for the uncertain active suspension system. Finally, this paper gives simulation results of an uncertain suspension system with the on-line adaptive T-S fuzzy-neural controller, and is shown to provide good effectiveness under the conditions that parts of the suspension system fail.

3. An Approach of DSM Techniques for Domestic Load Management Using Fuzzy Logic

Ravibabu Pallikonda, Praveen Abbaraju, Vikas Chandra Chinthala, Rashmi Reddy Pabhati Reddy, Karthik Ravi Teja Machiraju

Electrical Energy is a vital feature for any developing nation. To meet the growing demand, power generating plants of all types are being installed; even then the gap between the supply and demand is continuously increasing due to the depletion of natural resources. Hence, the way to overcome the problem is optimal utilization of available energy sources. In this paper, a methodology is shown to solve to design a model for load management during peak hours in case of domestic loads in both peak hours and off peak hours aiming to reduce the gap between the demand and the supply of electrical energy. Such that consumers and supplier both get beneficial at the same time. The paper also presents the application of fuzzy logic and DSM techniques to the domestic loads, where in the power consumption can be limited during the peak hours there by achieving power conservation. The current method developed is the extension and the part of the Demand Side Management. Simulation results are presented to show effectiveness of the proposed fuzzy logic and Demand Side Management strategy for load management.

4. Fuzzy Controller Design for Proportional Loss Differentiation Services

Reyhaneh Madadian, Mohammad Hossein Yaghmaee Moghaddam

The quality of services is one of the most important issues of today's internet. The programs and the different internet users' quality of services are different from one another. Varieties of methods have been presented in providing the internet's quality of services. The Proportional Differentiated services method is one of the newest ways of providing quality of services. In this essay, a proper fuzzy model for providing quality of services in the relative differentiated services is presented. The presented method is based on the JOBS method which is one of the newest methods of services differentiation. The suggested model is implemented and analyzed in ns2 simulation environment. The final results of this simulation reveal the superiority of the suggested fuzzy method compared with the non-fuzzy one.

Sun 15:30-16:50

Room #303

SS17B: Hybrid Learning in Fuzzy Control II

Chair: Jin-Tsong Jeng, National Formosa University

1. Hybrid SVM-GPs Learning for Modeling of Molecular Autoregulatory Feedback Loop Systems with Outliers

Jin-Tsong Jeng, Chen-Chia Chuang, Sheng-Lun Jheng

In this paper, the hybrid support vector machines (SVM) and Gaussian process (GPs) are proposed to deal with the molecular autoregulatory feedback loop systems with outliers. In the proposed approach, there are two-stage strategies. In the stage 1, the support vector machine regression (SVMR) approach is used to filter out the outliers in the training data set. Because of the large outliers in the training data set are almost removed, the large outlier's effects are reduce, so the concepts of robust statistic theory are not used to reduce the outlier's effects. The rest of the training data set after the

stage 1 is directly used to training the Gaussian process for regression (GPR) in the stage 2. According to the simulation results, the performance of the proposed approach is superior to the least squares support vector machines for regression, and GPR when the outliers are existed in the molecular autoregulatory feedback loop systems.

2. Robust Function Approximation Based on Fuzzy Sets and Rough Sets

Chih-Ching Hsiao

The rough set theory is successful to deal with imprecise, incomplete or uncertain information system. Fuzzy set and the rough set theories turned out to be particularly adequate for the analysis of various types of data, especially, when dealing with inexact, uncertain or vague knowledge. In this paper, we propose a novel algorithm, which is termed as Rough-Fuzzy C-regression model (RFCRM), that defines fuzzy subspaces in a fuzzy regression manner and also includes Rough-set theory for TSK modeling with robust capability against outliers.

3. An Improving Gene Selection for Microarray Data

Zne-Jung Lee, Chou-Yuan Lee, Yu-Lin Weng

The microarray data consists of tens of thousands of genes on a genomic scale. To avoid higher computational complexity, it needs gene selection to find the gene subsets that are able to explain the disease. In this paper, an improving gene selection for microarray data is proposed. In the proposed algorithm, scatter search is used to obtain suitable parameter settings for support vector machine and then a subset of beneficial genes is selected. These selected genes can increase the accuracy of classification for microarray data. From experimental results, it shows that the proposed algorithm can obtain a better parameter setting and reduce unnecessary genes.

4. An Improve Flush Material Belt Weigh Feeder System via Fuzzy Logic Controller and Adaptive Neural Networks

Tsung-Ying Sun, Ming-Chin Yang, Shang-Jeng Tsai, Jyun-Sian He

The Flush Material Belt Weigh Feeder (FMBWF) has been used in many material handling plants. The stability and the performance of the layer control system will affect the quality of the production. In general, the behavior of the flush material on the BWF is non-linear, time-lag, and disturbance character. The layer of the flush material on the belt is hard to be stably controlled especially the occurrence of unstable situation in flush material or the prefeeder feeding rate and the variation of the set point value of the FMBWF. This paper focuses on the performance improvement of the FMBWF via adopting a fuzzy controller under the situation of the Flow Rate Set Value (FRSV) variation. The proposed fuzzy controller is utilized instead of the original feed forward compensation function to deal with the problems of the temporary unstable situation. This paper offers the simulation result comparison of the set point value variations between the BWF for the original and the proposed control system. The simulation results are distinctly better than the original control system. The influence of the variations of the set point value can be successfully evaluated by the Fuzzy controller and adjusted the Proportional Actuator immediately. Finally the proposed control system remains convergence with smooth and stable. Therefore, the accuracy, stability and the performance of the control system are improved.

E02: Fuzzy Image, Speech and Signal Processing, Vision and Multimedia II

Chair: Hideaki Kawano, Kyushu Institute of Technology

1. Fuzzy Generalized Hough Transform Invariant to Rotation and Scale in Noisy Environment

Hamid Izadinia, Fereshteh Sadeghi, Mohammad Mehdi Ebadzadeh

Generalized Hough Transform (GHT) is an efficient method for detecting curves by exploiting the duality between points on a curve and parameters of that curve. However GHT has some practical limitations such as high computational cost and huge memory requirement for detecting scaled and rotated objects. In this paper a new method, namely Fuzzy Generalized Hough Transform (FGHT), is proposed that alleviates these deficiencies by utilizing the concept of fuzzy inference system. In FGHT the R-table consists of a set of fuzzy rules which are fired by the gradient direction of edge pixels and vote for the possible location of the center. Moreover, the proposed method can identify the boundary of the rotated and scaled object via a new voting strategy. To evaluate the effectiveness of FGHT several experiments with scaled, rotated, occluded and noisy images are conducted. The results are compared with two extensions of GHT and have revealed that the proposed method can locate and detect the prototype object with least error under various conditions.

2. Music Copyright Protection System Using Fuzzy Similarity Measure for Music Phoneme Segmentation

Kwang-Ho Kim, Minkyu Lim, Ji-Hwan Kim

In this paper, we propose a method for rejection using fuzzy similarity measure and devise a music copyright protection system with the combination of this rejection method and our previous HMM-based music identification system. We implement a music copyright protection system for 1,100 registered music files. Our system demonstrates identification results of 100% for these registered music files and robust identification performance for all signal-level variations of these files. Applying our method of rejection, the system successfully rejects 495 of 500 unregistered music files while its false acceptance rate stands at 0%. Surprisingly, the system achieves additional improvement in music identification when employing this rejection method.

3. Text Extraction from Degraded Document Image Independent of Character Color Based on MAP-MRF Approach

Hideaki Kawano, Hideaki Orii, Hiroshi Maeda, Norikazu Ikoma

We propose a novel background and foreground estimation algorithm in MAP-MRF approach for binarization of degraded document image. In the proposed algorithm, an assumption that background whiteness and foreground blackness is not employed differently from the conventional algorithm, and we employ characters' irregularities based on local statistics. This makes the method possible to apply to the image with various colored characters, ex. outlined characters by colored background. Experimental results show that the proposed method achieves promising results.

4. Fingerprint Classification Using the Stochastic Approach of Ridge Direction Information

Hye-Wuk Jung, Jee-Hyong Lee

Large scale, automatic fingerprint identification systems (AFISs) perform fingerprint classification to improve matching accuracy and reduce the matching time before fingerprint matching. Fingerprints are classified into several classes such as arch (A),

whorl (W), left loop (L) and right loop (L). The existing systems generally classify fingerprints based on the information of singular points. This approach is well suited for fingerprints acquired using paper and ink. However, it is not as efficient with recent automatic fingerprint systems because it cannot guarantee that singular points are well extracted since the recent systems have various sized sensors and use multifarious fingerprint acquisition methods. In this paper, a novel approach is proposed to use the fingerprint ridge direction, which is one of the global features. It is a probabilistic approach based on the fingerprint ridge characteristics of each class. FVC2000 DB1 and FVC2002 DB1 databases were used to evaluate the performance of our classification. Furthermore, the effectiveness of applying the probabilistic model to the classification of various exceptional fingerprint patterns was verified.

Sunday, August 23, 17:00-19:20

Sun 17:00-19:20

Samda A

SS26: Fusion Of Information System And Human Kansei, Emotion, and Biological Information

Chair: Tomoyuki Hiroyasu, Doshisha University

1. A Rough Set Approach to Extract Painting Composition Rules

Tomomi Ohira, Tsuyoshi Nakamura, Masayoshi Kanoh, Tsutomu Kunitachi, Hidenori Itoh

Non-photorealistic rendering (NPR) is a technique used in the field of computer graphics. Here, we restrict our attention to the subset of NPR developed to synthesize drawing and painting techniques. Specifically, we focus on the style of Cubist art, such as the works of Picasso. First, we examine the actual works of Picasso in order to understand and improve the qualities of Cubist style rendering. As a result, the painting composition rules are expected to be extracted from the analysis of Picasso's works. In the present paper, we propose a Cubist style rendering based on the analysis of painting compositions. The present paper describes the proposed method by which to construct a painting composition database and illustrates the rules extracted from the database. We use rough set theory to extract the rules, and using these rules; we render and illustrate a sample image in Cubist style.

2. Extraction of Design Variables Using Collaborative Filtering for Interactive Genetic Algorithms

Tomoyuki HIROYASU, Misato TANAKA, Mitsunori MIKI

Interactive Genetic Algorithm (iGA) is one of evolutionary computations in which the design candidates are evaluated by human. Using iGA, the sensibility and subjective feelings of humans can be optimized by learning the user's evaluation of presented individuals. In this research, iGA was applied to product recommendation on shopping sites. One of the most difficult points to be addressed in construction of a product recommendation system is to taking a long time to extract and assign values to design variables from all of the actual products on the site. It is also difficult to define product design variables appropriately. To address these problems, we propose a method to generate design variables automatically based on a lot of users' preference data on the Web. We constructed the design variables using the relevance of products obtained by Collaborative Filtering and discussed them. Through the simulation experiments, the effectiveness of the proposed method is discussed.

3. Detection of Preference Shift Timing Using Time-Series Clustering

Fuyuko Ito, Tomoyuki Hiroyasu, Mitsunori Miki, Hisatake Yokouchi

Recommendation methods help online users to purchase products more easily by presenting products that are likely to match their preferences. In these methods, user profiles are constructed according to past activities on the site. When a user accesses an e-commerce site, the user preferences may change during the course of web shopping. We called this a "preference shift" in this paper. However, conventional recommendation methods suppose that user profiles are static, and therefore these methods cannot follow the preference shift. Here, a novel product recommendation method is proposed, which responds to the preference shift. With use of this recommendation method, the users remain at the site longer than before. This paper discusses the detection method for finding the preference shift timing using time-series clustering. In the proposed method, the products preferred by a user are clustered and the preference shift timing is detected as the change in the clustering results.

4. Analyzing KANSEI from Facial Expressions with Fuzzy Quantification Theory II

Luis A. Diago, Tetsuko Kitaoka, Ichiro Hagiwara

There is no direct translation for Kansei into English, however the creator of the Kansei Engineering methodology describes Kansei as "the consumer's psychological feeling" towards a product. Here we describe an application where a picture presentation system was applied to define the properties of facial expressions. Instead of analyzing facial expressions of an individual to determine his emotional state, proposed system introduces Fuzzy Quantification Theory II to build a membership function that describes the emotions induced in a subject after the presentation of small set of facial expressions. Using type-II fuzzy quantification theory, the relationship between induced emotions and facial features is linearized by solving a dense generalized eigenvalue problem. As the matrices are ill-conditioned and indefinite, the theory describing the possible solutions of the eigenvalue problem gets complicated. After a generalization of Fix and Heiberger's algorithm is adapted to tackle the problem, facial expressions are sorted on the real number axis and membership functions of two subjects are analyzed.

5. Improvement of Interactive EC Fitting Based on Substitute Evaluation Using Sound Volume Preference

Miho Ohsaki

Interactive EC Fitting is an effective fitting method to set the signal processing parameters of a hearing aid reflecting the preference of each user. However, it sometimes generates uncomfortable sounds and takes long fitting time. This paper proposes an improvement of Interactive EC Fitting by embedding a function that screens out a subset of candidate settings which are predicted to cause uncomfortable sounds by using sound volume preference. We evaluated the improved method through a simulation-based experiment. The results statistically showed that the improved method reduces the variance of evaluation values of candidate settings and accelerates the EC convergence, compared to original Interactive EC Fitting. It was therefore indicated that the improved method is effective in screening uncomfortable sounds and shortening fitting time. We will confirm the actual effectiveness of the improved method by conducting psychological experiments in our future work.

6. Extraction of Important Keywords in Free Text of Questionnaire Data and Visualization of Relationship among Sentences

Yuki Uchida, Tomohiro Yoshikawa, Takeshi Furuhashi, Eiji Hirao, Hiroto Iguchi

Recently, companies often carry out questionnaire(s) and develop marketing strategies. There are usually two types of forms for the answer of a questionnaire. One is the form to select prepared answers and the other is free text form. The true message might be in the text form rather than the numerical part, then the analysis of free text form is needed. The amount of text in a questionnaire is, however, usually large and difficult to read whole text data for analysis. This study tries to develop a free text analysis support system which visualizes relationships among respondents based on their texts and shows their opinions using graph structure of keywords. First, this paper proposes the extraction method of important keywords in their opinions based on the modification relationships. Next, it clusters the respondents interactively on visible space using MDS. Finally, it shows their opinions using HK Graph which can visualize the relationship among words with hierarchical network structure based on the co-occurrence information for the keyword graph.

7. Selecting a Small Number of Representative Non-Dominated Solutions by a Hypervolume-Based Solution Selection Approach

Hisao Ishibuchi, Yuji Sakane, Noritaka Tsukamoto, Yusuke Nojima

A large number of non-dominated solutions are often obtained by a single run of an evolutionary multiobjective optimization (EMO) algorithm. In the EMO research area, it is usually assumed that a single solution is to be chosen from the obtained non-dominated solutions by the decision maker. It is, however, time-consuming and not easy for the decision maker to examine a large number of obtained non-dominated solutions. Motivated by these discussions, we proposed single-objective and multiobjective formulations of solution selection problems to present only a small number of representative non-dominated solutions to the decision maker in our former study. The basic idea is to minimize the number of solutions to be presented while maximizing their hypervolume. A number of single-objective formulations can be derived from such a two-objective solution selection problem. In this paper, single-objective rule selection is performed as a post-processing procedure of EMO algorithms to select a prespecified number of non-dominated solutions (e.g., 10 or 20 solutions). Through computational experiments on multiobjective 0/1 knapsack problems, we examine the characteristic features of selected non-dominated solutions. We also examine the effect of the choice of a reference point for hypervolume calculation on the distribution of selected non-dominated solutions.

technology development is a crucial key considering Korea's national energy security and environments. In this study, we establish the criteria list and prioritize relative weights of criteria and sub-criteria for assessing and selecting strategic Big-sized R&D programs in the sector of energy technology development. A fuzzy AHP approach, which integrates fuzzy theory into analytic hierarchy process (AHP) approach, reflects the vagueness of human thoughts and perception as making pairwise comparisons of criteria and alternatives. The fundamental data of this research results will support R&D planning phase for policy makers as selecting strategic R&D programs for producing well focused R&D outcomes.

2. Dilemma of Behavioral Uncertainty of R&D Alliance in Taiwan Machinery Industry

You-Hsin Tsai, Wen-Hsiang Lai, Pao-Long Chang, Junzo Watada

In view of global business competition, industries in Taiwan can no longer made use of its manufacturing advantage to create future businesses without constant research, development (R&D) and innovation as it could survive on the market in the past. As industries confronted with fast changing and ever increasingly competitive environment, the industries can make use of R&D alliance of project to swiftly obtain complementary resources and assets so that they can create knowledge assets for the organization internally and effective transfer of technology. However, the impact of hidden social resources is most significant in the formation and operation of R&D alliance. Therefore, the objective of this paper is to examine the three aspects of industrial environment, trust relationship among working partners and formation motif of R&D alliance and to investigate the current situation and dilemma of the R&D alliance in the Taiwan machinery industry (TMI). This study has employed expert interviews, questionnaires, and their rough sets analysis to clarify influential factors the TMI should confronts.

3. Optimal Revenue for Fuzzy Price Based on Interval-valued Fuzzy Numbers

Teng-San Shih, Jin-Shieh Su, Huey-Ming Lee

In this article, we study a fuzzy optimization problem in business and economics. In this problem, a fuzzy price is determined using a linear one degree demand function. The objective is to find the optimal fuzzy revenue, which is derived from the fuzzy price. We use level $(\lambda, 1)$ interval-valued fuzzy numbers to consider fuzzy price and fuzzy revenue. Using signed distance to defuzzify, we can get the demand function and revenue function in fuzzy sense. What follows is that we can find the maximum revenue in fuzzy sense.

4. New Perspectives and Applications of Real-Time Fuzzy Regression

Azizul Azhar Ramli, Junzo Watada, Witold Pedrycz

Fuzzy regression is one of important methods for data analysis. Fuzzy regression extends the concept of classical regression which has been constructed in the statistical framework. We show that a convex hull method can provide a powerful tool to reduce the computing time, especially for real-time data analysis. The main objective of this study is to propose an efficient real-time fuzzy regression analysis based on the use of convex hull, specifically a Beneath-Beyond algorithm. The reconstruction of convex hull edges depends on incoming vertices while a recomputing procedure can be implemented in real-time. An air pollution data is analyzed by applying the proposed approach. An important role of convex hull is emphasized in particular when dealing with the limitations of linear programming.

Sun 17:00-19:20

Samda B

SS22B: New Perspective of Fuzzy Approaches to Management Engineering II

Chair: Huey-Ming Lee, Chinese Culture University

1. Fuzzy Integrated Analytic Hierarchy Process Approach for Selecting Strategic Big-sized R&D Programs in the Sector of Energy Technology Development

Seongkon Lee, Gento Mogi, M. Koike, K.S. Hui, Jongwook Kim

Energy environment has been changing rapidly such as the fluctuation of oil prices and the effect on UNFCCC (United nations framework convention on climate change). Korea is easily affected by the change of oil prices due to poor natural resources and large dependence of consumed energy resources in Korea. Energy

5. An Evaluation of Survey by Fuzzy Linguistics Based on the Signed Distance Method

Lily Lin, Huey-Ming Lee

An evaluation of survey by fuzzy linguistics has been conducted using both the signed distance and centroid method. As to both methods, the proposed approaches, different from conventional survey algorithms via questionnaire rating item by linguistic variables, possessing the vague nature, we employed fuzzy sense of sampling to express the degree of interviewee's feelings based on his own concept, the result will be closer to interviewee's real thought. In this study, we re-model the previous method and use the signed distance method which would be effective and reliable to do aggregated assessment analysis.

6. Fuzzy Theory-Based Best Generation Mix Considering Renewable Energy Generators

Jaeseok Choi, Jeongje Park, Liang Wu, Junmin Cha, A. A. El-Keib, Watada Junzo

This paper proposes a fuzzy linear programming (LP)-based solution approach for the long-term multi-stages best generation mix (BGM) problem considering wind turbine generators (WTG) and solar cell generators (SCG), and CO₂ emissions constraints. The proposed method uses fuzzy set theory to consider the uncertain circumstances ambiguities associated with budgets and reliability criterion level. The proposed approach provides a more flexible solution compared to a crisp robust plan. The effectiveness of the proposed approach is demonstrated by applying it to solve the multi-years best generation mix problem on the Korean power system, which contains nuclear, coal, LNG, oil, pumped-storage hydro, and WTGs and SCGs.

7. Solving the Transportation Problem with Fuzzy Coefficients Using Genetic Algorithms

Feng-Tse Lin

The aim of this work is to introduce a genetic algorithm to solve transportation problem with fuzzy objective functions. The fuzzy objective functions have fuzzy demand and supply coefficients, which are represented as fuzzy numbers. The ranking fuzzy numbers with signed-distance measurement are used for the evaluation and selection of the algorithm. The proposed genetic algorithm is not only simulating fuzzy numbers that representing fuzzy coefficients, but also finding the best solution for the fuzzy transportation problem. The numerical simulation results show that the proposed algorithm is efficient for solving the transportation problem with fuzzy coefficients.

supervisory controller helps generate useful data and allows enough time for the fuzzy system to learn and improve through online adding new rules, replacing or deleting old rules and tune the parameters of rules according the latest on-line data. When the fuzzy system regains good approximation through learning and the model based main controller is capable of maintain system stability, the supervisory controller is idle. It is proven that the overall adaptive control scheme with the IACSFS and the supervisory controller guarantees the global stability in the sense that all the closed-loop signals are bounded. The effectiveness of the proposed control scheme is demonstrated through simulation.

2. iDEVs: New Method to Study Inaccurate Systems

Paul-Antoine Bisgambiglia, Emmanuelle de Gentili, Paul Bisgambiglia, Jean-Francois Santucci

Our recent research in the fields of modeling and simulation of complex systems, led us to study fuzzy systems. A system is fuzzy, because its parameters are inaccurate, or its behavior is uncertain. We propose in this paper to describe a new modeling method based on the association of DEVs formalism and the fuzzy sets theory. The combination of these two approaches we have permit to define a new method of inaccurate modeling. Our goal is to study systems with inaccurate parameters.

3. TSK Fuzzy Model Using Kernel-Based Fuzzy C-means Clustering

Qianfeng Cai, Wei Liu

In order to overcome the dimension problem of the traditional fuzzy clustering, we use kernel-based fuzzy c-means clustering (KFCM) to construct first-order TSK fuzzy models. The proposed algorithm is composed of two phases. In the first phase, the antecedent fuzzy sets are obtained by KFCM. We present the expression of the cluster prototypes of KFCM with different kernel functions in original input space. The use of cluster validity indices is a standard approach to determine an appropriate number of clusters in a data set. However, cluster validity index demands running the clustering algorithm for different number of clusters repeatedly. Therefore, a novel method specifying the number of clusters automatically is given for the purpose of reducing the computational complexity and eliminating the outliers. In the second phase, the consequent parameters can be identified by the least squares method. Experiment results show that the proposed method improves the generalization ability and robustness of fuzzy models compared with the traditional techniques.

4. Stability Analysis of Continuous-Time Recurrent Fuzzy Systems

Andreas Schwung, Thomas Gussner, Juergen Adamy

In this paper, we present a new approach for the stability analysis of continuous-time recurrent fuzzy systems (CTRFS). The approach is based on the representation of a CTRFS as a switched polynomial system, for which a Lyapunov function is constructed in a two step procedure. Both steps are based on semidefinite programming. The applicability is shown by an ecological system formulated as a rule based structure.

5. A Simple Adaptive Fuzzy Control for a Class of Strict-Feedback SISO Systems

Tie-shan Li

A simple adaptive fuzzy control (SAFC) is proposed for a class of strict-feedback uncertain nonlinear systems with both unknown system nonlinearities and unknown virtual control gain nonlinearities. Combining the dynamic surface control(DSC) technique with minimal-learning-parameters(MLP) algorithm, a systematic procedure for synthesis of SAFC is developed base on the universal approximation of Takagi-Sugeno(T-S) fuzzy system. An important feature of the proposed algorithm is that the number

Sun 17:00-19:00

Room #302

I01: Fuzzy Systems Design, Modeling, Identification, Fault Detection I

Chair: Paul-Antoine Bisgambiglia, University of Corsica

1. Nonlinear Identification and Adaptive Control Based on Self-Structuring Fuzzy Systems

Ruiyun Qi, Xuelian Yao

This paper presents a nonlinear identification and indirect control algorithm based on a self-structuring fuzzy system (SFS) with guaranteed stability. The overall controller consists of two parts: the indirect adaptive controller based on the self-structuring fuzzy system (IACSFS) is the dominant controller which maintains the closed-loop stability when the fuzzy system is a good approximation of the nonlinear plant. A supervisory controller is an auxiliary controller which is activated when the tracking error reaches the boundary of a predefined constraint set. The

of parameters updated on line for each subsystem is reduced dramatically to one, both problems of “explosion of complexity” and “curse of dimension” are avoided, such that the computation load is reduced drastically. It is shown that all closed-loop signals are semi-global uniform ultimate bound(SGUUB) via Lyapunov stability theory and the tracking error can be made arbitrary small. Finally, simulation results are presented to demonstrate the effectiveness and performance of the proposed scheme. Index Terms—Uncertain nonlinear systems, Takagi-Sugeno(T-S) fuzzy system, adaptive control, dynamic surface, minimal-learning parameters.

6. Optimization of Multiple Model Fuzzy Systems Using RCGKA and Their Application

Young-Keun Bang, Chul-Heui Lee

One of the most important goals of time series analysis is prediction basing on the analyzed information. But it is not easy to analyze the patterns, regularities and trends of non-stationary and/or chaos time series because their major characteristics are non-linear and vague. In this paper, we propose primary and secondary tuning procedures that can enhance the accuracy for designing fuzzy prediction systems. In the primary tuning procedure, the data preprocessing, model selection and general k-means clustering techniques are used to roughly tune the proposed fuzzy prediction systems. The primary tuning procedure is to choose the optimal difference candidates, partition the fuzzy sets for each candidate, and select the optimal difference interval (or predictor). In secondary tuning procedure, the real-coded genetic k-means algorithm (RCGKA) is used to enhance the efficiency of the clusters associated with non-stationary time series. The purpose of the secondary tuning procedure is to finely tune the fuzzy sets of the selected predictor. With two tuning procedures, the proposed prediction systems will reflect more clearly the characteristics of time series and predict more accurately the future values of the time series. Finally, in this paper, we verified the performances of the proposed prediction systems via typical time series simulations.

Sun 17:00-19:00

Room #303

SS25: Agent-Based Community Simulation and Soft Computing

Chair: Katsuhiko Honda, Osaka Prefecture University

1. Collaborative Filtering by Sequential Extraction of User-Item Clusters Based on Structural Balancing Approach

Katsuhiko Honda, Akira Notsu, Hidetomo Ichihashi

This paper considers a new approach to user-item clustering for collaborative filtering problems that achieves personalized recommendation. When user-item relations are given by an alternative process, personalized recommendation is performed by finding user-item neighborhoods (co-clusters) from a rectangular relational data matrix, in which users and items have mutually positive relations. In the proposed approach, user-item clusters are extracted one by one in a sequential manner via a structural balancing technique, used in conjunction with the sequential fuzzy cluster extraction method.

2. Cluster Validation in k-Means Clustering Based on PCA-Guided k-Means and Procrustean Transformation of PC Scores

Tomohiro Matsui, Katsuhiko Honda, Chi-Hyon Oh, Akira Notsu, Hidetomo Ichihashi

PCA-guided k-Means is a technique for analytically estimating a relaxed solution for k-Means clustering, while the derived cluster indicator is a rotated solution and the rotation matrix cannot be

explicitly estimated. Then, an approach such as visualization by ordering of samples in connectivity matrices is applied for visually accessing cluster structures. This paper introduces a technique for estimating a rotation matrix by Procrustean transformation of principal component scores in order to select the optimal solution from multiple solutions derived by k-Means, and proposes a cluster validation measure calculating the deviation between k-Means solutions and a re-constructed membership indicator matrix.

3. Conceptual Graph Generation from Text Documents Based on Perceptual Balance

Akira Notsu, Katsuhiko Honda, Hidetomo Ichihashi

A Conceptual Graph Generation method is proposed in this paper. A Conceptual Graph is useful for studying human verbal caring interactions such as counseling, based on an interpersonal psychological approach referred to as ‘Naïve Psychology’. We apply the Visual Assessment of Clustering Tendency (VAT) to naïve psychology, with particular reference to the visual understanding of people. A Conceptual Graph is constructed from words and sentences selected by morphological analysis. Furthermore, the VAT algorithm produces a visual display that can be used to assess clustering tendencies in a set of persons (notions) by reconstructing a digital image representation of a square relational dissimilarity matrix. This algorithm clearly represents two types of imbalanced situations in naïve psychology: namely the crisp and fuzzy situations. In addition, social simulations that utilize several graphs are introduced.

4. A Fuzzy Model-Based Community Simulator for Behavior Analysis in Virtual Theme Park

Chi-Hyon Oh, Katsuhiko Honda, Hidetomo Ichihashi

In order to achieve universal contents creation/distribution in a network community, it is necessary to create an environment in which anyone can produce any content they wish and in which content can be accessed while ensuring reliability. This paper considers a fuzzy model of a community simulator for behavior analysis in a virtual theme park that can be identified with a constrained network community. A number of agents with various tastes, whose action patterns are modeled based on answers from respondents to a questionnaire, act autonomously according to their action rules in the multi-agent system. Experimental results demonstrate that such fuzzy model-based agents are useful for analyzing the behaviors of guests in a large scale theme park.

5. Efficiency Measurement for Agent Simulation Based on DEA with Imprecise Data

Shingo Aoki, Kazushige Inoue, Tomoharu Nakashima, Katsuhiko Honda

This paper has proposed a framework in order to analyze in conditional efficient state. Proposed model can classify the objective DMU with imprecise data into following four state: (1) efficient state in any case, (2) efficient state in the condition that objective DMU has minimum input and maximum output and other DMU has any input/output levels, (3) efficient state in the condition that objective DMU has minimum input and maximum output and other DMU has qualified input/output levels, and (4) inefficient state in any case. In addition, this paper has applied the proposed method to the data for 25 soccer teams that participated in the Japan preliminaries of Robocup 2008 and demonstrated its effectiveness.

6. Evolution of Cooperative Behavior in a Spatial Iterated Prisoner's Dilemma Game with Different Representation Schemes of Game Strategies

Hisao Ishibuchi, Hiroyuki Ohyanagi, Yusuke Nojima

The iterated prisoner's dilemma (IPD) game has been frequently used to examine the evolution of cooperative behavior among agents in the field of evolutionary computation. A number of factors are known to be related to the evolution of cooperative behavior. One well-known factor is spatial relations among agents. The IPD game is often played in a grid-world. Such a spatial IPD game has a neighborhood structure which is used for local opponent selection in the IPD game and local parent selection in genetic operations. Another important factor is the choice of a representation scheme to encode each strategy. Different representation schemes often lead to totally different results. Whereas the choice of a representation scheme is known to be important, a mixture of different representation schemes has not been examined for the spatial IPD game in the literature. This means that a population of homogeneous agents with the same representation scheme has been assumed. In this paper, we introduce a different situation to the spatial IPD game in order to examine the evolution of cooperative behavior under more general assumptions. The main novelty of our spatial IPD game is the use of a mixture of different representation schemes. This means that we use a population of inhomogeneous agents with different representation schemes. Another novelty is the use of two neighborhood structures, each of which is used for local opponent selection and local parent selection. Under these specifications, we show a number of interesting observations on the evolution of cooperative behavior.

Sun 17:00-19:00

Room #401

SS28: Lattice and Poset Valued Fuzzy Structures - Theory and Applications

Chair: Branimir Seselja, University of Novi Sad

1. Lattice-Valued Fuzzy Turing Machines and Their Computing Power

Yongming Li

In this paper, fuzzy Turing machines with membership degrees in distributive lattices, which are called latticevalued fuzzy Turing machines, are studied. First several formulations of lattice-valued fuzzy Turing machines, including in particular deterministic and nondeterministic lattice-valued fuzzy Turing machines (l-DTMs and l-NTMs), are given. It is shown that l-DTMs and l-NTMs are not equivalent as the acceptors of fuzzy languages. This contrasts sharply with classical Turing machines. Second, it is shown that latticevalued fuzzy Turing machines can recognize n-r.e. sets in the sense of Bedregal and Figueira, the super-computing power of fuzzy Turing machines is established in the lattice-setting. Third, it is demonstrated that the truth-valued lattice being finite is a necessary and sufficient condition for the existence of a universal lattice-valued fuzzy Turing machine. For an infinite distributive lattice with a compact metric, it is declared that a universal fuzzy Turing machine exists in an approximate sense. This means, for any prescribed accuracy, there is a universal machine that can simulate any lattice-valued fuzzy Turing machine on it with the given accuracy.

2. Representation by Cuts in the Framework of Relational Valued Fuzzy Sets

Branimir Seselja, Andreja Tepavcevic

Generalized or relational-valued fuzzy sets are mappings from a set X to a relational system $S = (S; \frac{1}{2})$. Representation of collections

of subsets by relational-valued fuzzy sets in the cutworthy framework is presented. It is proved that for every collection F of subsets of a set X there is a relational system $S = (S; \frac{1}{2})$ and a fuzzy set $\lambda : X \rightarrow S$, such that the collection of cuts of λ coincides with F .

3. Fuzzy Identities

Branimir Seselja, Andreja Tepavcevic

Fuzzy subalgebras of a crisp algebra equipped with a compatible fuzzy equality are investigated. Fuzzy identities with respect to this fuzzy equality are considered. If a fuzzy subalgebra satisfies a fuzzy identity then the quotient cutalgebras over the corresponding cut-congruences fulfill the crisp version of the fuzzy identity. Particular cases of groupoid-like and similar algebras in this framework are also investigated.

4. On Quasi Hyper BCK-Algebras

Arsham Borumand Saeid, Lida Torzkadeh

By using the concept of fuzzy points, we generalize the notion of hyper BCK-algebra and the notions of fuzzy point hyper BCK-(sub) algebras, fuzzy point (weak, strong) hyper BCK-ideals, quasi hyper BCK-(sub) algebras and quasi (weak, strong) hyper BCK-ideals are introduced. The relationship between these notions are stated and proved.

5. On Vague BCK/BCI-Algebras

Arsham Borumand Saeid

In this note, by using the concept of vague sets, the notions of vague BCK/BCI-algebra is introduced. And the notions of α -cut and vague-cut is introduced and the relationship between these notions and crisp subalgebras are studied.

6. On Generalized Fuzzy BF-Algebras

Ali Reza Hadipour

By two relations belonging to (\in) and quasicoincidence (q) between fuzzy points and fuzzy sets, we define the concept of (α, β) -fuzzy subalgebras where α, β are any two of $\{\in, q, \in \vee q, \in \wedge q\}$ with $\alpha \neq \in \wedge q$. We state and prove some theorems in (α, β) -fuzzy BF-algebras.

Monday, August 24, 09:00-10:40

Mon 09:00-10:40

Samda A

SS13: Theory and Applications of Fuzzy Signatures

Chair: Sumudu Mendis, The Australian National University

1. Motion Control and Communication of Cooperating Intelligent Robots by Fuzzy Signatures

Aron Ballagi, T. Laszlo Koczy, Tamás D. Gedeon

This paper presents two examples of usage of fuzzy signatures in the field of mobile robotics. The first shows a complex lateral drift control method base on fuzzy signatures. This method inspects the motion system of the robot as a whole, unlike as simple parts of a complex system. The state space is written down by fuzzy signatures which add up flexibility, adaptability and learning ability to the system. In the second experiment a new communication approach is investigated for intelligent cooperation of autonomous mobile robots. Effective, fast and compact communication is one of the most important cornerstones of a high-end cooperating system.

In this paper we propose a fuzzy communication system where the codebooks are built up by fuzzy signatures. We use cooperating autonomous mobile robots to solve some logistic problems.

2. Multi-Layer Fuzzy Cognitive Modeling Using Fuzzy Signatures

Kok Wai Wong

This paper presents a class of fuzzy cognitive modeling which can handle granulation, organisation and causation. This cognitive modeling technique consists of multiple levels where the lowest level includes details required to make a decision or to transfer to the next stage. At the lowest level, fuzzy signatures are used to represent the concepts or knowledge.

3. Hierarchical Document Signature: A Specialized Application of Fuzzy Signature for Document Computing

Sukanya Manna, B. Sumudu U. Mendis, Tom Gedeon

We develop document computing procedures for the analysis of discourse structures within a document, represented by hierarchical document signatures. A signature is a string of data characterizing a certain case (e.g. characteristics of a sentence in case of a document). The place of the individual data is fixed within the string, it holds a local value semantics. Fuzzy granulation is a semantic background technique for all kinds of information which originates from human estimation or recorded by human valuation of numerical data. For analysis of such data the development of special procedures is suggested, different from the usual statistical methods. We used a form of fuzzy signature, called hierarchical document signature to modularize an unstructured document in a hierarchical manner, from Document level to sentence level, sentence level to attribute level and then to word level. We used occurrence of words as the information of the lowest module to find the similarity among the next higher module by aggregating the signature values giving sentence pair coherence.

4. Finding Input Sub-Spaces for Polymorphic Fuzzy Signatures

AmirHossein Hadad, Tomas D. Gedeon, B. Sumudu U. Mendis

A significant feature of fuzzy signatures is its applicability for complex and sparse data. To create Polymorphic Fuzzy Signatures (PFS) for sparse data, sparse input sub-spaces (ISSs) should be considered. Finding the optimal ISSs manually is not a simple task as it is time consuming; moreover, some knowledge about the dataset is necessary. Fuzzy C-Means (FCM) clustering employed with a trapezoidal approximation method is needed to find ISSs automatically. Furthermore, dealing with sparse data, we should be mindful about choosing a reliable trapezoidal approximation method. This facilitates the optimal ISS creation for the data. In our experiment, two trapezoidal approximation methods were used to find optimal ISSs. The results demonstrate that our version of trapezoidal approximation for creating ISSs result in an PFS with lower mean square error compared to the original trapezoidal approximation method.

5. Fuzzy Rough Signatures

B. Sumudu U. Mendis, T. Laszlo Koczy

We extend the idea of Fuzzy Signature to Fuzzy Rough Signature (FRS). The proposed Fuzzy Rough Signature is capable of handling most kind of uncertainty: epistemic and random uncertainty, vagueness due to indiscernibility, and linguistic vagueness that exists in both large as well as small sample data sets. Additionally, this system is capable of hierarchical organization of inputs and use of flexible aggregation selection will simplify the combinations of inputs from different sources.

SS19: Applications of Fuzzy Systems to Benefit Society

Chair: Keeley Crockett, Manchester Metropolitan University

1. A System to Perform CBIR on X-Ray Images Using Soft Computing Techniques

Juan Miguel Medina, Sergio Jaime-Castillo, Daniel Sanchez

This paper describes a Content-based image retrieval (CBIR) system to help in the diagnosis and treatment process of the scoliosis pathology. To do this, the system includes a module for the automatic extraction of scoliosis measures from X-rays. Also, the system includes a Fuzzy Object-Relational Database Management System (FORDBMS) to store images and its measures and to perform flexible retrieval of the images based on its spine measures. All functionality of the system is available to the specialist through a client application developed in Java or through a content which is dynamically generated and served by an application server.

2. Fuzzification of Discrete Attributes from Financial Data in Fuzzy Classification Trees

Keeley Crockett, Zuhair Bandar, James O'Shea

Fuzzy Decision Trees have been successfully applied to both classification and regression problems by allowing gradual transitions to exist between attribute values. Methodologies for fuzzification in fuzzy trees currently create such gradual transitions for continuous attributes. This is achieved by automatically creating fuzzy regions around tree nodes using an optimization algorithm or by using the knowledge of a human expert to create a series of fuzzy sets which are representative of the attributes domain. A problem occurs when trying to construct a fuzzy tree from real world data which comprises of only discrete or a mixture of discrete and continuous attributes. Discrete attribute values have no proximity to other values in the decision space, as there is no continuum between values. Consequently, within a fuzzy tree they are interpreted as crisp sets and contribute little towards the final outcome. This paper proposes a new approach for the fuzzification of discrete attributes in fuzzy decision trees. The approach ranks discrete values on the basis of their effect on the outcome rate and assigns a possibility of being a specific outcome. Experiments carried out on two real world financial datasets which contain a significant proportion of discrete attributes show improved classification accuracy compared with a crisp interpretation of such attributes within fuzzy trees.

3. On Quality Assessment of Corneal Endothelium and Its Possibility to Be Used for Surgical Corneal Transplantation

Francesc Tinena, Pilar Sobrevilla, Eduard Montseny

Transplantation of corneal tissue is a usual practice in hospitals. The analysis of microscopy images of donor corneal endothelium is routinely carried out at eye banks for the clinical assessment of cornea quality and suitability for transplantation. One of the main clinical parameters expressing the health of a cornea, and assessing their suitability as a human graft, is the cell density of its endothelium. Endothelium cell density is conventionally estimated by a long, tedious and error-prone manual counting procedure, carried out by experts who, according to a protocol, observe specimen images through an optical microscope. Besides a great subjectivity, this manual process causes a great disparity in the results derived from the protocol considered. Another additional and very important drawback is that images are often blurred and noisy, what makes very difficult the correct recognition of the cells. Taking into account aforementioned problems, this paper introduces a computer intelligence-based system for automatic segmentation of corneal endothelium images that in addition to facilitating technicians work of will reduce the disparity of results.

4. A Fuzzy Decision Tree Based Approach to Characterize Medical Data

Christophe Marsala

In this paper, two medical experiments are presented where the use of a fuzzy machine learning tool brought out a better understanding of the patients involved in the study. The use of fuzzy set theory to provide fuzzy labels and the construction of fuzzy decision trees to generate fuzzy rule bases enhance greatly the understandability and enable the Medical scientists to have a better understanding of the correlations between the description of the patients and their medical class. The results obtained in these two experiments highlight the usefulness of fuzzy data mining approach to handle real world data and to benefit Society.

5. Handling Fuzzy Gaps in Sequential Patterns: Application to Health

Sandra Bringay, Anne Laurent, Beatrice Orsetti, Paola Salle, Maelonne Teisseire

Dealing with digital data for mining novel knowledge is a non trivial task that has received much attention in the last years. However, it is still not easy to handle such data, especially when large volumes of values must be analyzed. In our work, we focus on biological data from DNA chips that biologists study in order to try and discover new gene correlations that could help understanding diseases like breast cancer. In this framework, we consider the values from the DNA microarrays, which convey the behavior of some genes, and we want to discover how these behaviors are correlated. This data are digital values that can be ordered and sorted. In previous work, sequential patterns like $h(1\ 5)(2)j$ have been discovered, meaning that genes 1 and 5 have the same expression level followed by gene 2 that has a higher expression value. However, such data are very noisy and considering close values as ordered is often false. We thus consider here fuzzy rankings based on a fuzzy partition provided by the experts. Rules can then better characterize how genes are correlated.

Mon 09:00-10:40

Room #302

P: Optimization, Decision Analysis, Decision Making, Multi-Criteria Decision Making

Chair: Sergio Alonso Burgos, University of Granada

1. Interval Random Dependent-Chance Programming and Its Application to Portfolio Selection

Wei Chen, Shaohua Tan

When employing fuzzy random variable in some real programming problems, it is not easy to specify the fuzzy values of random variables. But it is relatively easy to obtain the boundaries of the values of random variables. Hence, it is a good idea for people to determine the values of random variables as intervals. In this paper, we introduce the framework of interval random variable and interval random dependent-chance programming model. To pay attentions to both randomness and incompleteness of financial environment, we build the portfolio selection model by quantifying the stock return as interval random variable under this framework. Some computational results are discussed that demonstrate the potentially significant economic benefits of investing in portfolios computed using classical models and the model introduced here. The benefits are achieved at relatively high performance and low cost.

2. Measuring the Aggregative Risk Degree of Taiwanese Private University by Consistent Fuzzy Preference Relations

Tsung-Han Chang, Shu-Chen Hsu

When managing a university, the principal or administrators always encounter internal and external risk items or difficulties which they know even they don't know. This study therefore proposes an analytic hierarchy model to help the private university in Taiwan understand the critical risk factors influence the school management, and an aggregative risk degree is indicated. The importance weights of risk factors and occurrence ratings of two possible outcomes (risk and none-risk) are determined by using consistent fuzzy preference relations. By multiplying the importance weights of risk factors and occurrence ratings of possible outcomes, the aggregative risk degree of a private university is determined. University A is used to demonstrate the measuring procedures of this proposed approach. The results show that the five most important risk factors in managing the private university in Taiwan are: leadership and organization structure risk, development and plan risk, financial risk, environment and equipment risk, teaching and curriculum risk.

3. Improved Catfish Particle Swarm Optimization with Fuzzy Adaptation

Li-Yeh Chuang, Sheng-Wei Tsai, Cheng-Hong Yang

Catfish particle swarm optimization (CatfishPSO) algorithm is a novel swarm intelligence optimization, which inspired by the behavior between sardines and catfish, i.e. the so-called catfish effect is applied to improve the performance of particle swarm optimization (PSO). In this paper, we propose an improved CatfishPSO with fuzzy adaptive (F-CatfishPSO), which a fuzzy system is implemented to dynamically adapt the inertia weight of the CatfishPSO. In the conducted experiments, we adapt the inertia weight to strengthen the solution quality of PSO and CatfishPSO via fuzzy system. Six benchmark functions with unimodal and multimodal different trait are selected as the test functions. The experimental results indicate that the performance of the F-CatfishPSO is better than methods from the literature by statistical analysis.

4. A Fuzzy Group Decision Making Model for Large Groups of Individuals

Sergio Alonso, Ignacio J. Perez, Francisco J. Cabrerizo, Enrique Herrera-Viedma

Group Decision Making (GDM) refers to the selection of an alternative from a set of feasible alternatives that better satisfies some criteria according to a group of individuals (experts). There exist several different models to simulate GDM processes, but many of those models do not usually take into account some dynamical aspects of real decision processes. For example, those models normally do not allow the experts set to change during the process (adding or removing experts), the alternatives to change (incorporating or discarding alternatives) or even to change the criteria. In this work we present a new model which allows to undertake GDM situations in which a large number of individuals (for example an on-line community) has to choose among different alternatives. To be able to obtain a good solution of consensus, the group of experts will be firstly simplified into a smaller group (using a simple clustering technique and a kind of trust network) which can then discuss about best solution to be selected.

5. Enhancement of TOPSIS Using Compound Linguistic Ordinal Scale and Cognitive Pairwise Comparison

Kevin Kam Fung Yuen

TOPSIS is one of the popular multi-criteria decision making models. However, the determinations of the parametric settings of the rating scale and the weights for the decision matrix are still uncertain in TOPSIS. This research proposes the Compound

Linguistic Ordinal Scale (CLOS) as the rating scale for the subject measure, and the Cognitive Pairwise Comparison (CPC) for determining the weight. The usability and applicability of the enhanced TOPSIS are illustrated in a case of the robot selection problem.

Mon 09:00-10:40

Room #303

SS21: Atanassov's Intuitionistic Fuzzy Sets: Recent Advances

Chair: Vicenc Torra, IIIA-CSIC

1. On Hesitant Fuzzy Sets and Decision

Vicenc Torra, Yasuo Narukawa

Intuitionistic Fuzzy Sets (IFS) are a generalization of fuzzy sets where the membership is an interval. That is, membership, instead of being a single value, is an interval. A large number of operations have been defined for this type of fuzzy sets, and several applications have been developed in the last years. In this paper we describe hesitant fuzzy sets. They are another generalization of fuzzy sets. Although similar in intention to IFS, some basic differences on their interpretation and on their operators exist. In this paper we review their definition, the main results and we present an extension principle, which permits to generalize existing operations on fuzzy sets to this new type of fuzzy sets. We also discuss their use in decision making.

2. The ELECTRE Multicriteria Analysis Approach Based on Intuitionistic Fuzzy Sets

Ming-Che Wu, Ting-Yu Chen

Over the last decades, intuitionistic fuzzy sets have been applied to many different fields, such as logic programming, medical diagnosis, decision making, etc. The purpose of this paper is to develop a new methodology for solving multi-attribute decision-making problems with intuitionistic fuzzy information by using the concept of ELECTRE method. ELECTRE uses the concept of an outranking relationship. We also use TOPSIS method to rank all of the alternatives and to determine the best alternative. Finally, an illustrative example is given to verify the developed approach and to demonstrate its practicality and effectiveness.

3. A Comparison of Some Intuitionistic Fuzzy Similarity Measures Applied to Handwritten Arabic Sentences Recognition

Leila Baccour, Adel M. Alimi

In this paper we present a comparison of intuitionistic fuzzy similarity measures applied to Arabic sentences recognition using an extract of the IFN/ENIT data set. Such comparison shows the importance of similarity measures choice for any field of research needing to match between patterns.

4. The Differential Calculus on IF Sets

Alzbeta Michalikova

In this paper the set F of all IF sets is embedded to an $_$ -group. By using the previous researches on the calculus of IF sets the theory of derivative is construct and the properties of derivative on the $_$ -group are studied.

5. Operations on Intuitionistic Fuzzy Graphs

Rangasamy Parvathi, M.G.Karunambigai, Krassimir Todorov Atanassov

Intuitionistic fuzzy sets are generalization of fuzzy sets. In this paper, the definition of complement of an Intuitionistic Fuzzy Graph (IFG) is given and some properties of self-complementary IFGs are studied; The operations on IFGs such as Union, Join, Cartesian Product and Composition are defined and some of their properties are also analyzed.

Monday, August 24, 11:00-12:40

Mon 11:00-12:40

Samda A

K: Fuzzy Information Processing - Information Extraction and Retrieval, Fusion, Text Mining

Chair: Hichem Frigui, University of Louisville

1. On Fuzzy Queries with Contextual Predicates

Patrick Bosc, Olivier Pivert, Amine Mokhtari

This paper deals with the interpretation and processing of database queries with preference conditions of the form "attribute is low (resp. medium, high)" in the situation where the user is not aware of the actual content of the database but still wants to retrieve the best possible answers (relatively to that content). An approach to the definition of the terms "low", "medium" and "high" in a contextual and relative manner is introduced. A processing algorithm aimed at efficiently retrieving the top-k answers to such a query is also outlined.

2. Context Extraction for Local Fusion Using Fuzzy Clustering and Feature Discrimination

Ahmed Chamseddine Ben Abdallah, Hichem Frigui, Paul Gader

We present a novel method for fusing different classifiers outputs. Our approach, called Context Extraction for Local Fusion with Feature Discrimination (CELF-FD), is a local approach that adapts the fusion method to different regions of the feature space. It is based on a novel objective function that combines context identification and multi-algorithm fusion criteria into a joint objective function. This objective function is defined and optimized to produce contexts as compact clusters in subspaces of the high-dimensional feature space via unsupervised clustering and feature discrimination. Optimization of the objective function also provide optimal fusion parameters for each context. Our initial experiments have indicated that the proposed fusion approach outperforms all individual classifiers and the global fusion method.

3. Modelling Field Dependencies on Structured Documents with Fuzzy Logic

Joaquín Perez-Iglesias, Víctor Fresno, Jose R. Perez-Aguera

A new scenario has raised into the IR field with the increase in the use of mark-up languages. This new scenario has been defined as structured IR and is focused on documents with structure. The classic IR models have been extended in order to be applied to this document type. Generally these adaptations have been carried out by weighting the fields that form the document structure, and making the assumption of statistics independence between fields. This assumption force to an estimation of the different weights applied to each field. In this paper a new ranking function for structured IR is proposed. This new function is based on Fuzzy Logic, and its main aim is to model through heuristics and expert knowledge the relations between fields within a document.

4. Pagerank Algorithm Improvement by Page Relevance Measurement

Chia-Chen Yen, Jih-Shih Hsu

Pagerank algorithm evaluates the importance of web pages by the link analysis, and there are many techniques to improve the traditional pagerank algorithm to prevent from the biases of link spamming in recent years. The modified algorithms should concern not only the correctness, but also the efficiency should be considered. This paper proposes an associated pagerank algorithm for search engines to feedback quality results by scoring the relevance between web documents. The modified Pagerank algorithm increases the degree of relevance than the original one, and decreases the query time efforts of topicsensitive pagerank.

5. A Movie Rating Prediction System of User Propensity Analysis Based on Collaborative Filtering and Fuzzy System

Taeryong Jeon, Jaewoo Cho, Soojin Lee, Gyeongdong Baek, Sungshin Kim

Recently, an intelligent system is developed for proper service which isn't passive system. Recent system can answer and recommend to user before user's request. This intelligent system is used for personalized recommendation system and representative techniques are content-based and collaborative filtering. In this study, we propose a prediction system which is based on the techniques of recommendation system using a collaborative filtering and fuzzy system to solve the collaborative filtering problems. In order to verify the prediction system, we used the user's rating data about movies. We predicted the user's rating using this data. The accuracy of this prediction system is determined by computing the predicted RMSE (Root mean square error) of the system against the actual rating about the each movie. And predicted RMSE is compared with the existing system. Thus, this prediction system can be applied to base technology of recommendation system and also recommendation of multimedia such as music and books.

Mon 11:00-12:20

Samda B

SS08B: Human Symbiotic System II

Chair: Daisuke Katagami, Tokyo Institute of Technology

1. Automatic Generation Method of Twelve Tone Row for Musical Composition Used Genetic Algorithm

Yoichiro Maeda, Yusuke Kajihara

Recently, researches on interactive art regarding computer graphics and computer music are actively performed. In the computer music, genetic algorithm (GA) and interactive genetic algorithm (IGA) are usually used for the sound generation process, but it is difficult to just handle these methods directly for the music composition. In this research we propose a music composition system based on Twelve-tone Technique that is a music composition technique of the contemporary music. Because it is a technique to compose the music step by step, the Twelve-tone Technique has an advantage that it is suitable for the composition of computer music. Making of twelve-tone rows which is the first process of the Twelve-tone Technique is an important process to determine the subject and atmosphere of music. However, it is difficult for a human without the knowledge of music to evaluate twelve-tone rows. In this paper, we design the fitness function based on the relation between the consonance interval and dissonant interval that are a part of general musical theory and perform the automatic generation of twelve-tone row by searching the consonance tone row with GA. We confirmed the effectiveness of this system by constructing the simulator that generates twelve-tone rows and executing the comparison questionnaire of twelve-tone rows made by the simulator and humans.

2. Human Instruction Recognition and Self Behavior Acquisition Based on State Value

Yasutake Takahashi, Yoshihiro Tamura, Minoru Asada

A robot working with humans or other robots is supposed to be adaptive to changes in the environment. Reinforcement learning has been studied well for motor skill learning, robot behavior acquisition and adaptation of the behavior to the environmental changes. However, it is not practical that the robot learns and adapts its behavior only through trial and error by itself from scratch because huge exploration is needed. Fortunately, it is nothing unusual to have predecessors in the environment and it is reasonable to learn something from the observation of predecessors' behavior. In order to learn various behavior from the observation, the robot must segment the behavior based on reasonable criterion for itself and feedback the data to behavior learning by itself. This paper presents a case study for a robot to understand unfamiliar behavior shown by a human instructor through the collaboration between behavior acquisition and recognition of observed behavior, where the state value has an important role not simply for behavior acquisition (reinforcement learning) but also for behavior recognition (observation). The validity of the proposed method is shown by applying it to a dynamic environment where one robot and one human play soccer

3. Computer-Assisted Desinging System for Fixation Plate

Kouki Nagamune, Yasuro Kokubo, Hisatoshi Baba

Fixation plate for fracture is one of the most important devices for fractures of the human bone. In general, the fixed plate for medial care is selected from lineup of the maker. Therefore, the surgery is adapted to each plate due to limitation of the lineup. However, the surgery should be naturally adapted to each patient. To overcome this problem, this paper set the goal to develop a system which can proposed appropriate fixed plate model according to patient information, and make a prototype of the selected fixed plate with low cost. After evaluation of the prototype, the prototype is remade for practical use by the maker which has a license for medical device. By doing so, the longtime purpose of this study is to realize patient-oriented medicine (tailor-made medicine).

4. Development of Social Adaptive Agents in Simulation Game of Cross-Cultural Experience

Hidefumi Ohmura, Daisuke Katagami, Katsumi Nitta

Recently, researches of Human-Agent interaction (HAI) are popular toward autonomous agents to act and cope in various human societies. If agents adapt to humans' society, they have social skills. In this paper, we introduce how developing a social adaptive agent. There are many rules in societies. Therefore, social agents should have a social skill which is obtaining social rules. We develop agents adapting group as social adaptive agents. We improve some functions from a simulation game: Online BARNGA from BARNGA to observe humans' behavior. We observe humans' behavior in Online BARNGA. As a result, we find that humans have transitions of three inner states with "notice" and "behavior" to get implicit rules, and rules fall into two categories: a byelaw and an ethic. In Online BARNGA, a byelaw is a rule of card game, an ethic is a strategy. Based on the above results, we develop agents with transitions of three inner state with "notice" and "behavior" and two type learning modules. Furthermore, we analyze agents' behavior in Online BARNGA, and compare humans' that. As a result, we confirm that agent adapt socially as if it were human.

CD: Fuzzy Systems and Internet Applications / Kansei, Human-Machine Interface, Brain-Machine Interface

Chair: Simone Ludwig, University of Saskatchewan

1. Study on Analysis of Questionnaire Data Based on Interactive Clustering

Yosuke Watanabe, Tomohiro Yoshikawa, Takeshi Furuhashi

Recently, several kinds of values have been employed with respect to the diversification of individuality in the market. Some of these values are currently supported by only a few people, who are referred to as a “minority group”. However, there is the possibility that such groups will grow into majority groups with changes in historical background or people’s sensitivity. It is both important and effective for market analysis to determine these minority groups at an early stage. Companies often employ questionnaires to develop marketing strategies or design new products, which offer a chance to determine these minority groups. With conventional methods, respondents to a questionnaire are classified based on such attributes as gender and age, and then the classified groups are analyzed or compared. Although conventional analysis is effective for grasping the overall tendency of the evaluation data, it is difficult to determine minority groups because of the diversity of individuality. On the other hand, we have proposed clustering methods based on the tendencies of the answers to the questionnaire. This paper proposes a new method for visualizing the evaluated data based on both the obtained values and their correlation with cluster respondents interactively in the visible space. This paper applies the proposed method to web questionnaire data and shows that an analysis of the results effectively assists us to determine minority groups.

2. Fuzzy-Spray: Efficient Routing in Delay Tolerant Ad-hoc Network Based on Fuzzy Decision Mechanism

Akadet Mathurapoj, Chotipat Pornavalai, Goutam Chakraborty

Delay Tolerant Network (DTN) is a sparse and intermittently connected mobile wireless network where reliable communication and end-to-end connectivity cannot be assured. In DTN, a node delivers messages to the destination using store and forward scheme. Messages are copied and transferred to multiple relay-nodes in order to increase the opportunity for that message to reach the intended destination. Contact is the time duration for which two or more mobile nodes encounter each other within their radio transmission ranges, and are able to transfer messages. Due to arbitrary node movement, contact time will be varied, and is unlikely to be predictable. In this paper, we propose a fuzzy decision mechanism we called “fuzzy-spray”, to improve the routing and packet transfer efficiency in DTN environment. Fuzzy-spray can reduce overall latency in DTN by intelligently selecting appropriate messages to send to the relay-node during its next contact time. It uses fuzzy logic to prioritize messages that are stored in the buffer, based only on local parameters from each message, namely forward transmission count and message size. There is no need to know a priori information about network such as node mobility model, or node-distribution across the deployed area. The simulation results show that fuzzy-spray has the best performance in terms of overall speed of delivery, and lowest average message delay compared with other existing algorithms.

3. Nonnative Speech Recognition Based on Bilingual Model Modification

Qingqing ZHANG, Jielin PAN, Shui-duen CHAN, Yonghong YAN

Delay Tolerant Network (DTN) is a sparse and intermittently connected mobile wireless network where reliable communication and end-to-end connectivity cannot be assured. In DTN, a node delivers messages to the destination using store and forward scheme. Messages are copied and transferred to multiple relay-nodes in order to increase the opportunity for that message to reach the intended destination. Contact is the time duration for which two or more mobile nodes encounter each other within their radio transmission ranges, and are able to transfer messages. Due to arbitrary node movement, contact time will be varied, and is unlikely to be predictable. In this paper, we propose a fuzzy decision mechanism we called “fuzzy-spray”, to improve the routing and packet transfer efficiency in DTN environment. Fuzzy-spray can reduce overall latency in DTN by intelligently selecting appropriate messages to send to the relay-node during its next contact time. It uses fuzzy logic to prioritize messages that are stored in the buffer, based only on local parameters from each message, namely forward transmission count and message size. There is no need to know a priori information about network such as node mobility model, or node-distribution across the deployed area. The simulation results show that fuzzy-spray has the best performance in terms of overall speed of delivery, and lowest average message delay compared with other existing algorithms.

4. Fuzzy Approach for the Evaluation of Trust and Reputation of Services

Simone A. Ludwig, Venkat Pulimi, Andriy Hnativ

A service-oriented environment has special characteristics that distinguishes it from other computing environments: (i) the environment is dynamic; (ii) the number of service providers is unbounded; (iii) services are owned by various stakeholders with different aims and objectives; (iv) there is no central authority that can control all the service providers and consumers; (v) service providers and consumers are self-interested. Given these special characteristics, the evaluation of trust and reputation is very important in such an open, dynamic and distributed environment. Therefore, a fuzzy-based trust and reputation approach using three trust sources was developed. Simulating the real world in which deception happens, an evaluation is performed showing the usefulness and robustness of the fuzzy approach by a comparison with a weighted approach.

J01: Fuzzy Data Analysis - Clustering and Classifiers, Pattern Recognition, Bio-Informatics I

Chair: Miin-Shen Yang, Chung Yuan Christian University

1. Improving the Performance of Fuzzy Clustering Algorithms through Outlier Identification

Prabhjot Kaur, Anjana Gosain

Major clustering algorithms consider all data objects as good objects while dividing data-set into clusters, except some, that consider noise/outliers to some extent. As a result those algorithms are not capable to produce efficient clusters as there is some effect of noise on location of cluster centroids. The task of outlier identification is to find small groups of data objects that are exceptional when compared with rest large amount of data. They are not required or acceptable while dividing a data-set into clusters, as clusters refer to the similar group of data and these outliers don’t belong to any of the similar group. Yet they can be important in other applications. Through this paper we are trying to

prove that efficient clusters can only be produced by identifying outliers and separating them from the data-set into one cluster before applying any clustering algorithm. In this paper a density based algorithm for outlier identification is proposed. Before applying any of the clustering algorithms; proposed algorithm is applied on the data-set to identify outliers and separate them from original data-set. Proposed algorithm is applied on fuzzy clustering algorithms (FCM, PCM and PFCM). Numerical examples and tests show that fuzzy algorithms after applying proposed algorithm gives better results when compared with the performance of fuzzy clustering algorithms without applying proposed technique.

2. A Robust Segmentation Method for the AFCM-MRF Model in Noisy Image

Simon Chi Fung Tam, Chung Chu Leung, Wai Kin Tsui

A robust image segmentation algorithm based on Alternative Fuzzy C-mean clustering algorithm (AFCM) with Markov Random Field (MRF) is presented in this paper. Due to disregard of spatial constraint information, the results using Fuzzy C-Mean (FCM) and AFCM are corrupted by noise. In order to improve the robustness of noise, the spatial constraint information of an image is represented by MRF with the Gibbs function which is based on the AFCM. Comparison to the FCM, AFCM, FCM-MRF model, and the proposed algorithm has been demonstrated by the simulation and real images. Results show that AFCM-MRF model achieves better performance than other methods.

3. Block Fuzzy K-modes Clustering Algorithm

Miin-Shen Yang, Chih-Ying Lin

Most clustering algorithms, such as k-means and fuzzy c-means (FCM), are used to cluster a set of objects based on a function of dissimilarities between objects. However, clustering on attribute variables of objects may give more cluster information. Thus, to have a clustering algorithm that can be designated to construct simultaneously an optimal partition of objects and also attribute variables into homogeneous block is important. This kind of clustering was called block clustering (see Duffy and Quiroz, 1991). Recently, Govaert and Nadif (2003) proposed a block classification EM (block CEM) algorithm and then proposed block fuzzy c-methods (block FCM) in 2006. In this paper, based on Huang and Ng's (1999) fuzzy k-modes (FKM) method, we propose a block FKM clustering algorithm. Several examples are used to make the comparisons between block FCM and the proposed block FKM.

4. On Fuzzy Cluster Validity Indices for the Objects of Mixed Features

Mahnhoon Lee

Clustering is an unsupervised learning method that partitions the objects in a given object set into clusters in which objects are similar. Iterative clustering algorithms have been widely applied in a variety of key areas. Those algorithms find clusters of a fixed given number. The number of clusters must be decided before the algorithms run. The number of clusters is usually obtained by using cluster validity index algorithms. There have been many studies for cluster validity index, especially for fuzzy clustering. However, almost all of the studies focus only on the clustering of the objects of numerical features, even though most of the real objects include ordinal and categorical features as well. In this paper, we identify which fuzzy cluster validity indices can be applied for the objects of mixed features. We experiment with these selected indices and one new index on various synthetic object sets and real object sets, in which objects have mixed features. We present a few indices out of many indices as the experiment results, which work better for the most of experiment cases.

5. Clustering Large Data Sets Based on Data Compression Technique and Weighted Quality Measures

Minyar Sassi, Amel Grissa

Various algorithms have been proposed for clustering large data sets for the hard and fuzzy case, not as much work has been done for automatic clustering approaches in which the number of clusters is unknown for the user. These approaches need some measures, called validity function to evaluate the clustering result and to give to the user the optimal number of clusters. In order to obtain this number, three conditions are necessary: (1) a good compression technique for data reduction with limited memory allocated, (b) good measures for the evaluation of the goodness of clusters for varying number of clusters, and (c) a good cluster algorithm that can automatically produce the number of clusters and takes into account the used compression technique. In this paper, we propose new clustering approaches which deals with new compression technique based on quality measures.

Monday, August 24, 14:00-15:00

Mon 14:00-15:00

Samda A

O: Rough Sets, Grey Systems

Chair: Qiang Shen, Aberystwyth University

1. Interval-Valued Fuzzy-Rough Feature Selection in Datasets with Missing Values

Richard Jensen, Qiang Shen

One of the many successful applications of rough set theory has been to the area of feature selection. The rough set principle of using only the supplied data and no other information has many benefits, where most other methods require supplementary knowledge. Fuzzy-rough set theory has recently been proposed as an extension of this, in order to better handle the uncertainty present in real data. However, following this approach, there has been no investigation (theoretical or otherwise) into how to deal with missing values effectively, another problem encountered when using real world data. This paper proposes an extension of the fuzzy-rough feature selection methodology, based on interval-valued fuzzy sets, as a means to counter this problem via the representation of missing values in an intuitive way.

2. Generalized Upper and Lower Approximations in Set-Valued Information Systems

Qiong Liu, Zheng Pei, Liangzhong Yi, Jilin Yang

Under the framework of set-valued information system, based on application of quantifiers and OWA operator, the definition on upper and lower approximations is generalized to the common form associated with the parameter $\lambda \in [0, 1]$. The advantage of such generalization is that it could be flexibly used by restriction of additional linguistic quantifier, and is favorable to the further discussion on knowledge reduction and rules extraction in such model.

3. Attributes Reduction Based on Important Degree of Attributes in Incomplete Information System

Jilin Yang, Dongmei Wei, Qiong Liu, Yufeng Hai

In incomplete information systems, based on similarity relation, a method of attributes reduction is discussed in this paper. Relative important degree of attributes is defined. Important degree of attributes is obtained by using the OWA operator to aggregate relative important degree of attributes. Due to finding attributes

reduction in accordance with the reorder of attributes which identified by important degree of attributes, the advantage of our method is to reduce the search space of attribute reduction and avoid blindness. Finally, the specific example shows our method is effective.

Mon 14:00-15:00

Samda B

B01: Hybrid Systems of Computational Intelligence Techniques I

Chair: Buhm Lee, Chonnam National University

1. A Novel Dual Neuro-Fuzzy System Approach for Large-Scale Knowledge Consolidation

Richard J. Oentaryo, Michel Pasquier

Fuzzy and neuro-fuzzy systems are increasingly among the key technologies employed in many real-world applications. However, traditional neuro-fuzzy systems are generally still lacking the scalability traits required in the face of largescale data and the capability to incorporate new information without catastrophically disrupting the existing knowledge base. This work aims at addressing these issues by proposing a novel neuro-fuzzy system termed dual consolidation network (DCN) that models the complementary interactions between hippocampus and neocortex regions in the human brain to consolidate and exploit knowledge effectively. This approach allows the DCN to handle data sets with high-dimensional features and/or a very large number of samples efficiently, as well as to minimize interference when acquiring new information. Preliminary experiments employing DCN on large-scale biomedical data have shown encouraging results.

2. An Artificial Fish Swarm Algorithm for Steiner Tree Problem

Xuan Ma, Qing Liu

This paper presents an artificial fish swarm algorithm for solving Steiner tree problem. A novel encoding method of avoiding the loop generation for artificial fish representation of tree-structure and the operator of behaviors of artificial fish for searching optimal solution of Steiner tree problem are proposed. Simulation experiments have been carried out on different network topologies for networks consisting of 26-100 nodes. The results indicate that the proposed algorithm can find optimal Steiner tree with good success rate and also can find closer sub-optimal Steiner tree with high certainty for all the tested networks.

3. Development of Ideal Analytic Hierarchy Process - Application of Power Quality

Buhm Lee, Kyoung Min Kim

This paper presents a Ideal Analytic Hierarchy Process which can provide an overall assessment of system performance. To obtain a unified index, this paper presents the scaled performance of each item, and propose the use of the AHP model with three states: [Ideal] - [Actual] - [Possible] states. By calculating eigenvalues of states, the unified index can be obtained. The proposed method is applied to assess power quality index which is especially useful for planning. The proposed method has been applied to a relatively large actual system, and the usefulness of this method has been verified.

Mon 14:00-15:00

Room #302

SS09: Prospects for the Finland-Korea Cooperation in the Human Sciences and Technology

Chair: Patrik Eklund, Umea University

1. Some Fundamental Problems of Opinion Modeling with Implications to Committee Composition and Social Choice

Hannu Nurmi

The standard choice theory's assumption of transitive preference relation is discussed. It is argued that in multicriterion contexts it may be too demanding. The spatial choice theory's assumption that individuals prefer the alternative closest to their optimum point is also called into question in multi-criterion settings. Fuzzy preference relations may suggest avenues to overcome these and other problems. Especially in setting up multi-member representative bodies the fuzzy preference models may turn out useful once the problems of opinion elicitation are solved.

2. Solving Leontief Input-Output Model with Fuzzy Entries

Jorma Mattila, Pasi Luukka

A general fuzzy linear system is investigated using fuzzy numbers and Gauss-Seidel iteration formula. We have used our fuzzy linear system to solve Leontief input-output model with fuzzy entries. When solving Leontief input-output model we are usually making the assumption that we know entirely the consumption matrix from industrial entries and we are certain about the final demand. These assumptions however depend heavily on estimates and information received from the industry and hence in these estimates, uncertainty plays a crucial role. To address this type of uncertainty fuzzy methods are needed to model this and in this article we are giving a procedure to solve this problem. Numerical example is given to illustrate the procedure.

3. Early Diagnosis of Cognitive Disorder Based on Ground Categories for Decision Support Structures

Patrik Eklund

In this paper we discuss computerized assessments and guidelines for decision making, with accuracy and formalism being required for avoiding ambiguities and imprecision. Note the difference between imprecise or vague information, and being formal and accurate in reasoning with vague values. We may even have a logic allowing for vague reasoning, where the underlying logic is formal and precise, i.e. must always have a clear syntax and semantics together with a accurately described inference mechanism revealing the strength and weakness, and indeed the nature and capacities of that particular underlying logic. Our examples will be drawn from elderly care, in particular from assessments in old age psychiatry and early diagnosis of cognitive disorder.

Mon 14:00-15:00

Room #303

SS11: Brain and Perception

Chair: Isao Hayashi, Kansai University

1. Application of Reliability-Based Automatic Repeat Request to Multi-Class Classification for Brain-Computer Interfaces

Hiromu Takahashi, Tomohiro Yoshikawa, Takeshi Furuhashi

A Brain-Computer Interface (BCI) is a system which could enable patients like those with Amyotrophic Lateral Sclerosis to control some equipment and to communicate with other people, and has been anticipated to be achieved. One of the problems in BCI

research is a trade-off between transmission speed and accuracy. In the field of data transmission, on the other hand, Reliability-Based Hybrid Automatic Repeat reQuest (RB-HARQ), one of the error control methods, has been developed to achieve both of the performances. The authors, therefore, have considered BCIs as communications between users and computers, and applied Reliability-Based ARQ, customized RB-HARQ, to BCIs. It has been shown that the proposed method is superior to other error control methods in two-class classification. In this paper, the proposed method is extended to deal with multi-class classification of EEG data, and is shown to be effective in multi-class problems.

2. Design of Vehicle Speed Controller Based on Immune Feedback

Jinying Huang, Bo Ma, Haojing Wang

In term of the nonlinear complex motion process of speed tracking control in automatic driving which is interference by some uncertain factors such as environment and whose object model changing real-timely, it is impossible to reach the tracking target relied on the traditional control strategy to regulating speed. Combined with self-adaptive control theory, a fuzzy self-adaptive controller used in the speed tracking control in automatic driving is designed. This controller is a combinational controller of fuzzy control and PID control, and then it improves the fuzzy PID controller using the feedback mechanism of immunology system. Simulation experiment shows that the immunology PID fuzzy controller has the higher precision for the vehicle speed control.

3. Acquisition of Embodied Knowledge on Sport Skill Using TAM Network

Isao Hayashi, Toshiyuki Maeda, Masanori Fujii, Shuoyu Wang, Tokio Tasaka

In this paper, we discuss sport technique evaluation using motion analysis model by neural networks and data mining methods. For students of university, we recorded the continuous forehand stroke of the table tennis in the video frames, and analyzed the trajectory pattern of nine marking points attached at subject's body with a coach's technique evaluation and the motion analysis model. As a result, we obtained some technique rules classified member of table tennis club, middle level player and beginner as fuzzy rules, and also estimated the movement of the marking points to improve in table tennis technique.

2. Vendor Selection Using Fuzzy C Mean Algorithm and Analytic Hierarchy Process

M. S. Q. Zulkar Nine, Md. A. K. Khan, Mahedi Hasanul Hoque, Mohammad Ameer Ali, Nikhil C. Sil, Golam Sorwar

Vendor selection is a strategic issue in supply chain management for any organization to identify the right supplier. Such selection in most cases is based on the analysis of some specific criteria. Most of the researches so far concentrate on multi-criteria decisionmaking analysis. Though many approaches have been proposed, analytic hierarchy process (AHP) is the most well known as it can deal with a very complex criteria structure. In AHP, the selected criteria are ranked and organized in a hierarchical order from generic to specific to formulate the problem. Though this order of ranking is acceptably logical, it incurs a huge computational complexity when a large number of alternatives are considered as the selection criteria. Moreover, the AHP may generate wrong selection due to computational error. To address these limitations, a novel model namely vendor selection using fuzzy c-means algorithm and analytic hierarchy process (VFA) is presented in this paper by integrating the fuzzy c-means clustering (FCM) algorithm with analytic hierarchy process (AHP). The outcome of the proposed VFA algorithm is compared with the basic AHP algorithm and VFA outperforms the basic AHP and reduces the computational complexity of AHP by a factor of 7.

3. Unidimensional Fuzzy Pain Intensity Scale

Ernesto Araujo, Susana Abe Miyahira

A fuzzy pain scale for representing subjectivity and emotionality related to the fifth vital sign of medical condition is proposed in this paper. The classic intensity rating scales are inherently crisp sets. The medical and healthcare community does not realize that since the concept of fuzzy sets does not range all fields of knowledge yet. This paper extends the accepted international classic pain intensity rating scales to fuzzy set theory obtaining the fuzzy visual analog scale (FVAS), fuzzy numerical rating scale (FNRS), fuzzy qualitative pain scale (FQPS), and fuzzy face pain scale (FFPS). These fuzzy pain intensity scales take into account positive characteristics concerning classic pain intensity scales meanwhile represent the inherent imprecision, uncertainty and vagueness presented in the pain report and assessment. The proposed approach demonstrates how fuzzy set theory may push forwards the boundaries of medicine and healthcare by proposing a novel approach in order to improve the human quality level.

Mon 14:00-15:00

Room #401

F: Industrial, Financial, and Medical Applications

Chair: Golam Sorwar, Southern Cross University

1. Type-1 OWA Operator Based Non-Stationary Fuzzy Decision Support Systems for Breast Cancer Treatments

Shang-Ming Zhou, Jonathan Garibaldi, Francisco Chiclana, Robert John, Xiao-Ying Wang

In this paper, a novel type-1 OWA based non-stationary fuzzy system is proposed, in which the type-1 OWA operator is used in the fuzzy inference process to aggregate the non-stationary fuzzy outputs. The advantage of non-stationary fuzzy sets lies in their ability to model expert's variations in automated decision support systems. The proposed scheme offers an opportunity to combine different uncertain objects with uncertain weights into an overall decision in the fuzzy inference process. The agreement achieved between the pro-posed fuzzy system and clinical expert decision in selecting optimal treatment plans is used to evaluate the performance of the method. The experimental results on post-operative breast cancer treatments have demonstrated that the proposed fuzzy system can effectively diagnose breast cancer treatment in decision supports.

Author Index

A

Abbaraju, Praveen	SS18B-3
Abdallah, Ahmed Chamseddine Ben	K-2
Abdelkader, Tamer	SS27-2
Abuelenin, Sherif M.	R-1
Acampora, Giovanni	SS03-5
Adamy, Juergen	I01-4
Aizawa, Naohide	SS06-5
Ajorlou, A.	Poster-24
Ajorlou, S.	Poster-24
Akiguchi, Chuzo	SS23-2
Alcala, Rafael	SS29B-3
Alexander, Gregory L.	SS08A-3
Ali, Mohammad Ameer	F-2
Alimi, Adel M.	SS21-3 Poster-42
AlModarresi, Seyed Mohammad Taghi	Poster-29
Alonso, Javier	SS27-1
Alonso, Sergio	P-4
Ando, Kumiko	SS07-5
Ando, Masaki	SS24-1
Ando, Yoshinobu	SS23-3 SS23-5
Angryk, Rafal A.	Poster-50
Antona, Ottavio M. D'	N02-7
Aoki, Shingo	SS25-5
Araabi, Babak N.	I02-5
Arai, Kenta	SS14-2
Araki, Daisuke	SS07-6
Araujo, Ernesto	F-3 I02-3
Araujo, Fernando P. A.	I02-3
Asada, Minoru	SS08A-1 SS08B-2
Asari, Kazunari	SS07-1
Asgarian, Ehsan	Poster-2
Atanassov, Krassimir Todorov	SS21-5
Aziz, Ashraf M.	Poster-7 Poster-19

B

B. Sumudu U. Mendis,	SS13-5
Baba, Hisatoshi	SS08B-3
Babaali, Rasool	Poster-28
Babalou, Alireza	SS06-1
Baccour, Leila	SS21-3
Bae, Sunha	H-6

Baek, Gyeongdong	K-5
Bafandeh, Ali Reza	H-5
Bakhshmand, Saeed Mahdizadeh	SS20-2
Baklouti, Nesrine	Poster-42
Ballagi, Aron	SS13-1
Ban, Xiaojuan	Poster-30
Banda, Juan M.	Poster-50
Bandar, Zuhair	I02-1 SS19-2
Banerjee, Sreeparna	SS20-5
Bang, Young-Keun	I01-6 Poster-32
Bardallo, Juan M.	SS29A-5
Batyrshin, Ildar	Q-1
Becceneriharoldo, Jose C.	I02-3
Belohlavek, Radim	N02-1
Benyo, Zoltan	J04-1
Bernal, Miguel	SS04A-2
Bezdek, James C.	SS10-1
Bhongmakapat, Thongchai	SS16-4
Bien, Zeungnam	H-6 J04-4
Birkin, Philip A.S.	Poster-22
Bisgambiglia, Paul-Antoine	I01-2
Blanco, Armando	SS15-6
Blazic, Saso	G01-2
Bloch, Isabelle	E01-3
Boixader, Dionis	N01-6
Boongoen, Tossapon	H-7
Bosc, Patrick	K-1 Poster-63
Bouchon-Meunier, Bernadette	L-3
Boudy, Jerome	Poster-47
Bringay, Sandra	SS19-5
Brouwer, Roelof	J03-3

C

Cabrerizo, Francisco J.	P-4
Cai, Qianfeng	I01-3
Callaghan, Victor	SS03-1
Cano, Carlos	SS15-6
Cano, Isaac	SS15-1
Cao, Jiangtao	R-3 SS06-3
Capitaine, Hoel Le	J04-2
Carlsson, Christer	N02-4
Carmona, Cristobal Jose	SS29B-1
Carpentieri, Marco	A02-3 Poster-73
Casillas, Jorge	SS29B-2

Castillo, Oscar	SS0102B-2 Poster-48 Poster-68 Poster-69	Cho, Young Im Choi, Che-Wei	Poster-72 Poster-5 Poster-9
Cha, Junmin	SS22B-6	Choi, Jaeseok	SS22B-6
Chaari, Abdessattar	Poster-75	Chonnaparamutt, Winai	SS18A-2
Chakraborty, Basabi	SS27-6	Chou, Chang-Min	Poster-36
Chakraborty, Goutam	CD-2 SS27-5	Chou, Jyh-Horng	SS18B-1
Chamorro-Martinez, Jesus	SS20-3	Chowdhury, Ananda Sankar	Poster-74
Chan, Shui-duen	CD-3	Chua, Teck Wee	J02-3
Chan, Chee Seng	Poster-16	Chuang, Chen-Chia	SS17A-4 SS17B-1
Chang, Cheng-Yuan	SS18A-4 Poster-36	Chuang, Li-Yeh	P-3 SS10-2 SS10-3 SS10-4
Chang, Chong-Ching	SS03-2		
Chang, Hsueh-Wei	SS10-4	Chun, Myung Geun	A02-2
Chang, Juifang	Poster-44	Chung, I-Ling	Poster-36
Chang, Moon Soo	Poster-76	Cka, Martin` St`Epnir`	SS16-1
Chang, Pao-Long	SS22B-2	Claveau, Vincent	Poster-63
Chang, Tsung-Han	P-2 Poster-44	Codara, Pietro	N02-7
Changping, Sun	Poster-8	Cornelis, Chris	SS15-2
Chaslot, Guillaume	SS12-3	Coupland, Simon	SS0102B-3
Chen, Chih-Yang	SS0102A-3	Crockett, Keeley	I02-1 SS19-2
Chen, Ching-Shun	Poster-41		
Chen, Chun-Hao	SS29A-4	D	
Chen, Chun-Yao	SS17A-1	Dag, Olsen Rune	Poster-13
Chen, De-Hua	J02-5	Dambrine, Michel	G01-2
Chen, Deng-Rui	SS18A-4	Das, Swagatam	Poster-74
Chen, Ming-Chang	SS18B-2	Datta, Debasish	Poster-74
Chen, Rung Ching	SS27-6	Diago, Luis A.	SS26-4
Chen, Shinn-Horng	SS18B-1	Diolata, Ryan	Poster-18
Chen, Shyh-Huei	Poster-31	Doctor, Faiyaz	SS03-1
Chen, Song-Shyong	SS17A-5	Dongming Xu,	Poster-34
Chen, Ti-Hung	Poster-11	Dorizzi, Bernadette	Poster-47
Chen, Ting-Yu	SS21-2 Poster-5 Poster-9	Duan, Ji` An	SS05-1
Chen, Wei	H-1 N01-3 P-1	Dumitrescu, Dan	J03-5
Chen, Wei-Yu	A01-2		
Chen, Ying-Jen	SS18A-3 SS18A-5	E	
Chen, Yu-Jung	SS10-2	Ebadzadeh, Mohammad Mehdi	E02-1
Cheng, Yu-Huei	SS10-4	Eklund, Patrik	SS09-3
Cheu, Eng Yeow	A01-1	El Hajjaji, Ahmed	G02-5 Poster-75
Chiclana, Francisco	F-1 SS0102B-4	El-Keib, A. A.	SS22B-6
Chien, Yi-Hsing	SS18B-2	Ellis, Ian O.	SS16-5
Chinthala, Vikas Chandra	SS18B-3	Endo, Yasunori	SS14-3 SS14-4 SS14-5
Cho, Jae Hoon	A02-2		
Cho, Jaewoo	K-5		

F		Gussner, Thomas	I01-4
Fan, Jianping	SS05-5	H	
Fang, Ping	N01-4	Ha, Jung-Woo	A02-4
Feng, Lihua	Poster-4	Hadad, AmirHossein	SS13-4
Feng, Qin	N01-5	Hadipour, Ali Reaza	SS28-6
Fenza, Giuseppe	SS12-1	Haga, Naoki	SS14-6
Fernandez, Alberto	SS29A-3	Hagiwara, Ichiro	SS26-4
Ferrein, Alexander	SS06-4	Hagiwara, Masafumi	SS24-1
Ferreira, Carlos Cesar T.	SS04B-4	Hagras, Hani	SS0102B-1
Foelling, Alexander	SS29A-2		SS03-1
Frelicot, Carl	J04-2	Hai, Yufeng	O-3
Fresno, Victor	K-3	Hamasuna, Yukihiro	SS14-4
Frigui, Hichem	K-2		SS14-5
Fu, Xin	N01-1	Hamrawi, Hussam	SS0102B-3
Fujii, Masanori	SS11-3	Han, Cheol-hun	Poster-79
Fujiyoshi, Makoto	E01-2	Han, Hugang	SS04B-3
Fukusato, Yusuke	SS23-1	Han, Seung-Soo	Poster-26
Fuller, Robert	N02-4	Han, Yongkoo	Poster-56
FungTam, Simon Chi	J01-2	Hata, Yutaka	SS07-1
Furuhashi, Takeshi	CD-1		SS07-2
	SS11-1		SS07-4
	SS26-6		SS07-5
G		Hatakeyama, Yutaka	SS07-3
Gader, Paul	J03-1	Havens, Timothy C.	SS08A-3
	K-2	Hayashi, Isao	SS11-3
Galvez, David	Poster-15	He, Jyun-Sian	SS17B-4
Garcia, Fernando	SS15-6	Helmi, Mohammad	Poster-29
Garibaldi, Jonathan	F-1	Heo, Gyeongyong	J03-1
	SS16-2	Herrera, Francisco	SS29A-3
	SS16-5		SS29B-1
	Poster-22		SS29B-3
Gasir, Fathi	I02-1	Herrera-Viedma, Enrique	P-4
Gedeon, Tamás D.	SS13-1	Hirao, Eiji	SS26-6
	SS13-3	Hiroaki, Ishii	H-3
	SS13-4	Hirota, Kaoru	SS05-6
Gentili, Emmanuelle de	I01-2	Hirota, Shozo	SS07-5
Golmohammadi, Sayed Koosha	SS12-4	Hiroyasu, Tomoyuki	SS26-2
Gonzalez, Pedro	SS29B-1		SS26-3
Gosain, Anjana	J01-1	Hirsbrunner, Beat	J03-5
Granado, Javier V´azquez	SS03-4	Hnativ, Andriy	CD-4
Greenfield, Sarah	SS0102B-4		SS03-3
Gribovskiy, Alexey	Poster-21	Ho, Kiyotaka	SS07-2
Grimme, Christian	SS29A-2	Ho, Wen-Hsien	SS18B-1
Grissa, Amel	J01-5		
Guan, Cuntai	B02-3		
Guan, Donghai	Poster-56		
Guechi, El-Hadi	G01-2		
Guerra, Thierry-Marie	SS04A-2		
	SS04B-2		

Honda, Katsuhiko	E01-2 SS14-1 SS14-6 SS14-7 SS25-1 SS25-2 SS25-3 SS25-4 SS25-5 Poster-17		
Honda, Nakaji	G02-1		Poster-17
Hong, Chin-Ming	SS17A-1	Iclanzan, David	J03-5
Hong, Jin-Man	Poster-80	Ida, Masaaki	Q-3
Hong, Sang Jeen	Poster-26	Iguchi, Hiroto	SS26-6
Hong, Tzung-Pei	SS12-3 SS12-5 SS29A-4	Ikoma, Norikazu	E02-3
	Poster-14	Imawaki, Setsuro	SS07-5
Hong, Yi	Poster-37	Inoue, Kazushige	SS25-5
Hongwei, Mao	Poster-37	Iordache, R [˘] Azvan	E01-3
Hongxia, Pan	Poster-37	Ishibuchi, Hisao	SS25-6 SS26-7
Hoock, Jean-Baptiste	SS12-3		SS29B-3 SS29B-4 SS29B-5
Hoque, Mahedi Hasanul	F-2		SS16-4
Hoshino, Yuichi	SS07-6	Ishii, Hiroaki	SS07-5
Hoshino, Yukinobu	SS08A-4 Poster-59 Poster-60	Ishikura, Reiichi	
	SS10-3	Islam, M. M.	Poster-77
Hou, Yu-Jen	SS17B-2	Istrate, Dan	Poster-47
Hsiao, Chih-Ching	SS0102A-3 SS04A-4	Ito, Fuyuko	SS26-3
Hsiao, Ming-Ying	SS03-2	Ito, Shota	J02-4
Hsieh, Kuang-Liang	SS03-2	Itoh, Hidenori	SS26-1
Hsu, Chin-Yuan	K-4	Izadinia, Hamid	E02-1
Hsu, Jih-Shih	P-2		
Hsu, Shu-Chen	Poster-44	J	
Hsueh, Yao-Chu	SS17A-3	J. Perez, Ignacio	P-4
Hu, Chenglin	L-4 R-2	Jaime-Castillo, Sergio	SS19-1
Hu, Li-Sheng	Poster-51	Jang, Joon Hwan	A02-4
Huang, Jinying	SS11-2	Jang, Sanghun	J03-4
Huang, Liang-Chih	Poster-11	Jassbi, Javad	Poster-28
Huang, Yin-Fu	Poster-31	Jayaram, Balasubramaniam	SS16-1
Huang, Zhiheng	N02-2	Jeng, Don Jyh-Fu	SS22A-5
Hui, K.S.	SS22B-1	Jeng, Jin-Tsong	SS17A-4 SS17B-1
Hung, Sheng-Kai	SS17A-2	Jeng, Wen-Hau Roger	SS24-6
Hung, Wen-Liang	J02-5	Jensen, Richard	O-1 SS15-2
Hurlebaus, Stefan	G01-5	Jeon, Moon-Jin	J04-4
Hwang, Chih-Lyang	A01-2 G01-4	Jeon, Taeryong	K-5
	Poster-36	Jeong, Ji Seok	A02-2
Hwang, Fuh-Hsin	J03-2	Jesus, Maria Jose del	SS29B-1
Hwang, Kyung Soon	Poster-78	Jheng, Sheng-Lun	SS17B-1
Hwang, Kyung-Hoon		Ji, Xiaofei	R-3
		Jiang, Ye	SS05-4
		Jie Lin,	Poster-34

Jinying, Huang	Poster-37	Khoury, Mehdi	SS05-2
Jo, Taeho	A01-4	Kim, Bo Kyeong	B02-5
John, Robert I.	F-1	Kim, Byoung-Hee	A02-5
	SS0102B-4	Kim, Chang Suk	Poster-12
	SS16-2	Kim, Chong-kwon	Poster-62
Joo, Young Hoon	G02-3	Kim, Eun-Su	Q-2
	SS04B-5	Kim, Euntai	J03-4
	Poster-18	Kim, Hyun-Soo	Poster-26
	Poster-66	Kim, Hyun-Woo	A02-5
	Poster-67	Kim, Ikno	SS22A-5
Ju, Zhaojie	R-3	Kim, Jaekwang	B02-5
	SS06-2	Kim, Ji-Hwan	E02-2
Jun, Sunghae	Poster-71	Kim, Jin Kyu	Poster-66
Jung, Ho Gi	J03-4	Kim, Jin Tae	N02-3
Jung, Hye-Wuk	E02-4	Kim, Jinwook	I02-4
Jung, Jin-Woo	Poster-78	Kim, Jo-Hwan	Q-2
Jung, Sungyoung	Poster-65	Kim, Jong-Myon	J02-2
Jung, Wi Hoon	A02-4	Kim, Jongwook	SS22B-1
Junzo, Watada	SS22B-6	Kim, Jong-Wook	Q-2
		Kim, Jungmin	Poster-65
		Kim, Kwang-Baek	SS20-6
		Kim, Kwang-Ho	E02-2
		Kim, Kyoung Min	B01-3
		Kim, Se Jin	G02-3
		Kim, Su jin	Poster-52
		Kim, Sung-ho	Poster-52
		Kim, Sungshin	K-5
			Poster-65
		Kim, Yeesock	G01-5
		Kim, Yong Soo	H-6
		Kim, Yong-Jun	Poster-71
		Kitaoka, Tetsuko	SS26-4
		Kiyoto, Takeshi	Poster-59
		Klancar, Gregor	G01-2
		Ko, Dequan	A02-1
		Ko, Kwang-Eun	Poster-58
		Kobashi, Shoji	SS07-1
			SS07-2
			SS07-4
			SS07-5
		Koczy, T. Laszlo	SS13-1,
			SS13-5
		Kodama, Yuki	SS23-5
		Koike, M.	SS22B-1
		Kokubo, Yasuro	SS08B-3
		Konar, Amit	Poster-74
		Koo, Geun Bum	G02-3
		Koubaa, Yassine	Poster-75
		Kubo, Seiji	SS07-6
		Kubota, Naoyuki	SS06-5
			SS23-6
		Kuhr, Tomas	N02-1

K

Kaisho, Yutaka	SS29B-5		
Kajihara, Yusuke	SS08B-1		
Kalhor, Ahmad	I02-5		
Kang, Do-Hyung	A02-4		
Kang, Hoon	Poster-80		
Kang, Sun Mee	Poster-76		
Kang, Tae-Koo	E01-5		
Kanoh, Masayoshi	SS26-1		
Kanzawa, Yuchi	SS14-3		
Karagianni, Georgia	Poster-64		
Karim, Ziaul	Poster-77		
Karray, Fakhry	SS27-2		
Karunambigai, M.G.	SS21-5		
Katada, Tatsuya	E01-2		
Katagami, Daisuke	SS08B-4		
Kataoka, Hiromi	SS07-3		
Kato, Toshihiro	SS23-5		
Kato, Yuka	SS23-2		
Kaur, Prabhjot	J01-1		
Kawano, Hideaki	E02-3		
Kawasaki, Haruhisa	SS18A-2		
Kazemian, Hassan B	E01-1		
	E01-4		
Ke, Hua	Poster-81		
Keller, James M.	L-2		
	SS08A-3		
	SS10-1		
Kerkeni, Hichem	SS04B-2		
Khan, Md. A. K.	F-2		
Khanmohammadi, Sohrab	SS20-2		

Kumar, Satish	B02-1	Lee, Raymond S. T.	SS12-2
Kumdee, Orrawan	SS16-4		Poster-23
Kung, Chung-Chun	Poster-11		Poster-38
	Poster-27	Lee, Sang Wan	H-6
Kunieda, Junichi	SS08A-4	Lee, Seok Jong	N02-3
Kunitachi, Tsutomu	SS26-1	Lee, Seongkon	SS22B-1
Kuo, Yau-Hwang	SS12-3	Lee, Seunghun	B02-5
Kuramoto, Kei	SS07-2	Lee, Shie-Jue	SS24-6
Kuroda, Ryosuke	SS07-6	Lee, Soojin	K-5
Kuroiwa, Jousuke	Poster-55	Lee, Sungyoung	Poster-56
Kurosaka, Masahiro	SS07-6	Lee, Tsu-Tian	SS18B-2
Kusunoki, Toshiyuki	SS23-4	Lee, Young-Koo	Poster-56
Kwon, Jun Soo	A02-4	Lee, Zne-Jung	SS17B-3
Kwong, K. M.	Poster-38	Lepping, Joachim	SS29A-2
Kwong, Sam	Poster-14	Leu, Yih-Guang	SS17A-1
Kyriazopoulos, George C.	Poster-64	Leung, Chung Chu	J01-2
		Leung, Frank H.	G01-6
L		Li, Bo	Poster-6
			Poster-20
Lai, Chih-Chin	Poster-25	Li, Chengdong	SS0102A-1
Lai, Wen-Hsiang	SS22B-2		SS16-3
Lakemeyer, Gerhard	SS06-4	Li, Chengjie	Poster-20
Lam, H.K.	G02-2	Li, Chia-Hang	Poster-5
	SS04A-3	Li, Han-Xiong	SS05-3
Lam, Hak-Keung	G01-1		SS05-4
	G01-3	Li, Jungang	SS05-7
	G01-6	Li, Ping	SS06-3
Langari, Reza	G01-5	Li, Shoumei	SS05-7
Lauber, Jimmy	G01-2	Li, Tie-shan	I01-5
	SS04B-2	Li, Xiang	H-4
Laurent, Anne	SS19-5	Li, Yang	N01-5
Leal-Ramírez, Cecilia	SS0102B-2	Li, Yi-Wen	Poster-9
Lee, Buhm	B01-3	Li, Yongming	SS28-1
Lee, Chan Hee	J03-2	Lim, Chee Peng	Poster-1
Lee, Chang-Shing	SS03-2	Lim, Edward H. Y.	SS12-2
	SS12-3		Poster-23
Lee, Chih-Jen	Poster-57	Lim, Minkyu	E02-2
Lee, Chou-Yuan	SS17B-3	Lin, Chih-Ying	J01-3
Lee, Chul-Heui	I01-6	Lin, Chun-Wei	SS12-5
	Poster-32	Lin, Feng-Tse	SS22B-7
Lee, Dong Hwan	SS04B-5	Lin, Lily	SS22B-5
Lee, Heesung	J03-4	Lin, Tsau Young	SS24-4
Lee, Hong-Gi	Poster-80	Lin, Tzu-Chao	Poster-35
Lee, Huey-Ming	SS22B-3	Lippe, Wolfram	SS22A-3
	SS22B-5		SS22A-4
Lee, Jee-Hyong	B02-5	Liu, Derong	Poster-3
	E02-4	Liu, Honghai	R-3
Lee, Jin S.	I02-4		SS05-2
Lee, Keon Myung	J03-2		SS06-2
Lee, Mahnhoon	J01-4		SS06-3
	J02-1		Poster-16
		Liu, Hsin-Yu	Poster-46

Liu, James N. K.	SS12-2 Poster-23 Poster-38	Medjahed, Hamid Melin, Patricia	Poster-47 Poster-68 Poster-69
Liu, Qing	B01-2	Mendel, Jerry	SS0102A-2
Liu, Qiong	O-2 O-3	Mendis, B. Sumudu U.	SS13-3 SS13-4
Liu, Shiu-Ling	SS24-3	Mendoza, Olivia	Poster-69
Liu, Shun-Tsai	SS0102A-3	Michalikova, Alzbeta	SS21-4
Liu, Wei	I01-3	Miki, Mitsunori	SS26-2 SS26-3
Liu, Zhi	SS05-3	Miki, Tsutomu	G02-4
Lo, Ji-Chang	SS04A-1 SS18A-1	Milan Es, Vicente	SS27-1
Loia, Vincenzo	SS03-5 SS12-1	Min, Ji-Hee	J04-5
Lopez, Francisco J.	SS15-6	Miyahira, Susana Abe	F-3
Lu, Wen-Hsiang	SS12-5	Miyamoto, Sadaaki	SS14-2 SS14-3
Lucas, Caro	I02-5		SS14-4 SS14-5
Ludwig, Simone A.	CD-4 SS03-3	Mizukawa, Makoto	SS23-3 SS23-5
Luong, Huynh	J02-2	Moaveni, Bijan	Poster-70
Luukka, Pasi	SS09-2	Moeinzadeh, M-Hossein	Poster-2
Lv, Xiaolong	Poster-30	Moghaddam, Mohammad Hossein Yaghmaee	SS18B-4
M		Mogi, Gento	SS22B-1
Ma, Bo	SS11-2	Mohajeri, Kamran	Poster-70
Ma, Weimin	Poster-81	Mohamed, Chaabane	G02-5
Ma, Xuan	B01-2 Poster-55	Mohammad, Ameer Ali	Poster-77
Machiraju, Karthik Ravi Teja	SS18B-3	Mohammed, Chadli	G02-5
Madadian, Reyhaneh	SS18B-4	Mok, Seung Jun	Poster-76
Madrid, Nicolas	N02-6	Mokhtari, Amine	K-1
Maeda, Hiroshi	E02-3	Molina, Carlos	SS15-3
Maeda, Toshiyuki	SS11-3	Mondada, Francesco	Poster-21
Maeda, Yoichiro	SS08B-1	Montseny, Eduard	SS19-3
Maha, Bouattour	G02-5	Moon, Hyun Soo	SS04B-5
Mahmoudzade, Morteza	H-5	Muller, Serge	E01-3
Maio, Carmen De	SS12-1	Murakami, Masayuki	G02-1
Malki, Heidar	Poster-53	Murakawa, Yoshihiko	SS23-2
Mangalampalli, Ashish	SS15-4	Musa, Zalili Binti	Poster-40
Manish, Kakar	Poster-13	N	
Manna, Sukanya	SS13-3	Nagamune, Kouki	SS07-6 SS08B-3
Marquez, Francisco A.	SS29A-5	Nagar, A. K.	Poster-74
Marra, Vincenzo	N02-7	Nagaura, Kazuya	SS14-7
Marsala, Christophe	SS19-4	Naik, Kshirasagar	SS27-2 Poster-43
Martinez-Jimenez, Pedro	SS20-3	Nakajima, Hiroshi	SS07-2 SS07-4
Martinez-Marroquin, Ricardo	Poster-48	Nakajima, Noriaki	SS07-3
Masuta, Hiroyuki	SS23-6	Nakamura, Tsuyoshi	SS26-1
Mathurapoj, Akadet	CD-2		
Matsui, Tomohiro	SS25-2		
Mattila, Jorma	SS09-2		
Medina, Juan Miguel	SS19-1		

Z

Zakizadeh, Manijeh	Poster-70
Zamani, Iman	I02-2 I02-6
Zavala, Antonio Hernandez	Q-1
Zhang, Byoung-Tak	A02-4 A02-5
Zhang, Chen-Mou	SS18A-1
Zhang, Cong yi	Poster-52
Zhang, Huaguang	Poster-3
Zhang, Huazhen	E01-5
Zhang, Jun-Wei	Poster-46
Zhang, Qingqing	CD-3
Zhang, Tao	Poster-33
Zhang, Xian-Xia	SS05-4
Zhang, Xue-Lian	Poster-51
Zhang, Yalong	Poster-55
Zhang, Yang	H-4
Zhang, Zhi	Poster-51
Zhao, Dongbin	SS0102A-1 SS16-3
Zhengguang, Xu	Poster-8
Zhou, Haibo	SS05-1
Zhou, Shang-Ming	F-1 SS16-2
Zhu, Guopu	Poster-14