9th International Conference on Control, Automation, Robotics and Vision

ICARCV 2006 Short Courses

5 December 2006, 9 am – 5pm, Grand Hyatt Singapore

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Organisers

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TF1:

Computational Intelligence Techniques with Applications

By Professor Nikhil R. Pal

Fellow of IEEE, Editor in Chief, IEEE Trans. on Fuzzy Systems,
Indian Statistical Institute, India

TF2:

Collaborative Processing in Sensor Networks

By Associate Professor Lynne Parker

Senior Editor of the IEEE Transactions on Robotics
The University of Tennessee, USA

TF3:

High-Precision Motion Systems

By Professor Kok-Meng Lee

Fellow of IEEE and Fellow of ASME
Georgia Institute of Technology, USA

Early Bird Registration with attractive group discount ends on

25th Nov 2006

If you wish to attend the conference between 6 and 8 December, please visit the conference website to register:
http://www.icarcv.org/2006/

#TF1:
Computational Intelligence Techniques with Applications

By Professor Nikhil R. Pal
Fellow of IEEE, Editor in Chief, IEEE Trans. on Fuzzy Systems,
Indian Statistical Institute, India

Course Description

Computational intelligence (CI) techniques find applications in diverse fields including medicine, control, imaging and so on. Bioinformatics and medical image analysis are important areas in medicine. For example, automatic screening of breast cancer is still a challenging problem to researchers and needless to say that a low cost solution can save many lives. Similarly, predicting the structure of new protein or finding of biomarkers for a specific type of cancer can save lives. Intelligent control is another area where CI plays a very important role. This tutorial intends to provide adequate knowledge of CI tools and how these tools can be used to solve some of these challenging problems. As applications, we shall consider the following problems: identification of biomarkers (genes) for specific cancers, knowledge discovery in biological data, detection of microcalcification in mammograms, automatic designing of self-tuning controllers, etc.
Three main ingredients of CI are fuzzy computing, neuro-computing and evolutionary computing. The tutorial will be divided into four parts.

Part I: We shall introduce CI, its basic components, relevance and advantages. We shall discuss some important supervised and unsupervised models such as multilayer perceptrons, support vector machines, self-organizing maps, neural gas networks and so on. We will discuss some applications of these techniques in feature/gene selection, detection of microcalcifications from mammograms, image compression, segmentation of remote sensing data, sensor selection, intelligent control, etc.

Part II: In our day to day life we process primarily imprecise information and fuzzy sets is the most appropriate tool to model such imprecision and approximate reasoning with that. One can think neural network as hardware for the brain and fuzzy reasoning as a higher level information processing. We shall discuss the motivation and need for fuzzy sets, and then introduce it formally along with various operations on the same. The concept of linguistic variables and linguistic values and how to deal with them will also be discussed. We shall discuss the general architecture of a fuzzy rule based systems along with different inference and defuzzification schemes. As applications we shall consider satellite image analysis, detection of bounded weak echo regions relating to severe weather phenomena, and fuzzy control.

Part III: To design either fuzzy systems or neuro-systems we often need to optimize, and sometimes such objective functions are not well behaved. Evolutionary computing, another biologically inspired computing paradigm, is an attractive tool for solving such optimization problems. In this context, we shall introduce genetic algorithm, genetic programming, particle swarm optimization and differential evolution. We will also discuss their applications in gene/feature selection and gene regulatory networks.

Part IV: Each of the three major components of CI has its own advantages and limitations. Hence, a judicious integration of two or more of these tools into one system can lead to more “intelligent systems” with better properties. In this regard, we shall discuss different hybrid systems such as neuro-fuzzy, fuzzy-genetic systems. Selected applications of these hybrid systems will also be discussed.

Lecturer

Professor Nikhil R. Pal received B. Sc. degree with honors in physics and Master degree in business management from the University of Calcutta. He obtained MTech and PhD degrees in computer science from the Indian Statistical Institute, Calcutta. Currently, he is a Professor in the Electronics and Communication Sciences Unit of the Indian Statistical Institute. He is a Fellow of the IEEE, USA and Indian National Academy of Engineering. He has delivered several plenary, tutorial and invited talks.He has coauthored a book titled "Fuzzy Models and Algorithms for Pattern Recognition and Image Processing", Kluwer Academic Publishers, 1999; co-edited four volumes titled "Advances in Pattern Recognition and Digital Techniques", ICAPRDT'99, Narosa; "Advances in Soft Computing", AFSS 2002, Springer Verlag; "Neural Information Processing", ICONIP 2004, Springer Verlag; "Advanced echniques in data mining and knowledge discovery", Springer Verlag, 2005; and edited a book titled "Pattern Recognition in Soft Computing Paradigm", World Scientific, 2001. He is the Editor-in-Chief of IEEE Transactions on Fuzzy Systems. He is an Associate Editor of the IEEE Transactions on Systems, Man and Cybernetics-B. He serves on the editorial/advisory board of the International Journal of Approximate Reasoning, International Journal of Hybrid Intelligent Systems, Neural Information Processing - Letters and Reviews, International Journal of Knowledge-Based Intelligent Engineering Systems, Iranian Journal of Fuzzy Systems, Fuzzy Sets and Systems, and International Journal of Neural Systems.

He is a Steering Committee member of the journal "Applied Soft Computing", Elsevier Science. He was the president of and currently is serving as a governing board member of the Asia Pacific Neural Net Assembly. He was the Program Chair of the 4th International Conference on Advances in Pattern recognition and Digital Techniques, Dec. 1999, Calcutta, India. He was the General Chair of 2002 AFSS International Conference on Fuzzy Systems, Calcutta, 2002 and the 11th International Conference on Neural Information Processing, ICONIP 2004. He was a co-program chair of 2005 IEEE International Conference on Fuzzy Systems and is a co-program chair of 2006 IEEE International Conference on Fuzzy Systems.

#TF2:

Collaborative Processing in Sensor Networks

By Associate Professor Lynne Parker
Senior Editor of the IEEE Transactions on Robotics
The University of Tennessee, USA

Course Description

Sensors are considered the last missing link between the Internet and the physical world. A sensor network forms a loosely-coupled distributed environment where collaborative processing among multiple sensor nodes is essential in order to compensate for each other's limited capability in sensing, processing, power supply, and to tolerate faults. The extremely constraint resources of sensor networks have presented unique challenges to collaborative processing, the biggest of which is the contradictory requirements between energy efficiency and fault tolerance. While energy-efficient approaches try to limit the redundancy such that minimum amount of energy is required for fulfilling a certain task, redundancy is needed for providing fault tolerance since sensors might be faulty, malfunctioning, or even malicious. A balance has to be struck between these two objectives.

This tutorial discusses an integrated system design that tackles the unique challenges presented by sensor networks. This design concerns not only the development of effective processing algorithms, it also studies supporting computing paradigms and protocols which play an important role in facilitating the collaborative processing. We tackle challenging application problems like multiple target detection and unknown target identification, which add intelligence to the sensor network and eventually stimulate the practical deployment of sensor network in a more complex environment

Lecturer

Lynne Parker received her Ph.D. degree in Computer Science from the Massachusetts Institute of Technology (MIT) in 1994, performing research on cooperative control algorithms for multi-robot systems in MIT's Artificial Intelligence Laboratory, with a minor in brain and cognitive science. She recieved her M.S. degree in computer science from The University of Tennessee, Knoxville, and her B.S. degree in computer science from Tennessee Technological University, with a minor in mathematics. Dr. Parker joined the faculty of the Department of Computer Science at The University of Tennessee, Knoxville, as Associate Professor in 2002, founding the Distributed Intelligence Laboratory at that time. She also holds an appointment as Adjunct Distinguished Research and Development Staff Member in the Computer Science and Mathematics Division at Oak Ridge National Laboratory (ORNL), where she worked as a full time researcher for several years. Her current research is in the areas of distributed mobile robotics, artificial intelligence, sensor networks, machine learning, embedded systems, and multi-agent systems. Dr. Parker's research has been supported by the National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), ORNL, Department of Energy (DOE), NASA's Jet Propulsion Laboratory (JPL), Science Applications International Corporation (SAIC), Caterpillar, and Hughes Research Laboratory (HRL). Dr. Parker received the PECASE Award (U.S. Presidential Early Career Award for Scientists and Engineers) in 2000, the DOE Office of Science Early Career Scientist Award in 1999, the UT-Battelle Technical Achievement Award for Significant Research Accomplishments in 2000, and the University of Tennessee Angie Warren Perkins Award for scholarship, teaching, and contributions to campus life in 2006. She has published over 80 articles in peer-reviewed literature, including five edited books on the topic of distributed robotics. She is a frequent invited speaker at international conferences, workshops, and universities, having given over 90 invited lectures.

She is a Senior Editor of the IEEE Transactions on Robotics, an Associate Editor of IEEE Intelligent Systems Magazine, and is on the Editorial Advisory Board of the International Journal of Advanced Robotic Systems. Dr. Parker is a senior member of IEEE, and is also a member of Sigma Xi, AAAI, and ACM.

#TF3:

High-Precision Motion Systems

By Professor Kok-Meng Lee
Fellow of IEEE and Fellow of ASME
Georgia Institute of Technology, USA

Course Description

Modern machine tools, humanoid manipulators, spherical vehicle wheels and coordinate-measuring machines often require dexterous orientation control with several DOF, which are traditionally driven by open or closed chains of multiple single-axis actuating devices. Although single-axis motors can be controlled with high precision, small deviations in each joint could add up to a significant error at the endpoint of the kinematic chain. Along with illustrative examples, this tutorial focuses on several elements that play an essential role in a typical high-precision motion system. Specifically, the elements to be discussed are multi degrees-of-freedom (DOF) electromagnetic (EM) actuators, vision-based and optical sensors, model-based estimators for robust control, and selected application examples in robotics, automation and mechatronics. The first topic introduces methods of designing non-conventional EM actuators for high-precision multi-DOF motion systems. As accuracy of a motion system often depends on its sensor, the second topic presents non-contact sensors with emphases on vision-based measurements for real-time multi-DOF motion control, very high resolution optical position sensing, and computational intelligence in sensing. The third topic discusses methods to develop model-based estimators for control systems where direct measurements are difficult to make in real-time. Finally, several illustrative examples will be given to highlight the advantages, limitations and potential future developments of the above topics.

Lecturer

Professor Kok-Meng Lee received his B. S. degree from the State University of New York at Buffalo in 1980 and earned his S. M. and Ph. D. degrees from the Massachusetts Institute of Technology in 1982 and 1985 respectively, all in mechanical engineering. He is a Professor in the George W. Woodruff School of Mechanical Engineering at Georgia Institute of Technology. Dr. Lee's research interests include system dynamics and control, machine vision, mechatronics, robotics, and manufacturing automation. Dr. Lee is a Fellow of ASME and IEEE. Other recognition of his contributions includes the National Science Foundation (NSF) Presidential Young Investigator Award, Sigma Xi Junior Faculty Research Award, International Hall of Fame New Technology Award, and the IEEE/ICRA Kayamori Best Paper Award. He holds seven patents in machine vision, three DOF variable reluctance spherical motor, and optical orientation encoder.

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Course Fee

On or Before 25 Nov 2006
IEEE/IES members - S$350.00
Non-members - S$400.00
If two or more participants jointly register on or before 25 November 2006, each participant enjoys S$50/- discount.

After 25 Nov 2006
IEEE/IES members - S$400.00
Non-members - S$450.00

Course fee includes a set of course notes, two tea-breaks, one lunch and 5% GST.

Refund and Cancellations

- 75% of the registration fee will be refunded for cancellations made in writing and received by the secretariat on or before **25 November 2006**.
- There will be no refund for cancellations made after **25 November 2006.**
- Refunds (if any) will be made after the conference.
- Registration is transferable but it has to be conveyed to the Secretariat in writing before **25 November 2006.**

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The organiser reserves the right to cancel the course and fully refund the participants, should unforeseen circumstances warrant it.