ADVANCES IN MATHEMATICAL AND COMPUTATIONAL METHODS: ADDRESSING MODERN CHALLENGES OF SCIENCE, TECHNOLOGY, AND SOCIETY

Waterloo, Canada 25 – 29 July 2011

EDITORS

llias Kotsireas Roderick Melnik Brian West Wilfrid Laurier University, Waterloo, ON, Canada

All papers have been peer reviewed.

SPONSORING ORGANIZATIONS

Fields Institute for Research in Mathematical Sciences SHARCNET Mprime Maplesoft American Institute of Mathematical Sciences SIAM



Editors

Ilias Kotsireas Roderick Melnik Brian West

M²Net Lab and Mathematics Dept. and Dept. of Physics and Computer Science Wilfrid Laurier University 75 University Avenue West Waterloo, ON, Canada N2L3C5

Authorization to photocopy items for internal or personal use, beyond the free copying permitted under the 1978 U.S. Copyright Law (see statement below), is granted by the American Institute of Physics for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$30.00 per copy is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923, USA: http://www.copyright.com. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Services is: 978-0-7354-0928-6/11/\$30.00

© 2011 American Institute of Physics

No claim is made to original U.S. Government works.

Permission is granted to quote from the AIP Conference Proceedings with the customary acknowledgment of the source. Republication of an article or portions thereof (e.g., extensive excerpts, figures, tables, etc.) in original form or in translation, as well as other types of reuse (e.g., in course packs) require formal permission from AIP and may be subject to fees. As a courtesy, the author of the original proceedings article should be informed of any request for republication/reuse. Permission may be obtained online using RightsLink. Locate the article online at http://proceedings.aip.org, then simply click on the RightsLink icon/"Permissions/Reprints" link found in the article abstract. You may also address requests to: AIP Office of Rights and Permissions, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502, USA; Fax: 516-576-2450; Tel.: 516-576-2268; E-mail: rights@aip.org.

$AIP\ Conference\ Proceedings, Volume\ 1368$ Advances in Mathematical and Computational Methods: Addressing Modern Challenges of Science, Technology, and Society

Table of Contents

Preface: Advances in Mathematical and Computational Methods: Addressing Modern Challenges of Science, Technology, and Society Ilias Kotsireas, Roderick Melnik, and Brian West	1
MATHEMATICAL AND COMPUTATIONAL MODELS IN PHYSICAL SCIENCES AND ENGINEERING (PSE)	
A mixed finite element method with time relaxation for recirculating flows: The slip with	
friction boundary condition Monika Neda and Pengtao Sun	5
On conformal mappings of spherical domains Andrei Bourchtein and Ludmila Bourchtein	9
Numerical solution of the Dirac equation and applications in laser-matter interaction Francois Fillion-Gourdeau, Emmanuel Lorin de la Grandmaison, and André D. Bandrauk	13
Effects of pressure stress work and viscous dissipation in mixed convection flow along a vertical flat plate A. S. Bhuiyan and M. R. Biswas	17
The use of the Fourier transform for solving linear elasticity problems Tomas Kozubek and Lukas Mocek	21
Controllability and observability of linear time-varying impulsive systems on time scales Kexue Zhang and Xinzhi Liu	25
Effect of flow oscillation on dispersion of a solute in a tube P. Nagarani and B. T. Sebastian	29
Numerical bifurcation study of natural convection in a layer of fluid subject to spatially distributed heating A. Asgarian, M. Z. Hossain, and J. M. Floryan	33
Numerical experiments on existence and non-uniqueness of solutions of the thermistor problem with Helmholtz term Tim Kröger	37
Analysis and numerical approximation of viscosity solutions with shocks: Application to the plasma equation	
Susana Serna	41

Parallel FEM simulation of electromechanics in the heart Henian Xia, Kwai Wong, and Xiaopeng Zhao	45
Designing a Stochastic Adaptive Impulsive Observer for stochastic linear and nonlinear impulsive systems	
Moosa Ayati, Mohamad Alwan, Xinzhi Liu, and Hamid Khaloozadeh	49
Observer for singularly perturbed switched linear time-varying systems	
Moosa Ayati, Mohamad Alwan, Xinzhi Liu, and Hamid Khaloozadeh	53
Mean square stability of nonlinear stochastic impulsive systems with time delay Mohamad Alwan, Xinzhi Liu, and Wei-Chau Xie	57
Wohamad Alwan, Allizhi Elu, and Wel-Chau Ale	31
Thermally-robust asymmetric resonators for energy harvesting applications Pezhman A. Hassanpour, Patricia M. Nieva, and Amir Khajepour	61
Cell-centered finite difference methodology for solving partial differential equations on an unstructured mesh	
J. J. Situ, R. M. Barron, and M. Higgins	65
A cell-based finite difference method for the numerical solution of PDEs	
Ali Salih, R. M. Barron, and J. Freidl	69
Solving Fokker-Planck equation by two-dimensional differential transform Ümmügülsüm Cansu and Ozan Özkan	73
Stabilization of a class of nonlinear systems using state-dependent switching control and	
impulsive control Peter Stechlinski and Xinzhi Liu	77
Analysis and modelling towards hybrid piezo-electromagnetic vibrating energy harvesting	
devices Torsten Reuschel and Armaghan Salehian	81
Bulk properties of α-PbO from first-principle self-consistent calculations	
O. Rubel and A. Potvin	85
A regression algorithm for model reduction of large-scale multi-dimensional problems	0.0
Ehsan Rasekh	89
Large-eddy simulation of streamwise rotating turbulent thermal flows based on advanced subgrid-scale models	
Ye Zhang and Bing-Chen Wang	93
Symmetry-based design and fabrication of novel sensor systems	
A. Palacios, Huy Vu, Visarath In, and Patrick Longhini	97
Takens-Bogdanov bifurcation analysis in indirect field-oriented control	404
Fernando Verduzco and Francisco A. Carrillo	101

High-order method for modeling of aerodynamics of flapping wings: Airfoil-gust interaction Harish Gopalan and Alex Povitsky	105
Efficient methods for analysis of flows in grooved annuli H. Vafadar Moradi and J. M. Floryan	109
Mathematical results for some α models of turbulence with critical and subcritical regularizations Hani Ali	113
Inhomogeneous plane symmetric cosmological model in scale invariant theory B. Mishra	117
One dimensional model of semiconductor laser based on quantum well using non-equilibrium Green's functions method J. M. Miloszewski and M. S. Wartak	121
A linear programming network analysis of phosphorus reduction strategies for the Lake Simcoe watershed	
James MacLellan, Martin Bunch, and Kaz Higuchi	125
MATHEMATICAL AND COMPUTATIONAL MODELS IN LIFE SCIENCES (LS)	
Faster short DNA sequence alignment with parallel BWA D. Peters, K. Qiu, and P. Liang	131
Protein flexibility of dimers: Do symmetric motions play a role in allosteric interactions? Bernd Schulze, Adnan Sljoka, and Walter Whiteley	135
Computational graph theoretical model of the zebrafish sensorimotor pathway Joshua M. Peterson, Michael Stobb, Bori Mazzag, and Ethan Gahtan	139
Qualitative analysis of nutrient-phytoplankton models Qinghua Cai, Zakaria Mohamad, and Yuan Yuan	143
Towards inter- and intra- cellular protein interaction analysis: Applying the betweenness centrality graph measure for node importance Alan J. Barton and Arsalan S. Haqqani	147
Stability of stochastic switched SIRS models Xiaoying Meng, Xinzhi Liu, and Feiqi Deng	151
A Turing reaction-diffusion model for human cortical folding patterns and cortical pattern malformations Monica K. Hurdal and Deborah A. Striegel	155
Modeling the effect of topical oxygen therapy on wound healing Ephraim Agyingi, David Ross, and Sophia Maggelakis	159

Identification of transposon insertion polymorphisms by computational comparative	
analysis of next generation personal genome data Xuemei Luo, Frank Dehne, and Ping Liang	163
Predicting protein hinge motions and allostery using rigidity theory Adnan Sljoka and Alexandr Bezginov	167
The dynamics of a delayed predator-prey model with state dependent feedback control Anuraj Singh and Sunita Gakkhar	171
Modeling the effects of lipid composition on stratum corneum bilayers using molecular dynamics simulations J. Torin Huzil, Siv Sivaloganathan, Mohammad Kohandel, and Marianna Foldvari	175
Radiotherapy dose fractionation under parameter uncertainty Matt Davison, Daero Kim, and Harald Keller	179
MATHEMATICAL AND COMPUTATIONAL MODELS IN ECONOMICS, FINANCE, OPERATIONS RESEARCH AND SOCIAL SCIENCES (EFSS)	
An integrated model for supplier selection for a high-tech manufacturer Amy H. I. Lee, He-Yau Kang, and Chun-Yu Lin	185
New product development for green and low-carbon products—A case study of Taiwan's TFT-LCD manufacturer Chun-Yu Lin and Amy H. I. Lee	189
Worst case analysis for deterministic online algorithm in capacitated lot-sizing problem Ekaterina Kaganova	193
Pickup and delivery problem with stochastic travel times for semiconductor supply chains Chun-Mei Lai	197
The Augmented Lagrangian method applied to unsolvable power flows Mario C. Zambaldi, Juliano B. Francisco, and Luciano V. Barboza	201
Multi-objective programming for lot-sizing with quantity discount He-Yau Kang, Amy H. I. Lee, Chun-Mei Lai, Mei-Sung Kang	205
Game theory and social psychology: Conformity games Danielle Alessio and D. Marc Kilgour	209
A procedure for fair division of indivisible, identical objects with entitlements Andrew Kabbes, D. Marc Kilgour, and Ross Cressman	213
A hybrid modeling approach for option pricing Ehsan Hajizadeh and Abbas Seifi	217

Analysis of tax-deductible interest payments for re-advanceable Canadian mortgages Almas Naseem and Mark Reesor	221
Stochastic multi-commodity facility location based on a new scenario generation technique M. Mahootchi, M. Fattahi, and E. Khakbazan	225
Efficient variance reduction methods for Asian option pricing under exponential jump-diffusion models	
Yongzeng Lai, Yan Zeng, and Xiaojing Xi	229
NUMERICAL METHODS, ALGORITHMS, AND THEIR APPLICATIONS IN SCIENCES AND ENGINEERING (NMAA)	
Pointwise numerical index determination of unstructured DAEs René Lamour	235
A stability and cost study of explicit super and dyadic time stepping for stiff nonsymmetric problems	
K. F. Gurski	239
A time splitting semi-implicit scheme for atmospheric modeling Andrei Bourchtein and Ludmila Bourchtein	243
Sextic B-spline collocation algorithm for the modified equal width equation Saleh M. Hassan and D. G. Alamery	247
Hadamard factorization of stable polynomials Carlos Arturo Loredo-Villalobos and Baltazar Aguirre-Hernández	251
Steiner tree for fast data distribution Hongbing Fan and Yue-Ang Chen	255
Complexity and performance results for non FFT-based univariate polynomial multiplication	
Muhammad F. I. Chowdhury, Marc Moreno Maza, Wei Pan, and Eric Schost	259
Solving bivariate polynomial systems on a GPU Marc Moreno Maza and Wei Pan	263
Sparsity preserving computation for spectral projectors E. Fatih Yetkin and Hasan Dağ	267
On Hurwitz and Schur connecting-curves and dense trajectories J. A. López Rentería, B. Aguirre-Hernández, and F. Verduzco González	271

Strong-stability-preserving Hermite-Birkhoff time-discretizations of order 4 to 12 Truong Nguyen-Ba, Huong Nguyen-Thu, and Rémi Vaillancourt	275
Domain decomposition strategies with black box subdomain solvers Silvia Bertoluzza	279
Pryce structural analysis adapted to Hermite-Birkhoff-Taylor DAE solvers Truong Nguyen-Ba, Hemza Yagoub, and Rémi Vaillancourt	283
OTHER APPLICATIONS, INCLUDING DESIGN OF EXPERIMENTS, STATISTICAL SIGNAL AND IMAGE PROCESSING (OA)	METHODS,
Optimal and robust designs for full and reduced Fourier regression models Xiaojian Xu and Xiaoli Shang	289
Two maps and worldwide Ipod interest Reason L. Machete	293
Posterior density estimation for a class of on-line quality control models Chang C. Y. Dorea and Walter B. Santos	297
Analysis of monotonic discretizations for ODE parameter estimation Allan R. Willms and Emily K. Szusz	301
Exploiting domain knowledge to forecast heating oil consumption George F. Corliss, Tsuginosuke Sakauchi, Steven R. Vitullo, and Ronald H. Brown	305
Generating space-time auto-correlated fields on the sphere Martin Charron and Lubos Spacek	309
Robust designs for three commonly used nonlinear models Xiaojian Xu and Arnold Chen	313
Parallel univariate real root isolation on multicore processors Changbo Chen, Marc Moreno Maza, and Yuzhen Xie	317
Perceptual normalized information distance for image distortion analysis based on Kolmogorov complexity Nima Nikvand and Zhou Wang	321
Pipelined processing of x-ray microdiffraction data on multicores Michael A. Bauer, Alain Biem, Stewart McIntyre, and Yuzhen Xie	325
Counting vectors for orthogonal fractional factorial design generation Roberto Fontana	327
Author Index	331