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Latest Advances in Systems Science & Computational Intelligence

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Preface

This year the 11th WSEAS International Conference on System Science and Simulation in Engineering (ICOSSSE '12), the 11th WSEAS International Conference on Computational Intelligence, Man-Machine Systems and Cybernetics (CIMMACS '12), the 1st International Conference on Integrated Systems and Management for Energy, Development, Environment and Health (ISMAEDEH '12) and the 1st International Conference on Systems, Control, Power, Robotics (SCOPORO '12) were held in Singapore City, Singapore, May 11-13, 2012. The conferences provided a platform to discuss systems theory, control systems, non-linear systems, 3D programming, intelligent machines, environment modeling, web-based simulation, graph theory, power systems, computational intelligence, materials chemistry, environmental management, strategic management, mathematical biology, biochemistry, genetics, bioengineering, alternative energy systems, hybrid systems etc. with participants from all over the world, both from academia and from industry.

Their success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of these conferences are published in this Book that will be sent to international indexes. They will be also available in the E-Library of the WSEAS. Extended versions of the best papers will be promoted to many Journals for further evaluation.

Conferences such as these can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Learning Management and Web Mining

Professor Dr. Imre J. Rudas
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Peter Toth PhD
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Abstract: Data mining means database application in order to reveal latent connections within the data. Data mining is a multidisciplinary area uniting among other things the scientific fields of database management, statistics and artificial intelligence.
The question may arise as to how data mining or its special area, web mining is to contribute to the evaluation and further development of electronic syllabuses and learning environments. We wish to answer that question by connecting three models: ADDIE model for the development of virtual learning environments, Kirkpatrik's learning evaluation model and the model updated for web mining of the widespread data mining CRISP-DM model, therefore creating an integrated model for electronic syllabus development, course management and quality assurance.
Student interaction data related to electronic syllabuses and learning objects stored in virtual courses are saved in the form of database on servers. In the course of data mining these databases are analyzed by algorithms found in different programs (descriptive data mining).
The primary object of the investigation was to discover by methods of web mining the most important parameters of the learning activity during the completion of virtual courses. Instead of the classic form of electronic distance learning, a combination of traditional classroom work and online or offline learning methods was used (blended learning).
In analyzing the learning activity, the examination of students' click-series and the subsequent differentiation of student types and clusters were in the focus of attention. While the former shows what objects students visited in succession and how much time they spent processing them, the latter distinguishes between types of learning strategies. The examinations were performed at two levels, as macro and micro analyzes. The former one concentrated on learning objects whereas the latter one focused on individual web pages and their sequences.
As a result of the examination, the following aspects of learning management have been conceived:
- The formation of student communities via the application of collaborative and cooperative learning, parallel with the assurance of individual ways of learning
- The continuous involvement of students by the application of various forms of communication, the management and moderation of forum debates
- Learning management and the promotion of the creation of an adequate knowledge structure in consideration of different individual cognitive styles
- The application of a flexible syllabus structure and a varied types of media as required by the diversity of learning styles
- Assistance of the formation and development of self-regulating learning in students
- The advocation of the reproductive and productive application of the acquired material by a frequent allotment of tasks and problem situations
- The establishment of the relation with former skills (constructive pedagogical approach).

Brief Biography of the Speakers: Dr. Peter Toth Peter is a professor of Trefort Ágoston Centre for Engineering Education at Obuda University, Hungary where he is participating in technical initial teacher training and in-service training courses. Currently he is a director of the Centre.
He earned his MSc in Engineering Education at the Budapest University of Technology and Economics, and Peter Toth has Ph.D degree in Educational Research from Eötvös Loránd University.
He plays leading role in planning, development and managing traditional and virtual engineering programs. Dr. Toth is doing research on pedagogy of virtual learning environment, improvement of problem-solving thinking and analyzing of spatial abilities in engineering education. His actual research area is analysis of students' activities and behavior in virtual learning environment by web mining methods.

He has been contributing in some European researches and projects on pedagogical aspects of e-learning and development of creativity and abilities of future engineers and teachers as well. He is member of Committee for Teacher Training of Hungarian Rectors' Conference and secretary of Informatics Section of Pedagogical Committee of Hungarian Academy of Sciences. Dr. Toth has issued about 60 papers in several journals and conference proceedings.

Imre J. Rudas graduated from Bánki Donát Polytechnic, Budapest in 1971, received the Master Degree in Mathematics from the Eötvös Loránd University, Budapest, the Ph.D. in Robotics from the Hungarian Academy of Sciences in 1987, while the Doctor of Science degree from the Hungarian Academy of Sciences in 2004. He received his first Doctor Honoris Causa degree from the Technical University of Košice, Slovakia and the second one from "Polytechnica" University of Timisoara, Romania.
He is active as a full university professor. He served as the Rector of Budapest Tech from August 1, 2003 for a period of four years, and was reelected for three years in 2007. From 2010 Budapest Tech is changed to Óbuda University and he was elected as the rector for five years.
He is a Fellow of IEEE, Senior Administrative Committee member of IEEE Industrial Electronics Society, member of Board of Governors of IEEE SMC Society, Chair of IEEE Hungary Section and Vice-President of the Hungarian Academy of Engineering.
He is the treasurer of IFSA (International Fuzzy System Association), he had been the President of Hungarian Fuzzy Association for ten years.
He serves as an associate editor of some scientific journals, including IEEE Transactions on Industrial Electronics, member of editorial board of Journal of Advanced Computational Intelligence, member of various national and international scientific committees. He is the founder of the IEEE International Conference Series on Intelligent Engineering Systems (INES) and IEEE International Conference on Computational Cybernetics (ICCC), and some international symposia. He has served as General Chairman and Program Chairman of numerous scientific international conferences.
His present areas of research activity are Computational Cybernetics, Robotics with special emphasis on Robot Control, Soft Computing, Computed-aided Process Planning, Fuzzy Control and Fuzzy Sets. He has published books, more than 500 papers in books, various scientific journals and international conference proceedings. He received more than 750 citations for his publications.

Plenary Lecture 2

Multi-Input Control Systems in Biomedical Applications

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Abstract: Cancer research has made tremendous progress in the past decades and new treatments are emerging. Especially promising are combinations of traditional treatments like chemotherapy or radiotherapy with novels ones such as tumor anti-angiogenesis, an indirect cancer treatment approach that targets the vasculature of the tumor, or immunotherapy, which gives a boost to the immune system, in the hope of achieving synergistic effects. With novel approaches the underlying biological mechanisms are often not fully understood and several important questions such as how to best schedule these therapies over time still need to be answered. In clinical trials, because of the great complexity of the underlying medical problem, the scheduling of drugs is pursued in expensive, exhaustive, medically guided trial-and-error approaches. But these difficult scheduling questions are far from being answered, especially when more than one treatment is involved. Hence there exists a strong opportunity for mathematical modeling and analysis to be useful here.
The dynamics of the tumor growth and the interactions between cancer cells, healthy cells, immune system and the vasculature of the tumor can all be described as nonlinear systems with the actions of various drugs providing control inputs. In this talk, we shall present several systems describing these dynamical interactions between various types of cells under combination therapies for cancer. Starting with cell-cycle specific bilinear systems which allow the modeling of multiple drug treatments in chemotherapy, we then shall focus on dynamics given by nonlinear systems appearing in modeling of combinations of novel treatment with traditional treatments. The dimension of the systems increases if the pharmacokinetics of the therapeutic agents is taken into account.
Analyzing these systems as optimal control problems with the objective of minimizing the tumor volume, allows us to determine the form of the optimal controls representing drug protocols for these treatments. Both analytical and numerical results about the structures of optimal controls and corresponding responses of the system will be presented. Open questions and challenges will be discussed.

Brief Biography of the Speaker: Urszula Ledzewicz holds a position of Distinguished Research Professor in the Department of Mathematics and Statistics at Southern Illinois University Edwardsville in the USA. She has authored over 120 publications in refereed journals and refereed proceedings of international conferences. She is also the recipient of numerous research grants from the National Science Foundation (NSF), other funding agencies as well as many university awards. Besides widely publishing, she serves as Associate Editor on editorial boards of 8 international professional journals including Mathematical Biosciences and Engineering, Discrete and Continuous Dynamical Systems and she edited several special issues of these journals. U. Ledzewicz's research interests extend into the areas of optimal control theory, systems theory and their application to systems arising in biomedicine. Together with her collaborator, Heinz Schaettler of Washington University in St. Louis, she has analyzed various systems describing dynamics of cancer growth under both traditional and novel treatments. They provided new theoretical solutions for the most effective scheduling of these drugs. Their research crosses disciplinary boundaries to tackle large, real-life problems. U. Ledzewicz also puts a strong effort into disseminating her research. She gave close to 150 presentations, including many plenary talks at the conferences and universities all over the world. Besides journal publications and presentations jointly with H. Schaettler they are working on two research monographs containing both the theory of optimal control and its applications to biomedical systems. Both books will be published by Springer Verlag in 2012.

Plenary Lecture 3

The Geometric Effect on the Evolution of a Long Bubble in a Circular Tube

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Abstract: In this paper, a long bubble elongates through a contraction tube followed by an expansion tube filled with viscoplastic fluids was studied experimentally and numerically. The effects of both tube geometry and fluid characteristics on the bubble profiles and fractional converge were evaluated.
In the experimental aspect, the bubble profiles and the fractional converge were obtained by image processing the photos captured with a high-speed camera. In the numerical analysis aspect, the continuity equation and momentum equation were converted to the equations in the form of streamline and vorticity. The differential equations were discretized with the finite difference method. Gauss-Seidel Iteration method with successive over-relaxation (SOR) were applied in the computation of the viscous fluid flows. The evolution of the bubble contour predicted by a conservative Level Set Method was applied to this study.
The results showed that the fractional converge of the fluid, the bubble profile and velocity changed due to the effects of the fluid viscosity, the gas the flow rate and the contraction/ expansion angle of the tube. The bubble profile, developing along the stream line, was changed by the effects of the inertia force, surface tension and capillary force, etc. The bubble profiles and the flow fields generated by numerical simulation were applied to explain the experimental observations. Both experimental observation and numerical simulation results were in the same trend. A good consistency was shown between our results and the related researches.

Plenary Lecture 4

Numerical Method in Optimization as a Multi-stage Decision Control System

Professor B.S. Goh
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Abstract: The logical framework for a numerical method in optimization is as a multi-stage decision control system. We have a sequence of closed search regions and decisions should be made within a typical local search region. A good model of this process is driving a car, where most of the time we need to drive towards a target, taking into account the general direction and the constraints at any time. In the final stages, we need new tactics to park the car, taking into account the new constraints. Thus, in the final stages when the local search region contains the optimal solution, we should use the Newton method or similar. With this new dynamic approach in a numerical method in optimization, as a multi-stage decision problem, we conclude that we should abandon the standard trust region method and the penalty function technique. In place of a trust region method, which uses a quadratic model at a current point, we replace it by an approximate greatest descent method which computes approximately a point, which is always on the boundary of the local search region, except in the final stages, when Newton iterations should be used. The trust region method is qualitatively incorrect because it constructs an iteration so that the outcome is inside or on the boundary of a typical local search region. In place of the penalty function technique, we replace it by a multiple objectives decision problem in a local search region. For an optimization problem with equality constraints, we replace the penalty function method by a scalarized multiple objectives problem over a typical local search region. Typically, we seek to construct an iteration which generates a point on the boundary of a local search region so that the scalarized multiple objectives function is minimized. We only use the Newton method with Lagrange multipliers, when the optimal solution is inside the local search region. This new approach, using a multi-stage decision problem, simplifies the theory of numerical methods in optimization.

Brief Biography of the Speaker: B. S. Goh graduated from the Mathematics Department, University of Canterbury, Christchurch, New Zealand. He studied for the PhD degree under the rocket pioneer D F Lawden. Singular control theory was motivated by the occurrence of singular control in rocket and aircraft trajectories. It has found wide applications in the development of the maximum sustainable policy for fisheries and other renewable resources, economics, mathematical models in cancer treatment, robotics etc. The Goh transformation developed in the mid-sixties is a well known technique for the study of singular control solutions and it was used by B S Goh to establish the Legendre-Clebsch-Goh conditions for singular control. Goh is the author of, Management and Analysis of Biological Populations, Elsevier Press, New York, 1980. This book describes the applications of optimal control theory and stability theory to fisheries management, pest control and renewable resources. Recently Goh has developed a new framework for numerical methods in optimization by defining them as control systems. This new framework simplifies the theory of numerical methods in optimization. He has worked in Australia, USA, China, Malaysia and Singapore.