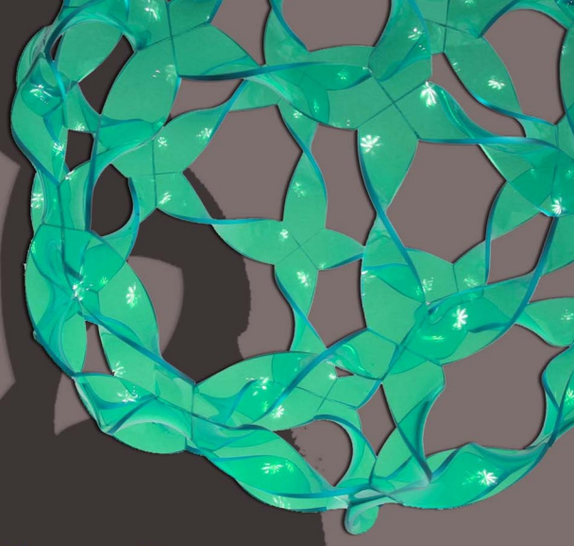

Advances in Applied and Pure Mathematics

Proceedings of the 2014 International Conference on
Pure Mathematics, Applied Mathematics, Computational Methods
(PMAMCM 2014)

Santorini Island, Greece, July 17-21, 2014

Edited by

Nikos E. Mastorakis
Panos M. Pardalos
Ravi P. Agarwal
Ljubiša Kočinac

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Keynote Lecture 1

New Developments in Clifford Fourier Transforms

Sen. Ass. Prof. Dr. rer. nat. Eckhard Hitzer
Department of Material Science
International Christian University
Tokyo, Japan
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Abstract: We show how real and complex Fourier transforms are extended to W.R. Hamilton's algebra of quaternions and to W.K. Clifford's geometric algebras. This was initially motivated by applications in nuclear magnetic resonance and electric engineering. Followed by an ever wider range of applications in color image and signal processing. Clifford's geometric algebras are complete algebras, algebraically encoding a vector space and all its subspace elements, including Grassmannians (a vector space and all its subspaces of given dimension k). Applications include electromagnetism, and the processing of images, color images, vector field and climate data. Further developments of Clifford Fourier Transforms include operator exponential representations, and extensions to wider classes of integral transforms, like Clifford algebra versions of linear canonical transforms and wavelets.

Brief Biography of the Speaker: http://erkenntnis.icu.ac.jp/

Keynote Lecture 2

Robust Adaptive Control of Linear Infinite Dimensional Symmetric Hyperbolic Systems with Application to Quantum Information Systems

Prof. Mark J. Balas
Distinguished Faculty
Aerospace Engineering Department &
Electrical Engineering Department
Embry-Riddle Aeronautical University
Daytona Beach, Florida
USA
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Abstract: Symmetric Hyperbolic Systems of partial differential equations describe many physical phenomena such as wave behavior, electromagnetic fields, and quantum fields. To illustrate the utility of the adaptive control law, we apply the results to control of symmetric hyperbolic systems with coercive boundary conditions.
Given a Symmetric Hyperbolic continuous-time infinite-dimensional plant on a Hilbert space and disturbances of known and unknown waveform, we show that there exists a stabilizing direct model reference adaptive control law with certain disturbance rejection and robustness properties. The closed loop system is shown to be exponentially convergent to a neighborhood with radius proportional to bounds on the size of the disturbance. The plant is described by a closed densely defined linear operator that generates a continuous semigroup of bounded operators on the Hilbert space of states. We will discuss the need and use of this kind of direct adaptive control in quantum information systems.

Brief Biography of the Speaker: Mark Balas is presently distinguished faculty in Aerospace Engineering at Embry-Riddle Aeronautical University. He was the Guthrie Nicholson Professor of Electrical Engineering and Head of the Electrical and Computer Engineering Department at the University of Wyoming. He has the following technical degrees: PhD in Mathematics, MS Electrical Engineering, MA Mathematics, and BS Electrical Engineering. He has held various positions in industry, academia, and government. Among his careers, he has been a university professor for over 35 years with RPI, MIT, University of Colorado-Boulder, and University of Wyoming, and has mentored 42 doctoral students. He has over 300 publications in archive journals, refereed conference proceedings and technical book chapters. He has been visiting faculty with the Institute for Quantum Information and the Control and Dynamics Division at the California Institute of Technology, the US Air Force Research Laboratory-Kirtland AFB, the NASA-Jet Propulsion Laboratory, the NASA Ames Research Center, and was the Associate Director of the University of Wyoming Wind Energy Research Center and adjunct faculty with the School of Energy Resources. He is a life fellow of the AIAA and a life fellow of the IEEE.

Keynote Lecture 3

Multidimensional Optimization Methods with Fewer Steps Than the Dimension: A Case of "Insider Trading" in Chemical Physics

Prof. Paul G. Mezey
Canada Research Chair in Scientific Modeling and Simulation
Department of Chemistry and Department of Physics and Physical Oceanography
Memorial University of Newfoundland
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Abstract: "Insider trading" in commerce takes advantage of information that is not commonly available, and a somewhat similar advantage plays a role in some specific, very high-dimensional optimization problems of chemical physics, in particular, molecular quantum mechanics. Using a specific application of the Variational Theorem for the expectation value of molecular Hamiltonians, an optimization problem of thousands of unknowns does often converge in fewer than hundred steps. The search for optimum, however, is typically starting from highly specific initial choices for the values of these unknowns, where the conditions imposed by physics, not formally included in the optimization algorithms, are taken into account in an implicit way. This rapid convergence also provides compatible choices for "hybrid optimization strategies", such as those applied in macromolecular quantum chemistry [1]. The efficiency of these approaches, although highly specific for the given problems, nevertheless, provides motivation for a similar, implicit use of side conditions for a better choice of approximate initial values of the unknowns to be determined.

[1]. P.G. Mezey, "On the Inherited "Purity" of Certain Extrapolated Density Matrices", Computational and Theoretical Chemistry, 1003, 130-133 (2013).

Brief Biography of the Speaker: http://www.mun.ca/research/explore/chairs/mezey.php

Keynote Lecture 4

MvStudium_Group: A Family of Tools for Modeling and Simulation of Complex Dynamical Systems

Professor Yuri B. Senichenkov
co-author: Professor Yu. B. Kolesov
Distributed Computing and Networking Department
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Abstract: Designing of new version of Rand Model Designing under the name RMD 7 is coming to an end. It will be possible using dynamic objects, dynamic connections (bonds), and arrays of objects in the new version. These types are used for Simulation Modeling, and Agent Based Modeling. The first trial version will be available at year-end.
The tools developed by MvStudium_Group are considered by authors as universal tools for automation modeling and simulation of complex dynamical systems. We are feeling strongly that at least nitty-gritty real system is multi-component, hierarchical, and event-driven system. Modeling of such systems requires using object-oriented technologies, expressive graphical languages and various mathematical models for event-driven systems. The last versions of Model Vision Modeling Language are intended for multi-component models with variable structure and event-driven behavior.

Brief Biography of the Speaker: PhD degree in Numerical Analysis from St. Petersburg State University (1984).
Dr. Sci. degree (Computer Science) from St. Petersburg Polytechnic University (2005).
Author of 125 scientific publications-conference papers, articles, monographs and textbooks.
A board member of National Simulation Society - NSS (http://simulation.su/en.html), and Federation of European Simulation Societies- EuroSim (http://www.eurosim.info/).
A member of Scientific Editorial Board of "Simulation Notes Europe" Journal (http://www.sne-journal.org/), and "Computer Tools in Education" Journal(http://ipo.spb.ru/journal/).
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