Recent Advances in Mathematical Methods in Applied Sciences

Proceedings of the 2014 International Conference on Mathematical Models and Methods in Applied Sciences (MMAS '14)

Proceedings of the 2014 International Conference on Economics and Applied Statistics (EAS '14)

Edited by

Yuri B. Senichenkov Vadim Korablev Igor Chernorytski Nikolay V. Korovkin S. Pozdnjkov Klimis Ntalianis

> Associate Editor Massimo Ceraolo

Saint Petersburg State Polytechnic University Saint Petersburg, Russia September 23-25, 2014

Co-organized by: Saint Petersburg State Polytechnic University



Mathematics and Computers in Science and Engineering Series | 32

RECENT ADVANCES in MATHEMATICAL METHODS in APPLIED SCIENCES

Proceedings of the 2014 International Conference on Mathematical Models and Methods in Applied Sciences (MMAS '14)

Proceedings of the 2014 International Conference on Economics and Applied Statistics (EAS '14)

> Saint Petersburg State Polytechnic University Saint Petersburg, Russia September 23-25, 2014



RECENT ADVANCES in MATHEMATICAL METHODS in APPLIED SCIENCES

Proceedings of the 2014 International Conference on Mathematical Models and Methods in Applied Sciences (MMAS '14)

Proceedings of the 2014 International Conference on Economics and Applied Statistics (EAS '14)

Saint Petersburg State Polytechnic University Saint Petersburg, Russia September 23-25, 2014

Copyright © 2014, by the editors

All the copyright of the present book belongs to the editors. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the editors.

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

Series: Mathematics and Computers in Science and Engineering Series | 32

ISSN: 2227-4588 ISBN: 978-1-61804-251-4

RECENT ADVANCES in MATHEMATICAL METHODS in APPLIED SCIENCES

Proceedings of the 2014 International Conference on Mathematical Models and Methods in Applied Sciences (MMAS '14)

Proceedings of the 2014 International Conference on Economics and Applied Statistics (EAS '14)

> Saint Petersburg State Polytechnic University Saint Petersburg, Russia September 23-25, 2014

Organizing Committee

Editors:

Prof. Yuri B. Senichenkov, St. Petersburg State Politechnical University, Saint Petersburg, Russia
Prof. V. Korablev, St. Petersburg State Politechnical University, Saint Petersburg, Russia
Prof. Igor Chernorytski, St. Petersburg State Politechnical University, Saint Petersburg, Russia
Prof. N. Korovkin, St. Petersburg State Politechnical University, Saint Petersburg, Russia
Prof. S. Pozdnjkov, St. Petersburg State Politechnical University, Saint Petersburg, Russia
Prof. Klimis Ntalianis, Technological Educational Institute of Athens, Greece

Associate Editor:

Prof. Massimo Ceraolo, University of Pisa, Italy.

Senior Program Chair

Prof. Ljubiša Kočinac, University of Nis, Nis, Serbia

Program Chairs

Prof. Yuri B. Senichenkov, St. Petersburg State Politechnical University, Saint Petersburg, Russia Prof. Constantin Udriste, University Politehnica of Bucharest, Bucharest Romania Prof. Marcia Cristina A. B. Federson, Universidade de São Paulo, São Paulo, Brazil

Tutorials Chair

Prof. Yury A. Rossikhin, Voronezh State University of Architecture and Civil Engineering, Voronezh, Russia

Special Session Chair

Prof. Yuri B. Senichenkov, St. Petersburg State Politechnical University, Saint Petersburg, Russia

Workshops Chair

Prof. Sehie Park, The National Academy of Sciences, Republic of Korea

Local Organizing Chair

Prof. Vadim Korablev, St. Petersburg State Politechnical University, Saint Petersburg, Russia

Publication Chair

Prof. Marina Shitikova, Voronezh State University of Architecture and Civil Engineering, Voronezh, Russia

Publicity Committee

Prof. Vjacheslav Yurko, Saratov State University, Astrakhanskaya, Russia Prof. Myriam Lazard Institut Superieur d' Ingenierie de la Conception Saint Die, France

International Liaisons

Professor Jinhu Lu, IEEE Fellow Institute of Systems Science Academy of Mathematics and Systems Science **Chinese Academy of Sciences** Beijing 100190, P. R. China Prof. Olga Martin **Applied Sciences Faculty** Politehnica University of Bucharest Romania Prof. Vincenzo Niola Departement of Mechanical Engineering for Energetics University of Naples "Federico II" Naples, Italy Prof. Eduardo Mario Dias **Electrical Energy and Automation Engineering Department** Escola Politecnica da Universidade de Sao Paulo Brazil

Steering Committee

Prof. Dr. H. M. Srivastava, University of Victoria, Canada
Prof. Stefan Siegmund, Technische Universitaet Dresden, Germany
Prof. Natig M. Atakishiyev, National Autonomous University of Mexico, Mexico
Prof. Narcisa C. Apreutesei, Technical University of Iasi, Iasi, Romania
Prof. Imre Rudas, Obuda University, Budapest, Hungary

Program Committee

Prof. Nasser-Eddine Mohamed Ali Tatar, King Fahd University of Petroleum and Mineral, Dhahran, Saudi Arabia

Prof. Jianging Chen, Fujian Normal University, Cangshan, Fuzhou, Fujian, China Prof. Josef Diblik, Brno University of Technology, Brno, Czech Republic Prof. Stanislaw Migorski, Jagiellonian University in Krakow, Krakow, Poland Prof. Qing-Wen Wang, Shanghai University, Shanghai, China Prof. Luis Castro, University of Aveiro, Aveiro, Portugal Prof. Alberto Fiorenza, Universita' di Napoli "Federico II", Napoli (Naples), Italy Prof. Patricia J. Y. Wong, Nanyang Technological University, Singapore Prof. Salvatore A. Marano, Universita degli Studi di Catania, Catania, Italy Prof. Sung Guen Kim, Kyungpook National University, Daegu, South Korea Prof. Maria Alessandra Ragusa, Universita di Catania, Catania, Italy Prof. Gerassimos Barbatis, University of Athens, Athens, Greece Prof. Jinde Cao, Distinguished Prof., Southeast University, Nanjing 210096, China Prof. Kailash C. Patidar, University of the Western Cape, 7535 Bellville, South Africa Prof. Mitsuharu Otani, Waseda University, Japan Prof. Luigi Rodino, University of Torino, Torino, Italy Prof. Carlos Lizama, Universidad de Santiago de Chile, Santiago, Chile Prof. Jinhu Lu, Chinese Academy of Sciences, Beijing, China Prof. Narcisa C. Apreutesei, Technical University of Iasi, Iasi, Romania Prof. Sining Zheng, Dalian University of Technology, Dalian, China Prof. Daoyi Xu, Sichuan University, Chengdu, China Prof. Ferhan M. Atici, Western KentuckyUniversity, Bowling Green, KY 42101, USA Prof. Ravi P. Agarwal, Texas A&M University - Kingsville, Kingsville, TX, USA Prof. Martin Bohner, Missouri University of Science and Technology, Rolla, Missouri, USA Prof. Dashan Fan, University of Wisconsin-Milwaukee, Milwaukee, WI, USA Prof. Paolo Marcellini. University of Firenze, Firenze, Italy Prof. Xiaodong Yan, University of Connecticut, Connecticut, USA Prof. Ming Mei, McGill University, Montreal, Quebec, Canada Prof. Enrique Llorens, University of Valencia, Valencia, Spain Prof. Yuriy V. Rogovchenko, University of Agder, Kristiansand, Norway Prof. Yong Hong Wu, Curtin University of Technology, Perth, WA, Australia Prof. Angelo Favini, University of Bologna, Bologna, Italy Prof. Andrew Pickering, Universidad Rey Juan Carlos, Mostoles, Madrid, Spain Prof. Guozhen Lu, Wayne state university, Detroit, MI 48202, USA Prof. Gerd Teschke, Hochschule Neubrandenburg - University of Applied Sciences, Germany Prof. Michel Chipot, University of Zurich, Switzerland Prof. Juan Carlos Cortes Lopez, Universidad Politecnica de Valencia, Spain Prof. Julian Lopez-Gomez, Universitad Complutense de Madrid, Madrid, Spain Prof. Jozef Banas, Rzeszow University of Technology, Rzeszow, Poland Prof. Ivan G. Avramidi, New Mexico Tech, Socorro, New Mexico, USA Prof. Kevin R. Payne, Universita' degli Studi di Milano, Milan, Italy Prof. Juan Pablo Rincon-Zapatero, Universidad Carlos III De Madrid, Madrid, Spain Prof. Valery Y. Glizer, ORT Braude College, Karmiel, Israel Prof. Norio Yoshida, University of Toyama, Toyama, Japan Prof. Feliz Minhos, Universidade de Evora, Evora, Portugal Prof. Mihai Mihailescu, University of Craiova, Craiova, Romania Prof. Lucas Jodar, Universitat Politecnica de Valencia, Valencia, Spain Prof. Dumitru Baleanu, Cankaya University, Ankara, Turkey Prof. Jianming Zhan, Hubei University for Nationalities, Enshi, Hubei Province, China Prof. Zhenya Yan, Institute of Systems Science, AMSS, Chinese Academy of Sciences, Beijing, China Prof. Zili Wu, Xi'an Jiaotong-Liverpool University, Suzhou, Jiangsu, China Prof. Wei-Shih Du, National Kaohsiung Normal University, Kaohsiung City, Taiwan Prof. Khalil Ezzinbi, Universite Cadi Ayyad, Marrakesh, Morocco Prof. Youyu Wang, Tianjin University of Finance and Economics, Tianjin, China Prof. Satit Saejung, Khon Kaen University, Thailand

Prof. Chun-Gang Zhu, Dalian University of Technology, Dalian, China Prof. Mohamed Kamal Aouf, Mansoura University, Mansoura City, Egypt Prof. Yansheng Liu, Shandong Normal University, Jinan, Shandong, China Prof. Naseer Shahzad, King Abdulaziz University, Jeddah, Saudi Arabia Prof. Janusz Brzdek, Pedagogical University of Cracow, Poland Prof. Mohammad T. Darvishi, Razi University, Kermanshah, Iran Prof. Ahmed El-Sayed, Alexandria University, Alexandria, Egypt Prof. Martin Bohner, Missouri University of Science and Technology, Rolla, Missouri, USA Prof. Martin Schechter, University of California, Irvine, USA Prof. Ivan G. Avramidi, New Mexico Tech, Socorro, New Mexico, USA Prof. Michel Chipot, University of Zurich, Zurich, Switzerland Prof. Xiaodong Yan, University of Connecticut, Connecticut USA Prof. Ravi P. Agarwal, Texas A&M University - Kingsville, Kingsville, TX, USA Prof. Yushun Wang, Nanjing Normal university, Nanjing, China Prof. Detlev Buchholz, Universitaet Goettingen, Goettingen, Germany Prof. Patricia J. Y. Wong, Nanyang Technological University, Singapore Prof. Andrei Korobeinikov, Centre de Recerca Matematica, Barcelona, Spain Prof. Jim Zhu, Western Michigan University, Kalamazoo, MI, USA Prof. Ferhan M. Atici, Department of Mathematics, Western Kentucky University, USA Prof. Gerd Teschke, Institute for Computational Mathematics in Science and Technology, Neubrandenburg, Berlin-Dahlem, Germany Prof. Meirong Zhang, Tsinghua University, Beijing, China Prof. Lucio Boccardo, Universita degli Studi di Roma "La Sapienza", Roma, Italy Prof. Shanhe Wu, Longyan University, Longyan, Fujian, China Prof. Natig M. Atakishiyev, National Autonomous University of Mexico, Mexico Prof. Jianming Zhan, Hubei University for Nationalities, Enshi, Hubei Province, China Prof. Narcisa C. Apreutesei, Technical University of Iasi, Iasi, Romania Prof. Chun-Gang Zhu, Dalian University of Technology, Dalian, China Prof. Abdelghani Bellouquid, University Cadi Ayyad, Morocco Prof. Jinde Cao, Southeast University/ King Abdulaziz University, China Prof. Josef Diblik, Brno University of Technology, Brno, Czech Republic Prof. Jianqing Chen, Fujian Normal University, Fuzhou, Fujian, China Prof. Naseer Shahzad, King Abdulaziz University, Jeddah, Saudi Arabia Prof. Sining Zheng, Dalian University of Technology, Dalian, China Prof. Leszek Gasinski, Uniwersytet Jagielloński, Krakowie, Poland Prof. Satit Saejung, Khon Kaen University, Muang District, Khon Kaen, Thailand Prof. Juan J. Trujillo, Universidad de La Laguna, La Laguna, Tenerife, Spain Prof. Tiecheng Xia, Department of Mathematics, Shanghai University, China Prof. Stevo Stevic, Mathematical Institute Serbian Academy of Sciences and Arts, Beogrand, Serbia Prof. Lucas Jodar, Universitat Politecnica de Valencia, Valencia, Spain Prof. Noemi Wolanski, Universidad de Buenos Aires, Buenos Aires, Argentina Prof. Zhenya Yan, Chinese Academy of Sciences, Beijing, China Prof. Juan Carlos Cortes Lopez, Universidad Politecnica de Valencia, Spain Prof. Wei-Shih Du, National Kaohsiung Normal University, Kaohsiung City, Taiwan Prof. Kailash C. Patidar, University of the Western Cape, Cape Town, South Africa Prof. Hossein Jafari, University of Mazandaran, Babolsar, Iran Prof. Abdel-Maksoud A Soliman, Suez Canal University, Egypt Prof. Janusz Brzdek, Pedagogical University of Cracow, Cracow, Poland Dr. Fasma Diele, Italian National Research Council (C.N.R.), Bari, Italy.

Additional Reviewers

Bazil Taha Ahmed M. Javed Khan James Vance Minhui Yan Angel F. Tenorio Jose Flores Francesco Zirilli Kei Eguchi Jon Burley Imre Rudas Philippe Dondon Zhong-Jie Han **George Barreto** Frederic Kuznik **Stavros Ponis** Lesley Farmer Francesco Rotondo Gengi Xu Manoj K. Jha Hessam Ghasemnejad **Ole Christian Boe** Deolinda Rasteiro Masaji Tanaka Takuya Yamano Konstantin Volkov José Carlos Metrôlho Moran Wang Santoso Wibowo Yamagishi Hiromitsu Kazuhiko Natori Abelha Antonio Matthias Buyle Tetsuya Yoshida **Miguel Carriegos** Andrey Dmitriev **Dmitrijs Serdjuks** Shinji Osada Tetsuya Shimamura Valeri Mladenov João Bastos Sorinel Oprisan Alejandro Fuentes-Penna Xiang Bai Eleazar Jimenez Serrano

Universidad Autonoma de Madrid, Spain Tuskegee University, AL, USA The University of Virginia's College at Wise, VA, USA Shanghai Maritime University, China Universidad Pablo de Olavide, Spain The University of South Dakota, SD, USA Sapienza Universita di Roma, Italy Fukuoka Institute of Technology, Japan Michigan State University, MI, USA Obuda University, Budapest, Hungary Institut polytechnique de Bordeaux, France Tianjin University, China Pontificia Universidad Javeriana, Colombia National Institute of Applied Sciences, Lyon, France National Technical University of Athens, Greece California State University Long Beach, CA, USA Polytechnic of Bari University, Italy Tianjin University, China Morgan State University in Baltimore, USA Kingston University London, UK Norwegian Military Academy, Norway Coimbra Institute of Engineering, Portugal Okayama University of Science, Japan Kanagawa University, Japan Kingston University London, UK Instituto Politecnico de Castelo Branco, Portugal Tsinghua University, China CQ University, Australia Ehime University, Japan Toho University, Japan Universidade do Minho, Portugal Artesis Hogeschool Antwerpen, Belgium Hokkaido University, Japan Universidad de Leon, Spain Russian Academy of Sciences, Russia Riga Technical University, Latvia Gifu University School of Medicine, Japan Saitama University, Japan Technical University of Sofia, Bulgaria Instituto Superior de Engenharia do Porto, Portugal College of Charleston, CA, USA Universidad Autónoma del Estado de Hidalgo, Mexico Huazhong University of Science and Technology, China Kyushu University, Japan

Table of Contents

Plenary Lecture 1: Stiff Models and Gradient Methods with the Exponential Relaxation	17
Igor G. Chernorutskiy	
Plenary Lecture 2: EMG-Analysis for Enhancing Efficiency and Performance of Electric	18
Power Systems by Using Smart Grid Technology	
Nikolay V. Korovkin	
Plenary Lecture 3: Modeling of Mechanism of State and Private Partnership Development	19
of the Social Infrastructure in the Regions	
Vladimir V. Gluhov	
Plenary Lecture 4: On Complete Monotonicity of Some Functions of the Mittag-Leffler	21
Type in Non-Debye Relaxation Processes	
Francesco Mainardi	
Plenary Lecture 5: From Physical to Mathematical Circuits: Theoretical and Practical	22
<u>Issues</u>	
Massimo Ceraolo	
Dynamic Response of a Hereditarily Elastic Beam with Rabotnov's Kernel Impacted by an	25
Elastic Rod	
Yury A. Rossikhin, Marina V. Shitikova, Ivan I. Popov	
Robust Normal Two-Armed Bandit and Parallel Data Processing	32
Alexander V. Kolnogorov	
Nonlinear Heat Conduction Problem in Doubly Periodic 2D Composite Materials	41
Marina Dubatovskaya, Gennady Mishuris, Sergei Rogosin	
Variable Structure Algorithm Using Explicit and L-Stable Methods	47
Eugeny A. Novikov, Anton E. Novikov	
Necessary Conditions of Optimality for Stochastic Switching Systems with Delay	54
Charkaz Aghayeva	
Finding Minimax Strategy and Minimax Risk for Bernoulli Multi-Armed Bandit	59
Alexander V. Kolnogorov	
Thermochemical Non-Equilibrium Reentry Flows in Three-Dimensions: Seven Species	67
Model – Part I – Structured Solutions	
Edisson S. G. Maciel, Amilcar P. Pimenta, Nikos E. Mastorakis	
Higher Symmetries and Inverse Problems for Ordinary Differential Equations	86

Valentin Zaitsev, Lidiya Linchuk, Alexander Flegontov

Tangency-Saddle Singularities of Planar Bimodal Linear Systems	90
Josep Ferrer, Marta Pena, Antonio Susin	
Lower Bounds on the Convergence Rate of the Markov Symmetric Random Search	93
Alexey Tikhomirov	
Simulation of Emission Spectra for LH2 Ring: Fluctuations in Radial Positions of Molecules Pavel Herman, David Zapletal, Pavel Kahrhel	96
Gradient Methods with the Exponential Relaxation Igor G. Chernorutskiy	102
Dynamic Response of a Doubly Curved Shallow Shell Rectangular in Plan Impacted by a	109
<mark>Sphere</mark> Yury A. Rossikhin, Marina V. Shitikova, Muhammed Salih Khalid J. M.	
<u>Fractional Viscoelastic Model of the Tooth Root Displacements in "Noncompensable"</u> <u>Periodontal Ligament</u> Sergei Bosiakov, Sergei Rogosin	114
Fractional Model of Electron Diffusion in Dye-Sensitized Nanocrystalline Solar Cells R. T. Sibatov, V. V. Svetukhin, V. V. Uchaikin, E. V. Morozova	118
(M, 2)-Methods of Accuracy of a Maximal Order for Stiff Systems	122
Eugeny A. Novikov	
<u>A Macroeconomic Model of Consumption and Investment Spending: An Econometric</u> <u>Application for the Economy of Cyprus</u> Panayiotis Diacos	126
Method of Unbalanced Power Minimization in Three-Phase Systems	134
Nikolay Korovkin, Sy Vu Quang, Roman Yazenin, Oleg Frolov, Nikolay Silin	
Integrated Technology for Industrial Software Verification and Testing V. Kotlyarov, P. Drobintsev, I. Nikiforov	138
About Detection Substitutions in Nonlinear Algebraic Equations with Help of Tarjan's	146
<u>Algorithm</u> A. A. Isakov, Yu. B. Senichenkov	
Dynamic Model of the Inverted Pendulum on a Mobile Base with Two Active Wheels and Desing of an Control Law J. E. Moisés Gutiérrez , J. Gabriel Escamilla, J. Eladio Flores, M. Montserrat Morin, Josefina Castaneda	151
custuneuu	

Multiport Thevenen and Northon Theorems Analog for ARC-Circuits with Nonlinear and 1	.59
Parametric R-Elements	
Anatoliy V. Bondarenko, Alla A. Lebedeva, Nikolay V. Korovkin	
Time-Dependent Mesodiffusion through a Boundary: The Current Inversion Phenomenon 10	.63
V. V. Uchaikin, R. T. Sibatov	
Analysis of Processes in DC Arc Plasma Torches for Spraying that Use Air as Plasma 10	.67
Forming Gas	
Vladimir Ya. Frolov, Dmitry V. Ivanov	
Quantification of Selected Factors of Longevity 1	.70
V. Pacáková, P. Jindrová	
Specification and Analysis of Hybrid Systems with PDE in ISMA Simulation Environment 1	.75
Yu. V. Shornikov, A. V. Bessonov, M. S. Myssak, D. N. Dostovalov	
Piecewise-Regular Object Recognition in Real-Time Applications	.83
Andrey V. Savchenko, Vladimir R. Milov	
Methods of Assessing and Predicting the Energy Efficiency of Electrical Complexes of 19	.90
Urban Distributive Power Grids	
V. Frolov, A. Korotkov	
Modeling Silicon Spintronics	.95
Viktor Sverdlov, Joydeep Ghosh, Dmitri Osintsev, Sieafried Selberherr	
A Simulation Based Decision-Making Support Approach for Foundry Plants Investment	.99
Projects Estimation of Efficiency	
Mikhail V. Zenkovich, Yury G. Drevs	
Decision-Making Support Tools in Data Bases to Improve the Efficiency of Inventory 20	.04
Management for Small Businesses	
Svetlana V. Shirokova, Oksana Y. Iliashenko	
Adjustment Semantics of Real Time Constructions in UCM Language for Implementation 2	13
in Translator of UCM to Basic Protocols	
V. Kotlyarov, P. Drobintsev, I. Nikiforov	
Bayesian Probability Models for Critical Illness Insurance	18
P lindrová V Pacáková	10
On a Method of Texture Analysis 22	22
Natalia B. Ampilova, Igor P. Soloviev	
Knowledge Representation in the Category of Unformalized Decision-Making Problems 22	26

Lyudmila V. Borisova, Inna N. Nurutdinova, Valery P. Dimitrov

Methods to Choosing Subcontexts in Good Maximally Redundant Tests Inferring Xenia Naidenova, Vladimir Parkhomenko	230
Colombian Manufacturing Soctory Industrial Structures 2000-2012	220
Karina Manrique Lopez, Sergio Ardila Rodriguez, Carlos Julio Castillo Rincon	238
The Effect of the Variation of Popov's Parameter on the Size of the Region of Absolute Robust Stability of a Monotonous Nonlinear Impulsive Control System	252
N. A. Tseligorov, G. M. Mafura	
Computer Simulation of Hybrid Systems by ISMA Instrumental Facilities Yu. V. Shornikov, M. S. Myssak, D. N. Dostovalov	257
Mathematical Modelling as Analytical Instrument of Research of Innovative Processes Galina Yu. Silkina	263
Tropical Cryptography and Analysis of Implementation of New Matrix One-Way Function Richard P. Megrelishvili	273
Analysis of Non-Stationary Transport of Electrical Charge in Polymer and Composite Materials M. E. Borisova	276
Mathematical Simulation of Thermal Contact of the Thermocouple for Research of an <u>Error of Measurements</u> Olga S. Yashutina, Yuliana K. Atroshenko, Pavel A. Strizhak	280
Game-Theoretical Model of Coordination of Interests of State-Private Partnership Vladimir V. Glukhov, Igor V. Ilin	284
Modeling the Unreliability and Condition Evolution of Engine Room Equipment with Respect to Maintenance and Overhaul Effect Lenka Jirsová, Libor Jelinek	290
On Improvement of Fault-Tolerance in Distributed Hardware-Software Multi-Agent Systems and Assessment of Assured Reliability Alexei V. Igumnov, Sergey E. Saradgishvili	295
General Theory for Reproducible Data Processing: Apparatus Function and Reduction to an "Ideal" Experiment R. R. Nigmatullin, D. Striccoli, W. Zhang	303
Eddy Currents Computation by an Integral Equation Method A. Kalimov, S. Shimansky	306
A Soft Clustering Approached with Feature Reduction using Principal Component Analysis	310

Phichete Julrode

Social Return Valuation by Means of Linear and Nonlinear Transformation Methods in	315
Income Taxation	
Olga Kalinina	
Multivariate k-Nearest Neighbors Distribution Function Estimates in Dose-Effect	325
<u>Relationship</u>	
Mikhail Tikhov, Maxim Ivkin	
A Fast Heuristics for Inferring Approximately Minimal Diagnostic Tests	330
Xenia Naidenova, Vladimir Parkhomenko, Alexander Rudenko	
New Approach for Learning Process Evaluation in Neurodegenerative Diseases Research	335
Lucie Houdová, Eduard Janeček	
Concentration Transfer for the Problem of Two-Phase Flow of a Fluid and	341
Multicomponent Gas Mixture in Anisotropic Medium	
D. O. Dill, A. M. Bubenchikov	
The Mathematical Model of the Dynamics of Bounded Cartesian Plumes	345
Khaled S. Al-Mashrafi	
Pole Shape Optimization in Multipole Magnets	358
A. Kalimov, P. Nalimov	
Implementation of ECDH through Software Code Scheduling with Minimum Number of	362
Point Computations	
Sakthivel Arumugam	
Computer Modelling of Hydropower-Driven Systems with Thermal and Electric Energy	368
<u>Sources</u>	
A. I. Ozersky	
Dynamics of Financial Market Stability Factors in Terms of Financial Globalization	375
Rustam R. Akhmetov	
Social Investments of Russian Business: Problems and Prospects	382
Anna B. Teslya	
Radial-Basis Functions Neural Network forText Independent Speaker Recognition	389
A. A.Yakovenko, G. F. Malyhina	
The Application of Discriminant Analysis for Estimation of the Regional Investment	393
Attractiveness	
Aleksandr Izotov, Olga Rostova	

Approach to Information Requirements Identification of Procurement Process of Custom	401
Production	
Anastasia I. Lyovina, Alissa S. Dubgorn	
Economic and Mathematical Models and Statistical Models of Operational Planning	412
V. A. Leventsov	
Dynamic State Model of Steam Turbine Hall Equipment Condition for Maintenance	420
Planning and Decision-making Support	
Lenka Jirsová, Miroslav Flídr	
An Economic and Mathematical Approach to Determining Key Product Quality	424
Parameters when Placing a State Defense Order	
E. S. Artemenko	
The Procedure of Image Identification as a Method of Raising Consumer Demand	428
Yakovlev Andrey Anatolyevich	
Improvement of Strategic and Operational Efficiency of Clusters Based on Enterprise	432
Architecture Model	-
Igor V. Ilin, Aleksei B. Anisiforov	
Authors Index	438



Stiff Models and Gradient Methods with the Exponential Relaxation

Professor Igor G. Chernorutskiy Saint Petersburg State Polytechnical University Russia E-mail: igcher@spbstu.ru

Abstract: 1. For a class of matrix gradient methods a new concept of the relaxation function is suggested. This concept allows to evaluate the effectiveness of each gradient optimization procedure, and to synthesize new methods for special classes of ill conditioned (stiff) non-convex optimization problems. According to the suggested formula , it is possible to build relevant search procedures for any given relaxation function.

2. The theorem about the relaxation conditions of each matrix gradient method is proven. Based on the concept of the relaxation functions it is given the geometric interpretation of relaxation properties of gradient methods. According to this interpretation it is possible to build a relaxation area, and to evaluate the speed of the objective function values decreasing.

3. The analysis of classical matrix gradient schemes such as simple gradient method, Newton's methods, Marquardt method is given. It is shown that the relaxation function and its geometric interpretation gives almost full information about the properties and capabilities of relevant gradient optimization methods.

4. A new class of matrix gradient methods with the exponential relaxation function (ERF) is suggested. It is shown that ERF-method summarizes the classical gradient methods including Newton methods, and Marquardt method. In contrast to these methods, ERF-methods have the relaxation functions, entirely located in the relaxation area, which significantly increases the computational efficiency of gradient methods.

5. The ERF-methods convergence for a wide class of non-convex objective functions is established.

Brief Biography of the Speaker: Dr. Chernorutskiy currently is a Professor of Saint-Petersburg State Polytechnical University (SPbSPU). Degrees (SPbSPU): Professor, 1990; Doctor of Technical Science, 1987; Associate Professor, 1982; Ph.D., 1978; M.S., 1970.

Professor Chernorutskiy is the Chair of Information & Control Systems Division of Computer Science and Engineering School (CSES).

Research Interests

Applied Software Engineering, Optimization Tools, Real - Time Systems Modeling and Simulation, Parameter Estimation, and Adaptive Optimization, Decision Support Systems, Artificial Intelligence and Expert Systems.

Enhancing Efficiency and Performance of Electric Power Systems by Using Smart Grid Technology



Professor Nikolay V. Korovkin Chef of Theoretical Electrical Engineering Department Saint Petersburg State Polytechnical University Russia E-mail: nikolay.korovkin@gmail.com

Abstract: A new approach for optimization of power system states with Smart grid utilities will be proposed.

The development of electric power systems (EPS) goes to the construction of power plants, connection of new consumers to networks, introduction into service of new power transmission lines. The complication of electric power system structure and configuration results in reduction of their flexibility and has an adverse effect on the main indices of EPS performance: power distribution losses, power quality and power supply security. Actual conditions of operation and development of large EPS call for new control techniques to be introduced, that is why the elaboration of methods to control the power system operation and to optimize its states with respect to various criteria is now the trend of scientific researches of current concern.

Brief Biography of the Speaker: Education (degrees, dates, universities):

1978, Leningrad Polytechnic Institute, research engineer

1984, Leningrad State University, candidate of science (Phd)

1997, Saint Petersburg Polytechnic university, doctor of science

Career/Employment (employers, positions and dates):

1978, Leningrad State University, assistance professor

1984, Leningrad State University, docent

1997, Saint Petersburg Polytechnical university, professor

2010, Saint Petersburg Polytechnical university, head of Theoretical Electrical Engineering department

Modeling of Mechanism of State and Private Partnership Development of the Social Infrastructure in the Regions



Professor, Doctor of Science, Vice Rector Vladimir V. Gluhov Saint Petersburg State Polytechnical University Polytechnicheskaja str., 29, 195251, St. Petersburg Russia E-mail: vicerector.me@spbstu.ru

Abstract: 1. There are identified and analyzed the problems of development of social infrastructure in the regions of Russia. It is developed the mechanism and proposed the forms of cooperation for their solution on the basis of private and state partnership.

2. It is developed institutional framework for interaction between city administrations and business communities, aimed at creating an environment for effective development of the social infrastructure in the regions.

3. It is developed the game theory approach for modeling the interaction of city administrations and businesses considering the possible development of the institutional environment.

4. It is described a class of cooperative games simulating the interaction of businesses and city administration.

5. It is proposed a mechanism for solving the problems of social infrastructure development based on the analysis of game interaction models of city administrations and businesses.

Brief Biography of the Speaker: Vice-Rector for administrative and economic activity of St. Petersburg State Polytechnic University, Professor of Russian-German Center of Management and Marketing "Progress", laureate of state prize "President of Russian Federation Prize in Higher Education", laureate of St. Petersburg governor prize for excellence in higher education, laureate of V.V. Novozhilov prize (the Russian Academy of Sciences).

Member of following Academies:

- International Academy of Technological Cybernetics
- International Academy of Informational Support
- Baltic Academy of Informational Support
- International Academy of Ecology and Security Sciences
- Academy of Humanities
- International Academy of Higher School Science
- Academy of Municipal Sciences

The scholarly works of Vladimir V. Gloukhov develop the "effective management" research area.

Vladimir V. Gloukhov developed the full system of optimization mathematical models for iron and steel enterprises, which found their places in engineering practice and were described in "Mathematical methods and models in manufacturing planning and management" scientific work. These models formed a basis of new school of thought and applied research area – optimization models of iron and steel production.

Vladimir V. Gloukhov has also developed some methods of economic analysis of newest technological processes (in the fields of powder metallurgy, laser processing, ferrous and non-ferrous industry), which have later been implemented in many production enterprises of Russia. The theory of economic analysis of newest technological processes allowed to form the "economics and management of innovation technologies" educational direction.

On Complete Monotonicity of Some Functions of the Mittag-Leffler Type in Non-Debye Relaxation Processes



Professor Francesco Mainardi Department of Physics, University of Bologna, and INFN Via Irnerio 46, I-40126 Bologna, Italy E-mail: francesco.mainardi@bo.infn.it.it

Abstract: In this talk we discuss some interesting examples of relaxation occurring in viscoelastic and dielectric materials, which are described by special completely monotone functions of the Mittag-Leffler type. This means that these response functions are represented by continuous distributions of elementary (i.e. exponential) relaxation processes via non-negative spectra of relaxation in frequency or time. In addition to the well known functions of Mittag-Leffler type in one and two parameters, we revisit two more general kinds of Mittag-Leffler functions in three parameters, that is the Prabhakar and the Kilbas-Saigo functions. For all these functions we prove the conditions on the parameters to ensure the complete monotonicity and compute the corresponding frequency spectra. For some study-cases we present numerical results with illustrative plots for the field variable and for the corresponding spectral distribution. We hope that our results can be adopted when the field variable is the response function associated with non-Debye relaxation processes found e.g. in dielectrics. In particular we have derived as noteworthy particular cases the classical models of non-Debye relaxation phenomena referred to as Cole-Cole, Davidson-Cole, Havriliak-Negami along with the so-called Kohlrausch-Williams-Watts (KWW) law based on the stretched exponential function.

Brief Biography of the Speaker: For a full biography, list of references on author's papers and books see:

Home Page: http://www.fracalmo.org/mainardi/index.htm and http://scholar.google.com/citations?user=UYxWyEEAAAAJ&hl=en&oi=ao

From Physical to Mathematical Circuits: Theoretical and Practical Issues



Professor Massimo Ceraolo University of Pisa Italy E-mail: massimo.ceraolo@unipi.it

Abstract: Electrical engineers typically talk about "circuits", without first defining what a circuit really is. If we mean circuits to be sets of elements containing insulating and conducting material, as well as magnetic material, nearly everything is a circuit.

If, instead, we mean circuits as "sets of elements in which some wires that connect components to each other are clearly distinguishable", they constitute a set (the set of all possible circuits) that is a bit more limited, and maybe clear enough.

When talking about circuits, typically electrical engineers think of this latter definition. In addition, they typically assume that Kirchhoff's equations are valid for all circuits.

This creates theoretical and practical issues that are normally underestimated. In particular:

• Kirchhoff's laws are not valid in general. In the speech examples of "circuits" (according to the above definition) for which they are not valid are reported;

• the very concept of "potential" of points of the circuits is vague if not totally wrong.

The speech will discuss this inconsistence thoroughly and proposes a solution to the issues the fol-lowing approach:

• Systems in which electric and magnetic phenomena occur are simply called electromagnetic systems; for them Maxwell's equations are valid, where Kirchhoff's laws not only are not valid, but even loose meaning

• Systems in which electric magnetic phenomena occur and have a circuital shape, i.e. are composted by lumped components connected to each other by means of insulated wires, are called physical circuits. For them Maxwell's equations are still valid; they are susceptible to be abstracted in such a way that, under given conditions, mathematical circuits can be inferred from them

• Mathematical circuits, or simply circuits, are abstracted structures, that constitute under given conditions, approximations of actual physical circuits, for which Kirchhoff's equations are valid, or better, are postulated to be valid. As such, Kirchhoff's equations are just the version of the continuity (charge conservation) equation and energy conservation for mathematical circuits. Instead of the Maxwell's equations, for circuits Kirchhoff's and constitutive equations are valid.

Once circuits (the short name of mathematical circuits) are defined, not all problems are solved.

In the speech, the author shows that to obtain circuits from physical circuits containing transmission lines, for which Kirchhoff's laws are valid, is not always possible; however, a special version of them, that will be called metacircuit, will be introduced.

Again, it will be discussed that in circuits with ideal transformers do not allow Kirchhoff's laws to be written in their more common form, and special treatment is needed.

Circuits are lumped component systems: i.e., systems composed by components that are connected to each other through interfaces. Therefore their behavior over time can be computer-simulated using object-oriented tools and languages. The final part of the speech will show that the modern si-mulation language Modelica has an approach that is one perfectly in line with the analysis of this speech, and even the graphical tricks used to evidence lumped components and connections are in total agreement with the Modelica approach.

This gives additional usefulness to the approach proposed in the speech, and in its companion paper.

Brief Biography of the Speaker: Born in 1960, he took his Ms Degree in Electrical Engineering from the University of Pisa, with honours, in 1985. For some years he has worked in an Italian private research centre. Since 1992 he has been working in Electric Power Systems first as a researcher, then as a professor.

He is full professor of Electric Power Systems since 2002, and teaches Electric and Hybrid Vehicles at the University of Pisa and on-board Electrical Systems at the Naval Academy of Livorno.

He is author or co-author of more than one hundred National and International scientific papers, mainly regarding power systems, electrochemical energy storage, and electric and hybrid vehicles.

He is the chairman of the School of Engineering of the University of Pisa, that coordinates teaching activities of around 250 researchers and professors.

He is the main author of the IEEE-Wiley book "Fundamentals of Electric Power Engineering – from Electromagnetics to Power Systems".