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Mathematical Methods and Systems in Science and Engineering

- *Proceedings of the 17th International Conference on Mathematical Methods, Computational Techniques and Intelligent Systems (MAMECTIS '15)*
- *Proceedings of the 8th International Conference on Manufacturing Engineering, Quality and Production Systems (MEQAPS '15)*
- *Proceedings of the 6th European Conference on Applied Mathematics and Informatics (AMATHI '15)*

Tenerife, Canary Islands, Spain, January 10-12, 2015

Mathematical Methods and Systems in Science and Engineering

Mathematics and Computers in Science and Engineering Series | 41

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Mathematics and Computers in Science and Engineering Series | 41

ISSN: 2227-4588
ISBN: 978-1-61804-281-1

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Published by WSEAS Press
www.wseas.org

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All papers of the present volume were peer reviewed by no less that two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.

ISSN: 2227-4588
ISBN: 978-1-61804-281-1

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Plenary Lecture 1

Swarm Intelligence Algorithms Hybridization

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Abstract: Most real-life problems in almost every field of science, business, engineering etc. can be modeled as some kind of optimization problem. Powerful mathematical techniques have been developed over centuries for most optimization problems, however a class of problems of great practical importance remains computationally intractable. When the problem dimension is high and when there are many local optima, the 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 find suboptimal solutions to hard optimization problems in a reasonable amount of computational time, by simulating collective intelligence of swarms of very simple agents like bees, ants, fireflies etc. Swarm intelligence metaheuristics employ iterative, population based, stochastic approach, and do not make any assumptions about the fitness landscape. They are based on intensification (exploitation) and diversifications (exploration) where intensification performs search around the current best solutions, while diversification explores the search space more broadly by conducting essentially a random search. Swarm intelligence algorithms exhibit excellent performance on many hard optimization problems, however for many problems the results remain unsatisfying. Success depends on the balance between exploitation and exploration and better balance can often be achieved by hybridization i.e. using combination of appropriate elements from two or more different algorithms. Selection of hybridization elements has to be carefully targeted so that the advantages of one algorithm overcome shortcomings of the other. This plenary lecture presents some successful hybridizations of various recent swarm intelligence algorithms.

Brief Biography of the Speaker: Milan Tuba is the Dean of Graduate School 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 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 theses supervisor. 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, University of Belgrade, 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. Dean Tuba 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, IEEE, AMS, SIAM, IFNA.

ISBN: 978-1-61804-281-1

Plenary Lecture 2

On Optimal Bidding in Internet Concurrent Auctions

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Abstract: Online auctions have become a popular and effective tool for Internet-based E-markets. We investigate problems and models of optimal adaptive automated bidding in an environment of concurrent online auctions, where multiple auctions for identical items are running simultaneously. We develop new models for a firm where its item valuation derives from the sale of the acquired items via their demand distribution, sale price, acquisition cost, salvage value and lost sales. We establish monotonicity properties for the value function and the optimal dynamic bid strategy and we present computations.

Brief Biography of the Speaker: Michael N. Katehakis is a Professor in the Management Science and Information Systems Department at Rutgers University. He is known for his work on Markov decision processes, Stochastic Models, data-driven analytics and their application to queuing, reliability and service systems. He has served on many panels (NSF, IEEE, conferences), as judge (for the 2013 and 2014 INFORMS Innovative Applications in Analytics Award, the 2013 INFORMS Interactive Sessions Award, and the Jacob Wolfowitz Prize 1994-2006), and editorial boards including the `Annals of Operations Research', the `Naval Research Logistics', `Operations Research Letters', and the `Probability in the Engineering and Informational Sciences'. His contributions to the profession have been recognized by INFORMS with an INFORMS Fellow award. He is an Elected member of the International Statistical Institute (ISI) and a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE). In addition to Rutgers he has taught at Stanford, Columbia, SUNY at Stony Brook and at the University of Athens, and at the University of Crete in Greece. Besides to research and teaching, he works with firms in a number of industries on analytics and process improvement projects and he has held industry positions at Bell-Labs and at Brookhaven National Lab.

ISBN: 978-1-61804-281-1

Plenary Lecture 3

Stable Solution of Ill-Posed Problems by Projection Methods

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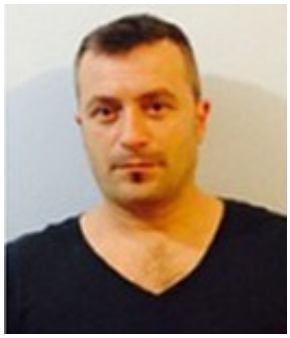
Abstract: Ill-posed problems are problems, solutions of which are unstable under data perturbations (which may be for example the measurement errors). Typical examples of the ill-posed problems are integral equations of the first kind. For the solution of ill-posed problems special regularization methods are derived (Tikhonov method, iterative methods etc). For numerical realization of these methods on the computer their discretization is unavoidable. In some cases successful discretization method can be viewed as regularization method and then other regularization is not needed. Namely, if the discretization method converges in case of exact data, then in case of noisy data we can choose the discretization step in dependence of the noise level of the data in such a way, that the solution of the discretized problem converges to the solution of continuous problem if noise level tends to zero. Such phenomenon is called self-regularization. We consider self-regularization of ill-posed problems in Hilbert and Banach spaces by the following projection methods: least squares method, least error method, collocation method. In these methods the regularization parameter is the dimension of the projected equation. We choose this dimension by the discrepancy principle or by the monotone error rule and give convergence results.

Brief Biography of the Speaker: Uno Hämarik is the associated professor of the Institute of Mathematics of the Universityof Tartu, Estonia. He is born in 1955, obtained Dipl.-Math. degree from the University of Tartu, in 1978 and PhD from the Institute of Mathematics and Mechanics of Ural Centre of UdSSR, Sverdlovsk in 1986. He has worked at the University of Tartu 1978-1981 as Assistant Prof., 1984-1995 as researcher and senior researcher and from 1995 as the Assoc. Professor. U. Hämarik has held several appointments as Visiting Professor in Germany (in Universities of Kaiserslautern, Zittau/Görlitz and Kiel). He is a member of the Editorial Boards of the journals "Abstract and Applied Analysis" and "Mathematical Modelling and Analysis" and served as a referee for 22 international journals (SIAM J. Numerical Analysis, SIAM J. Optimization and Control, Inverse Problems, Numerical Functional Analysis and Optimization etc). U. Hämarik has published more than 50 papers in research journals and conference proceedings. Main topic has been regularization of ill-posed problems, especially self-regularization of ill-posed problems by projection methods and rules for the choice of the regularization parameter in many regularization methods (Tikhonov method, iterative methods, projection methods).

ISBN: 978-1-61804-281-1

Plenary Lecture 4

Soft Biometrics: Its Use for Biomedical Applications



Professor Carlos M. Travieso-González
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Abstract: Soft biometrics is a technological evolution of biometrics systems applied to security. Its use has been extended to many fields, for example, social networks, where the information of the facial images can say the range of age, type of gender and race to find automatically the preferences of a relationship, or the facial identification for labelling photos.
In particular for biomedical applications, the use of soft biometrics too has been used. It is acquired physiological measures and/or a set of phenomenon or psycho-physiological reactions from diverse stimulus where it can be obtained a normal or altered (pathology) answer. Soft biometrics modalities as voice, electrocardiogram, electroencephalogram, face, etc. have been applied.
For Neurology, besides the purely experiential, subjective and phenomenological aspect, there are physiological processes due to changes caused by the thoughts or behaviors, which lead to that emotion. Thus, it can be mentioned one of the most important and visible manifestations, which are caused after an emotion behavioral manifestation external, called "emotional expression".
Among the different modes of manifestation, the facial expression is one of the more evidence the emotional states of the person whose major muscles of the face that modify these facial expressions are specifically controlled by the facial nerve and the trigeminal nerve, which controls the muscles of the jaw. The found experimental results are correlated with the previous manifestations; and under medical supervision, validate the use of soft biometrics on biomedical applications.

Brief Biography of the Speaker: Carlos M. Travieso-González received the M.Sc. degree in 1997 in Telecommunication Engineering at Polytechnic University of Catalonia (UPC), Spain; and Ph.D. degree in 2002 at University of Las Palmas de Gran Canaria (ULPGC-Spain). He is an Associate Professor from 2001 in ULPGC, teaching subjects on signal processing and learning theory. His research lines are soft-biometrics, biometrics, biomedical signals, data mining, machine learning, classification system, signal, image and video processing, and environmental intelligence. He has researched in more than 35 European, International and Spanish Research Projects, some of them as head researcher. Currently, he has three patents' applications in the Spanish Office of patents and brands. He is co-author of 2 books, co-editor of 8 Proceedings Book, Editorial Board member of JCIN, JAEE, JCS and JBIA (journals) and Guest Editor for five international journals and up to 15 book chapters. He has been invited 5 times as Plenary Speaker on international conferences. He has over 300 papers published in international journals and conferences. He is being reviewer up to 30 international journals (JCR-ISI) and has been Program Committee Conference member up to 50. He is member of IASTED Technical Committee on Image Processing from 2007 and member of IASTED Technical Committee on Artificial Intelligence and Expert Systems from 2011. He will be IEEE-IWOBI 2015 General Chair; and was IEEE-IWOBI 2014, InnoEducaTIC 2014, IEEE-INES 2013 General Chair, NoLISP 2011 General Chair, JRBP 2012 General Chair and Co-Chair on 39th Annual 2005 IEEE-ICCST. He was Vice-Dean from 2004 to 2010 in Higher Technical School of Telecommunication Engineers in ULPGC. Nowadays, he is a Vice-Dean of Head of Graduate and Postgraduate Studies from March 2013.

ISBN: 978-1-61804-281-1

Plenary Lecture 5

Statistical Analysis of Psychomotor Therapy in Children with Attention Deficit / Hyperactivity Disorder

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Abstract: One of the most common behavioural disorders in school age children, which has registered a high increase of the prevalence rate in the last decade is Attention deficit/hyperactivity disorder (ADHD) – a neurological condition that involves problems with inattention and hyperactivity-impulsivity that are developmentally inconsistent with the age of the child. ADHD has much comorbidity affecting the child's life in every domain with a negative influence in the prognosis of this condition. Psychomotor deficits are responsible for many of the learning disabilities of these children. A sample of children with the diagnosis of ADHD, under psychomotor therapy, was submitted to a Psychomotor Battery (PMB) in order to characterize the population followed in the Department of Child Psychiatry of the Centro Hospitalar Cova da Beira (in Portugal). Nonparametric tests and nonparametric approach of graphical techniques were applied to the data, collected at baseline and at the end of the intervention, and the main result shows that the psychomotor profile has a statistical significant improvement after psychomotor therapy (supported by both total scores of PMB and some particular psychomotor factors).

Brief Biography of the Speaker: Luis Miguel Grilo (PhD in Mathematics and Statistics, Technical University of Lisbon, 2006) is currently Adjunct Professor and Director of the Department of Mathematics and Physics, as well as Director of Surveys and Statistical Studies Center of the Polytechnic Institute of Tomar (IPT) and of a Post Graduation in Computational Data Analysis. As a member of the Center for Mathematics and Applications of the New University of Lisbon (CMA UNL), develops scientific research in Distributions Theory (exact and near-exact distributions of some statistics used in Multivariate Analysis) and Statistics Applications (with special interest in Health). Publishes papers regularly in international scientific journals and has made several presentations at national and international meetings of Statistics, including as an Invited Speaker, receiving the "Best presentation award", in the PhD student category, with a paper presented at the International Conference on Statistics, Combinatorics and Related Areas and X Conference of the Forum for Interdisciplinary Mathematics (SCRA2003|FIMX), University of Southern Maine, USA. At the moment, is Academic editor of the British Journal of Mathematics & Computer Science, member of the Editorial Board of the Asian Journal of Mathematics and Computer Research and member of the board of CLAD (Portuguese Association of Classification and Data Analysis). As a member of Scientific and Organizing Committees, has participated in several national and international meetings of Statistics. In particular, in the IPT was the Chair of the International Conferences SCRA2006|FIM XIII, the XIX Conference on Classification and Data Analysis (JOCLAD2012), the 7th Workshop on Statistics, Mathematics and Computation (WSMC7, 2013) and the 5th International Conference on Risk Analysis (ICRA5, 2013).

ISBN: 978-1-61804-281-1

Plenary Lecture 6

Production System Design: Analytics and Simulation Methods

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Abstract: The purpose of this communication is to give an overview and an analysis of the research about 'production systems design' and in particular production lines. The production system design is complex since it involves several difficult and hard subproblems. These issues might include: the equipment selection; the sizing and allocation of buffer; the workstations workload balancing; the selection and dimensioning of transport resources and also the workshop layout.
This presentation aims to give an overview of some recent and well known results on some issues above. A particular focus will be made on analytical models and resolution algorithms to firstly assess the performance and then to optimize the design of production lines.
Quite clearly, the execution of a task requires material resources and human skills and respect of technological and organizational conditions and precedence constraints, for instance. The various problems, cited above, are generally common to any approach to the optimization of the design of a production system. However, there are several types of production lines. According to Boysen et al., a classification of the different production lines is possible as: the model type (single, joint, multiple), the goods transfer mode between stations (synchronous, asynchronous, and continuous), line processing (manual or automated) and finally design or re-design (first installation or reconfiguration). The presentation will focus on the:
- Models and techniques of analytical simulation modeling of production lines with work on aggregation methods and simulation:
- The EMM (Equivalent Machines methods) method, which is to propose a new analytical approach to the assessment of the performance of a production line in series. This line is composed of unreliable machines separated by intermediate stocks to finite capacity.
- Line system representation by simulation techniques
- Optimization of the spaces of storages
- Optimization of robotic lines
- Multi-objective methods for the design of lines

ISBN: 978-1-61804-281-1

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ISBN: 978-1-61804-281-1