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Mathematics and Computers in Biology & Biomedical Informatics

- Proceedings of the 14th International Conference on Mathematics and Computers in Biology and Chemistry (MCBC '13)
- Proceedings of the 6th International Conference on Biomedical Electronics and Biomedical Informatics (BEBI '13)

Baltimore, MD, USA, September 17-19, 2013

Scientific Sponsors

ISBN: 978-960-474-333-9

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Published by WSEAS Press
www.wseas.org

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.
See also: http://www.worldses.org/review/index.html

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Preface

This year the 14th International Conference on Mathematics and Computers in Biology and Chemistry (MCBC '13) and the 6th International Conference on Biomedical Electronics and Biomedical Informatics (BEBI '13) were held in Baltimore, MD, USA, September 17-19, 2013. The conferences provided a platform to discuss biochemistry, bio-engineering, chemical engineering, cell biology, bioinformatics, biomedical devices, neural engineering, medical imaging 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

Modeling Arterial Blood Flow with Stenosis

Professor Daniel N. Riahi
Professor Emeritus of Mechanical Science and Engineering
University of Illinois at Urbana-Champaign
&
Department of Mathematics
University of Texas-Pan American
USA
E-mail: driahi@utpa.edu

Abstract: In this lecture we first review mathematical modeling and analyses that have been carried out recently for steady and unsteady single-phase blood flow in arteries with stationary or time dependent stenosis of different types. The types of fluid were either Newtonian with an Einstein type viscosity model or non-Newtonian. Next, we consider the relevant governing equations for the two-phase blood flow in an artery and in the presence of a realistic stenosis. We determine solutions for the dependent variables of the flow system and present the results for various quantities such as the flow speed, pressure drop, impedance, shear stress and the associated forces for the blood flow system. We explain the main mechanisms that can be operative in such artery flow system and discuss the human operating conditions, under which our results can be beneficial to the patience's health.

Brief Biography of the Speaker: Daniel N. Riahi is Professor Emeritus in the Dept of Mechanical Science and Engineering at The University of Illinois at Urbana-Champaign (UIUC) and as Professor in the Dept of Math at The University of Texas-Pan American (UTPA). Dr. Riahi's research work & interest include studies in convection, flow instabilities & turbulence, flow during solidification & crystal growth, electromagnetic applications, and math modeling and theoretical developments with applications in engineering, mechanical and physical sciences. His research accomplishments include new theories and a number of discoveries in fundamental areas of convective and shear flows, some of which were already confirmed by the experimental studies.
Professor Riahi is Associate Fellow of American Institute of Aeronautics and Astronautics (AIAA) and Fellow of Wessex Institute of Technology of Great Britain. He was Honorary General Chair of the World Congress on Engineering and Technology (China, 2011) and Plenary Lecturers of several International Conferences. He received a number of awards including Service Recognition, Certificates, Honorific Title & Research Awards from UIUC. He was author of Chapters in a book that won the Best Basic Science Book-Award by IAA. He was awarded grants from NSF, NCSA, UIUC-RB, UTPA-FRC & URI and supervised NASA Sponsored Res. Projects. He is Editor and Editorial Board Member of over 20 technical journals and book series. He is author of over 360 publications mostly published in rigorously refereed journals, including books, invited articles, review articles and chapters of books.

ISBN: 978-960-474-333-9

Plenary Lecture 2

On Measuring Distance Between Distributions of Biological and Chemical Data

Professor Sung-Hyuk Cha
Seidenberg School of Computer Science and Information Systems
Pace University
USA
E-mail: scha@pace.edu

Abstract: Similarity or distance measure between two distributions plays important role in many problems in biology, chemistry, clustering, pattern recognition, statistics, and machine learning areas. The traditional minimum cost flow problem has been utilized as a distance measure between two distributions (transportation problem) such as the earth mover' distance (EMD). If the distributions have b number of bins or taxa, the cost matrix is b × b square matrix. While generic algorithms such as Simplex method or Hungarian method to compute the EMD take too long for users to wait for the output, efficient algorithms are known for several special histogram types such as nominal Θ(b), ordinal Θ(b), modulo O(b2). In this presentation, a variety of special classes of cost matrices such as star, linear, tree and ring cost matrices are formally defined and generalized and their respective efficient algorithms to compute the EMD shall be presented. A pendant arc elimination algorithm shall be also demonstrated to compute the EMD with a phylogenetic network in Θ(b). Algorithms to test whether a given cost matrix belongs to one of special topological classes of cost matrices will be also described. Main objective of this presentation pertains to reducing the computational complexity of EMD by analyzing topological patterns in cost matrices of various biological and chemical data.

Brief Biography of the Speaker: Dr. S.-H. Cha received his Ph.D. in Computer Science from State University of New York at Buffalo in 2001 and B.S. and M.S. degrees in Computer Science from Rutgers, the State University of New Jersey in 1994 and 1996, respectively. From 1996 to 1998, he was working in the area of medical information systems such as PACS, teleradiology, and telemedicine at Information Technology R&D Center, Samsung SDS. During his PhD years, he was affiliated with the Center of Excellence for Document Analysis and Recognition (CEDAR). Major contribution made at CEDAR includes dichotomy model to establish the individuality of handwriting, distance measures on histograms and strings, a nearest neighbor search algorithm, apriori algorithm, etc. supervised by Prof. Sargur N. Srihari. He has been a faculty member of Computer Science department at Pace University since 2001. His main interests include computer vision, data mining, pattern matching & recognition. He is a member of AAAI, IEEE and its Computer Society, and naun. He has over one hundred publications in highly rated ISI journals and conference proceedings with an h-index of 19.

ISBN: 978-960-474-333-9

Plenary Lecture 3

Computational Modeling of Agroindustrial Biosystems via Lattice-Boltzmann Method

Professor José A. Rabi
Department of Biosystems Engineering
Faculty of Animal Science and Food Engineering
University of São Paulo - Pirassununga Campus
Brazil
E-mail: jrabi@usp.br

Abstract: Computational modeling of food and bioprocesses has continuously increased not only because its importance has been recognized but also as suitable numerical techniques have been developed and applied. Lattice-Boltzmann method (LBM) is an alternative bottom-up approach dissimilar not only from long-standing top-down discretization methods (like finite differences, finite elements or finite volumes) but also from molecular dynamics, which is another bottom-up method. Besides code simplicity and possibility of parallel processing from the computational viewpoint, LBM benefits from fluid flow simulation by dismissing Navier-Stokes equations as well as from the ability to effortlessly deal with multiphase phenomena or moving boundaries on the modeling side. This lecture addresses basic concepts of LBM bearing in mind its application towards biospecific affinity chromatography, supercritical fluid extraction and bioreactors for wastewater treatment.

Brief Biography of the Speaker: José Rabi holds B.Sc. in Applied Physics from University of São Paulo (USP, 1995), M.Sc. in Mechanical Engineering from Aeronautical Institute of Technology (ITA, 1998) and Ph.D. in Mechanical Engineering from University of Campinas (UNICAMP, 2002), all aforesaid degrees received in Brazil. In 2003-2004 he joined the Department of Mechanical and Manufacturing Engineering at University of Calgary (Canada) as postdoctoral fellow and in 2009-2010 he joined IRSTEA - Institut National de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture (formerly CEMAGREF, France) as research fellow. From 2002 to 2004, he enrolled Catholic University of Minas Gerais (PUC-MG, Brazil), mostly teaching Numerical Methods and Transport Phenomena for Civil Engineering undergraduate courses and since late 2004 he has been affiliated to the Faculty of Animal Science and Food Engineering, University of São Paulo (FZEA-USP). Current graduate teaching comprises Numerical Methods for Materials Simulation and Scientific Research in Engineering while undergraduate teaching includes Transport Phenomena, Numerical Methods, Modeling & Simulation of Biosystems, Operations Research & Optimization. Former undergraduate teaching comprised Thermodynamics, Fluid Mechanics, Industrial Facilities, Fundamentals of Food Engineering, besides collaboration to Hydraulics, Electricity & Heat Generation, Heat & Mass Transfer, Introduction to Food Engineering and Introduction to Technical Writing. Research interests include computational modeling of agroindustrial biosystems via lattice-Boltzmann method, being author and co-author in more than 70 publications in terms of journal papers, congress full-papers and international book chapters.

ISBN: 978-960-474-333-9

Plenary Lecture 4

Numerical Methods to Boundary Layer Problems for Non-Newtonian Media

Professor Gabriella Bognar
Department of Analysis
Faculty of Mechanical Engineering and Informatics
University of Miskolc
Hungary
E-mail: matvbg@uni-miskolc.hu

Abstract: Fluid mechanics plays a much more important role than ever before since Prandtl proposed the boundary layer theory. So far, this theory has been widely used in metallurgical industry, material industry, and petrochemical industry.
We consider the two-dimensional steady flow of a non-Newtonian fluid of constant density modeled by a power law fluid due to Ostwald-de Waele over a plate moving continuously with a constant velocity in an otherwise quiescent fluid medium, or over a steady plate placed into a fluid flow. The boundary layer equations, the continuity and momentum equations, and the appropriate boundary conditions are considered.
Similarity analysis of the boundary flow over a flat surface in a non-Newtonian fluid is considered. Introducing the stream function in governing partial differential equations of mathematical models of various physical processes and similarity analysis is applied to obtain the corresponding boundary value problems. We study the applicability of different numeric techniques for the determination of the velocity profiles to different problems.

Brief Biography of the Speaker: Professor Bognar received the M.Sc. in Mechanical Engineering from University of Miskolc, Miskolc, Hungary, Ph.D. and 'Candidate' degree in mathematics from the Hungarian Academy of Sciences. Since her graduation she has been teaching different subjects of mathematics for undergraduate, graduate and doctoral students at University of Miskolc. She was conferred the postdoctoral lecture qualification (Dr. habil) in 2006. Her research interests include boundary and eigenvalue problems of nonlinear ordinary and partial differential equations. Gabriella Bognar has authored/edited 11 books, and published over 120 research papers. She also serves as the Vice Dean for Research and International Affairs at the Faculty of Mechanical Engineering and Informatics, University of Miskolc.

ISBN: 978-960-474-333-9

Plenary Lecture 5

Computational Models for Tinnitus Generation and its Management by Sound Therapy

Professor Hirofumi Nagashino
Subdivision of Biomedical Information Science
Division of Health Sciences
Institute of Health Biosciences
The University of Tokushima
Japan
E-mail: nagasino@medsci.tokushima-u.ac.jp

Abstract: Tinnitus is the perception of sound in the ears or in the head where no external source is present. Sound therapy is one of the most effective techniques for tinnitus treatment that have been proposed. The contribution of neural plasticity to tinnitus has been widely discussed in order to understand the neural correlates of tinnitus. In order to investigate mechanisms of tinnitus generation and the clinical effects of sound therapy, we have proposed computational and dynamical models with plasticity using a neural oscillator or a neuronal network model described by simplified Hodgkin-Huxley equations or an integrate-and-fire neuron model. For generation of tinnitus and effect of sound therapy, Hebbian hypothesis, spie-time-dependent plasticity or homeostatic plasticity is employed in the models. The computer simulation of the models shows that the models are able to replicate the generation of tinnitus and the clinical results that human auditory system temporarily halts perception of tinnitus following sound therapy.

Brief Biography of the Speaker: Hirofumi Nagashino received the Bachelor of Engineering and Master of Engineering degrees in Electrical Engineering from The University of Tokushima, Japan in 1972 and 1974, respectively. He received the Doctor of Engineering degree in 1982 from Osaka University, Japan, with the study of analysis of neural network models with reciprocal inhibition.
In 1974 he joined Department of Electrical Engineering, Faculty of Engineering, The University of Tokushima as an assistant professor and was promoted to associate professor in Department of Electrical and Electronic Engineering, Faculty of Engineering, The University of Tokushima. Since 2002 he has been a professor in Department of Radiologic Science and Engineering, School of Health Sciences, Faculty of Medicine, The University of Tokushima. Since 2008 he also has been a professor in Subdivision of Biomedical Information Science, Division of Health Sciences, Institute of Health Biosciences, The University of Tokushima. His research interest includes biocybernetics, neural networks and its application to biomedical engineering, particularly neural network models for oscillatory activities, signal source identification, pattern recognition, etc. He is an author (co-author) of more than 100 papers published in international journals and conference proceedings.

ISBN: 978-960-474-333-9

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ISBN: 978-960-474-333-9