Computers and Mathematics in Automation and Materials Science

Editor

Oludare Owolabi

Computers and Mathematics in Automation and Materials Science

- ***Proceedings of the 5th International Conference on Applied Mathematics and Informatics (AMATHI '14)***
- ***Proceedings of the 5th International Conference on Automotive and Transportation Systems (ICAT '14)***
- ***Proceedings of the 7th International Conference on Materials Science (MATERIALS '14)***

Cambridge, MA, USA, January 29-31, 2014

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Preface

This year the 5th International Conference on Applied Mathematics and Informatics (AMATHI '14), the 5th International Conference on Automotive and Transportation Systems (ICAT '14) and the 7th International Conference on Materials Science (MATERIALS '14) were held in Cambridge, MA, USA, in January 29-31, 2014. The conferences provided a platform to discuss numerical analysis, differential equations, scientific computing, optimization, computational geometry, aerodynamics, automotive technology and management, vehicle autonomous systems, material science 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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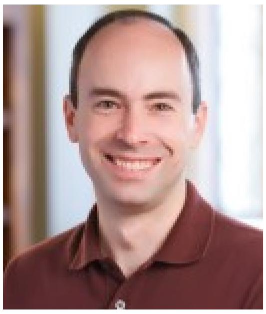
Plenary Lecture 1

Using Local Feedback Control to Stabilize Global Behavior in Excitable Media



Associate Professor John W. Cain
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Abstract: If one end of a one-dimensional excitable medium is forced periodically via impulsive stimuli, the usual response is a periodic wavetrain of propagating pulses. When the forcing period is large, the pulses are uniformly spaced and have identical propagation speed. If the forcing period B becomes critically small, the periodic wavetrain may lose stability via a period-doubling bifurcation that occurs at the stimulus site. In certain contexts (e.g., if the excitable medium is cardiac tissue), it is desirable to stabilize the periodic wavetrain solution by perturbing B, adjusting the timing of the nth stimulus by some small amount En. Previous studies have suggested that if the stimuli are delivered at a single point, then stabilization is possible only in some small radius of the stimulus site. In this presentation, I will explain why controlling global spatiotemporal dynamics via locally applied feedback control (i.e., perturbations to B at the stimulus site) is so difficult. Not only does our analysis reveal why traditional feedback control typically fails, it leads to a constructive algorithm for selecting the perturbations En in such a way that stabilization of the periodic wavetrain can succeed.

Brief Biography of the Speaker: John W. Cain graduated from Duke University (Durham, NC, USA) in 2005 with a Ph.D. in Mathematics. Presently, Dr. Cain is an Associate Professor of Mathematics and Computer Science at the University of Richmond (Richmond, VA, USA) and Visiting Associate Professor of Mathematics at Harvard University (Cambridge, MA, USA). Dr. Cain's research lies at the interface of mathematics, biology and medicine, and has been featured in interviews with Science (http://scim.ag/math2heart), the American Mathematical Society (http://www.ams.org/samplings/mathmoments/mm91-heartbeat-podcast), and in the Notices of the AMS (April 2011). In addition to his biomathematics research articles, he has co-authored two textbooks on differential equations, dynamical systems and bifurcations.

Plenary Lecture 2

Generalized Least-Squares Regression

Professor Nataniel Greene
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Abstract: Ordinary least-squares regression suffers from a fundamental lack of symmetry: the inverse of the regression line of y given x is not the regression line of x given y. Alternative symmetric regression methods have been developed to address this concern, notably: orthogonal regression and geometric mean regression. In our previous work a variety of symmetric and weighted least-squares regression methods were derived and analyzed, some of which may not have been known or fully explicated. A general approach to deriving, analyzing and classifying all generalized least-squares methods was also developed. This talk describes the further development of this theory.

Plenary Lecture 3

Swarm Intelligence Algorithms for Portfolio Selection Problem

Professor Milan Tuba
University Megatrend Belgrade
Faculty of Computer Science
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Abstract: Portfolio selection (optimization) is an important problem in the area of economy, management and finance. Portfolio includes various financial securities, such as bonds and stocks owned by an organization or by individual. Portfolio optimization is the process of choosing the proportions (weights) of various assets to be held in the portfolio, according to some optimization criteria and constraints. The optimization criteria mix together, directly or indirectly, considerations of the expected value of the portfolio's rate of return and the return's dispersion and possibly other measures of financial risk. Portfolio selection problem is a multi-criteria optimization problem where the goal is to minimize risks, while maximizing returns. With the inclusion of additional real-world constraints (such as the transaction costs, constraints arising from the legal environment, the finite divisibility of the assets etc.), the problem becomes much harder. In that case, traditional deterministic methods cannot cope with the computational complexity of the problem and the use of nondeterministic optimization metaheuristics is more promising. Swarm intelligence is a relatively new branch of nature inspired algorithms that very successfully finds suboptimal solutions to hard optimization problems by simulating collective intelligence of swarms of very simple agents like bees, ants, fireflies etc. This plenary lecture presents some successful applications of various swarm intelligence algorithms to portfolio selection problems with different constraint sets.

Brief Biography of the Speaker: Milan Tuba is Professor of Computer Science and Provost for mathematical, natural and technical sciences at Megatrend University of Belgrade. He received B. S. in Mathematics, M. S. in Mathematics, M. S. in Computer Science, M. Ph. in Computer Science, Ph. D. in Computer Science from University of Belgrade and New York University. From 1983 to 1994 he was in the U.S.A. first as a graduate student and teaching and research assistant at Vanderbilt University in Nashville and Courant Institute of Mathematical Sciences, New York University and later as Assistant Professor of Electrical Engineering at Cooper Union Graduate School of Engineering, New York. During that time he was the founder and director of Microprocessor Lab and VLSI Lab, leader of scientific projects and supervisor of many theses. From 1994 he was Assistant Professor of Computer Science and Director of Computer Center at University of Belgrade, from 2001 Associate Professor, Faculty of Mathematics, and from 2004 also a Professor of Computer Science and Dean of the College of Computer Science, Megatrend University Belgrade. He was teaching more than 20 graduate and undergraduate courses, from VLSI Design and Computer Architecture to Computer Networks, Operating Systems, Image Processing, Calculus and Queuing Theory. His research interest includes mathematical, queuing theory and heuristic optimizations applied to computer networks, image processing and combinatorial problems. He is the author or coauthor of more than 150 scientific papers and coeditor or member of the editorial board or scientific committee of number of scientific journals and conferences. Member of the ACM since 1983, IEEE 1984, New York Academy of Sciences 1987, AMS 1995, WSEAS, SIAM, IFNA.

Plenary Lecture 4

The Principles of Starch Gelatinization and Retrogradation

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Abstract: We have investigated gelatinization and retrogradation mechanism of starch (rice, potato and wheat) in proceeding papers. Gelatinization might occur after formation of intermolecular hydrogen bonding between O-6 of the amylose and OH-2 of the amylopectin molecules. The short side-chains (A and B1), which are free from intramolecular hydrogen bonding, of amylopectin molecules might take part in the intermolecular association. On the retrogradation process, another intermolecular association might take place between OH-2 of the former molecule and O-6 of the latter molecule. The starch molecules (amylose and amylopectin) in water changed into ice-like structure with hydrogen bonding in part between polymer and water molecules, and between water molecules even at concentration range of 2.0-4.0% (w/v) at room temperature, because of a little high kinetic energy of short side-chains (A and B1) of amylopectin molecules. Starch molecules played a dominant role in the center of the tetrahedral cavities occupied by water molecules, the arrangement of which was very nearly a tetrahedral ice-like structure and should lead to a cooperative effect stabilizing extended regions of ice-like water with hydrogen bonding on the surface of the polymer molecules, in which hemiacetal oxygen and hydroxyl groups might participate in hydrogen bonding with water molecules, and more extended ice-like hydrogen bonding through water molecules might be achieved on retrogradation process.

Brief Biography of the Speaker: Masakuni Tako: Male, Carbohydrate Bio-physical Chemist, dropped out Graduate School of Kyushu University, Doctoral Course in Food Science and Technology in 1975. He worked for University of the Ryukyus in 1982. He has published 120 papers and got 2 items of awards. His academic fields are structure-function relationship of polysaccharides and development of industrially functional polysaccharides from bio-resources. He has also published 4 books on Beethoven, Mozart, Schubert, Brahms, Liszt, Van't Hoff, Emil Fischer, Max Planck, Walther Nernst, Svante Arrhenius, Umetarou Suzuki, Han von Euler-Chelpin, and Danji Nomura, the last 8 scientists of which are his academic great grandfather (6), grandfather (1) and father (1). He is retired in 2012 and now director of Health and Longevity Research Laboratory, Integrated Innovation Research Center, University of the Ryukyus.

Plenary Lecture 5

Toward Damage Tolerance Design of Nonlinear Cracked Laminated Composite Shell Structures under Internal Pressure

Professor Cho Wing Solomon To
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Abstract: Currently, the commonly adopted approach of damage tolerance design for shell structures under static or steady state internal pressure is the application of bulging factors. As pointed out in a recent paper by the authors, bulging factors available in the literature have several important shortcomings for damage tolerance design and characterization of cracked cylindrical shell structures under internal pressure. For example, the bulging factorsare hinged on stress intensity factor at the crack tip and therefore numerical results obtained by techniques such as the finite element method (FEM) are very sensitive to the mesh around the crack tip. Further, bulging factors are only applicable to isotropic cracked shell structures under internal static and steady state internal pressure. The authors have recently proposed the equivalent bulging factors for cracked laminated composite shell structures under internal dynamic pressure. While the equivalent bulging factors have potential to be applied to the damage tolerance design of nonlinear cracked laminated composite shell structures under internal dynamic pressure they still suffer the same important limitation that they are only applicable to specific ranges of ratios of crack length to diameter of the shell structures. In order to circumvent this important limitation the maximum nonlinear transversal or out-of-plane response at the center of the flange or edge of the crack is proposed as a viable alternative to damage tolerance design of laminated composite shell structures which are commonly employed in many aircrafts, and aerospace and automotive systems. Computed results for various laminated composite cylindrical shell structures under internal dynamic pressure, and their implications are included in this presentation.

Brief Biography of the Speaker: Dr. To obtained his doctoral degree in sound and vibration studies from the University of Southampton in April 1980. He is currently a professor in the Department of Mechanical Engineering at the University of Nebraska (UNL). Prior to joining UNL he was a professor (1994-96) and an associate professor (1986-94) at the University of Western Ontario. He was an associate professor (1985-86) and an assistant professor (1982-85) at the University of Calgary. Between 1982 and 1992 he was a University Research Fellow of the Natural Sciences and Engineering Research Council, Canada. He was a Research Fellow at the Institute of Sound and Vibration Research (ISVR), University of Southampton during his doctoral degree studies. After his doctoral degree studies he worked briefly in the Wolfson Unit of the ISVR on machinery noise and vibration problems of drop hammers, and vibration diagnostics in helicopters of the Royal Navy before moving to the University of Calgary. His main academic interests are in nonlinear stochastic structural dynamics, nonlinear finite element analysis with particular reference to laminated composite plates and shells, nonlinear dynamics and control, and mechanics of carbon nano-tubes.