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Recent Advances in Robotics, Aeronautical & Mechanical Engineering

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Proceedings of the 1st International Conference on Aeronautical and Mechanical Engineering (AEME '13)

Vouliagmeni, Athens, Greece, May 14-16, 2013

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Preface

This year the 1st International Conference on Mechanical and Robotics Engineering (MREN '13) and the 1st International Conference on Aeronautical and Mechanical Engineering (AEME '13) were held in Vouliagmeni, Athens, Greece, May 14-16, 2013. The conferences provided a platform to discuss mechanics of nanomaterials, advanced materials and smart structures, autonomous vehicles, human-robot interaction, robot intelligence, control and supervision systems, image processing, mathematical modeling in fluid mechanics, wave modeling, atmospheric chemistry, alternative fuels 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

Authentication And Secure Robot Communication

Professor Evangelos A. Yfantis
Director of the ICIS Laboratory
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Abstract: The majority of industrial, educational, medical and other robots have internet connection for wireless communication to their file server, and communication with one another. Wireless communication makes the devices vulnerable to hacker attacks, considering that many of these devices often times are not well protected. Hackers therefore target robots and use them as an entry point to the robot's organization network in order to either obtain scientific and technical information illegally, or cause distraction to the organizational network. We provide a method for secure wireless communication in this case with secret key distribution along with confidentiality and authentication. Our system includes public private key cryptography along with session key generation and symmetric key cryptography. The Public private key is generated using elliptic curves $y^2=x^3+ax^2+b \bmod p$ where $0\le x,y\le p-1$ and $1\le a,b\le p-1$. The coefficients a, b are chosen so that the genus 1 elliptic curve expressed by the Weierstrass equation is nonsingular and therefore satisfies the condition $4a^3+27b^2\ge 0$ p is chosen to be a 256-bit prime number, thus we developed 512 software bit registers in our board to perform 256 bit multiplications and divisions.

Brief Biography of the Speaker: E. A. Yfantis, is the director of the ICIS lab. And a full professor of Computer Science, which is part of the Engineering College at the Unversity of Nevada, Las Vegas. Dr. Yfantis is the author of over 200 reseach papers and technical reports in the areas of Computer Science, Information theory, Internet Intelligence, Signal Processing, Communication, Statistical Pattern Recognition, Probability theory, Statistics, Ocean Engineering, Aerodynamics, Electrical Engineering, Medicine, Visualization, Enviromental Protection, and Chemometrics. He has been a consultant for NASA, Los Alamos Scientific Laboratory, Sandia Laboratories, Lawrence Livermore Laboratories, EG&G, Naval Ocean System Center in Santiego California, Corps of Engineers U.S. Army, Lockheed Engineering and Aerospace, Northrop, NSTeC, U.S. EPA, U.S. Department of Energy, SGI, Exxon Corporation, Shell Oil Company, Bedix Corporation, Nevada Gaming Control Board, and many other companys in the US and Canada. His Education includes: Computer Science, Mathematics, Signal Processing, Statistics, Aeronautics, Ocean Engineering, and Electrical Engineering. He was educated at the Universities of: Athens Greece, Rutgers University in New Brunswick, N.J. U.S.A., New Jersey Institute of Technology, Newark, N.J., Fairleigh Dickinson University, Teaneck, N.J., U.S.A., University of Wyoming, Laramie, U.S.A., Columbia University in N.Y., N.Y., U.S.A, the University of Delaware, Newark, Delaware, U.S.A., School of Aeronautics in Teteboro N.J., U.S.A. He holds a Pilot's License, and is a certified Scuba Diver by PADI. Hi current research interests are Computer-Robot Vision, Machine Vision, Machine Intelligence, Statistical Pattern Recognition, and Multimedia Communication.

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Plenary Lecture 2

The Robot Real Time Control Using the Extenics Multidimensional Theory

Professor Luige Vladareanu
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Abstract: The paper presents new concepts and approaches for solving contradictory problems in the constrained motion robot control using extenics multidimensional theory. Starting from the extension distance defined by Prof. Cai Wen, the founder of Extenics and using the linear and non-linear attraction point principle and the network of attraction curves, there is determined the 2D space Dependent Function generated by position and force in relation to Standard Positive Field for a active compliant control. The generalization of the extension distance and dependent function to two dimensions through Extenics multidimensional theory, eliminates the crisp logic matrix of Cantor logic which describes the position-force sequences. Defining the location value of a point and processing of the dependent function of a point on a single finit interval from one dimension, force or position, to two dimensions, force and position, the architecture of the extension hybrid force-position control was developed applying the dynamic feedback control with resolved acceleration, followed by processing of the final error through fuzzy control. Using extended transformations onto the real numbers set and an optimization function generated by the extended dependence function in 2 D space, the final conclusions lead to a methodology that allows obtaining high level results for hybrid position-force control in comparison to the classical method using sequential logic matrices corresponding to Cantor logic. The obtained results, by applying this advanced method of the extension hybrid force-position control, have allowed relaxation of the control system, improving the motion accuracy in conditions of high stability of the robotics and mechatronics systems.

Brief Biography of the Speaker: Luige Vladareanu received Ph.D. degree in electronics field from the Institute of Solid Mechanics of Romanian Academy, in 1998. From 2003, Ministry of Education and Research, executive Department for Financing Superior Education and of Scientific University Research - High Level Expert Consulting for MEC/CNCSIS project, from 2003-2005, member of Engineering Science Committee of Romanian National Research Council, from 2005, Scientific Researcher Gr.I (Professor) of Romanian Academy, from 2009 Head of Robotics and Mechatronics Department of Institute of Solid Mechanics, Romanian Academy. His scientific work is focused on real time control in solid mechanics applied in robot trajectory control, hybrid position – force control, multi-microprocessor systems for robot control, acquisition and processing of experimental physical data, experimental methods and signal processing, nano-micro manipulators, semi-active control of mechanical system vibrations, semi-active control of magnetorheological dissipaters systems, complex industrial automations with programmable logical controllers in distributed and decentralized structure. He has published over 35 books and book chapters, 11 edited books, over 200 papers in journals, proceedings and conferences in the areas. Director and coordinator of over 15 grants of international and national research – development programs in the last 5 years, 15 invention patents, developing 17 advanced work methods resulting from applicative research activities and more then 60 research projects. He is the winner of the two Prize and Gold of Excellence in Research 2000, SIR 2000, of the Romanian Government and the Agency for Science, Technology and Innovation. 9 International Invention and Innovation Competition Awards and Gold of World's Exhibition of Inventions, Geneva 2007 - 2009, and other 9 International Invention Awards and Gold of the Brussels, Zagreb, Bucharest International Exhibition. He received "Traian Vuia" (2006) award of the Romanian Academy, Romania's highest scientific research forum, for a group of scientific papers published in the real time control in the solid mechanics. He is a member of the International Institute of Acoustics and Vibration (IIAV), Auburn University, USA (2006), ABI´s Research Board of Advisors, American Biographical Institute (2006), World Scientific and Engineering Academy Society, WSEAS (2005), International Association for Modelling and Simulation Techniques in Enterprises - AMSE, France (2004), National Research Council from Romania(2003-2005), etc. He is a PhD advisor in the field of mechanical engineering at the Romanian Academy. He was an organizer of several international conferences such as the General Chair of four WSEAS International Conferences (http://www.wseas.org/conferences/2008/romania/amta/index.html), chaired Plenary Lectures to Houston 2009, Harvard, Boston 2010 and Penang, Malaysia 2010, Paris 2011 to the WSEAS International Conferences, is team leader of WSEAS scientific research project: Mechanics & Robotics Systems and is serving on various other conferences and academic societies.

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Plenary Lecture 3

Application of Nano Fluids in Machining

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Abstract: This paper focuses on the application of eco friendly nano fluids in machining processes like turning. One of the most critical factors which determine the work piece quality is the heat generated at cutting zone during machining operations. Conventional cutting fluids are vastly employed to dissipate the heat generated during machining. In spite of their wide use, conventional cutting fluids do cast a check to the health of workers and ecological balance. Owing to this reason, researchers have initiated the search for ecologically safe and user friendly alternatives to conventional cutting fluids. In this context, experiments are being carried out by researches to assess the performance of vegetable oil based nano cutting fluids in machining. An attempt is made in this paper to present the affirmative performance of nano solid lubricant suspensions in vegetable oils in turning of AISI1040 steel in minimum quantity lubrication (MQL).
Nano cutting fluids are prepared using three vegetable oils, they being canola, coconut and soy bean oils, which act as base lubricants with suspensions of 100nm sized boric acid particles. Characterization of nano particles is done by X-Ray Diffraction (XRD) to confirm their purity. Particle size analyzer is used to check the particle size of nano solid lubricant. To check the viability of nano lubricants in machining, variation of basic properties like thermal conductivity, specific heat and heat transfer coefficient are evaluated from empirical relations. The variation of cutting tool temperatures, average tool flank wear and surface roughness of the machined surface with cutting speed and feed are studied with the prepared nano cutting fluids. It has been observed results are encouraging, especially among the three oils used coconut oil based nano cutting fluid has exhibited better performance.

Brief Biography of the Speaker: G. Krishna Mohana Rao is a member of ASME, ISTE, IE(I). He was born at Machilipatnam, AP, India on 05.05.1970. He received his bachelors' degree in mechanical engineering from Nagarjuna University, AP, India in the year 1992. Later, he was awarded masters degree in mechanical engineering by the Indian Institute if Science, Bangalore, India in the year 1994. He received his doctoral degree in mechanical engineering from JNT University, Hyderabad, AP, India in the year 2007. He has been working for JNT University, AP, India since 1994. He is on the review board for many international journals. He has published 40 technical papers in international journals and conferences. He co-authored a book on engineering mechanics published by Pearson education. He visited countries including USA, UK, Egypt, UAE, China, Malaysia, Singapore, Hongkong, Thailand, Italy, Switzerland and Austria for presenting his papers in various international conferences. His areas of research include non-traditional machining, casting, welding. Presently, he is guiding 13 research students in the area of mechanical engineering.

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Plenary Lecture 4

The Flow of Gravity Currents and Intrusions: A Test-Case for the Power and Limitations of Simple Mathematical Models in the Prediction of Complex Phenomena

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Abstract: A gravity current appears when fluid of one density, ρc, propagates into another fluid of a different density, ρa, and the motion is mainly in the horizontal direction. A gravity current is formed when we open the door of a heated house and cold air from outside flows over the floor into the less dense warm air inside. A gravity current is formed when we pour honey on a pancake and we let it spread out on its own. A gravity current which propagates inside a stratified fluid (rather than along a boundary) is called "intrusion." Gravity currents (intrusions) originate in many natural and industrial circumstances and are present in the atmosphere, lakes and oceans as winds, cold or warm streams or currents, polluted discharges, volcanic ash clouds, etc. The efficient understanding and prediction of this phenomenon is important in numerous industrial, geophysical, and environmental circumstances.
Simple qualitative consideration and observations indicate that the gravity current is a very com- plex, multi-faced, and parameter-rich physical manifestation. Nevertheless, the gravity current also turns out to be a modeling-friendly phenomenon. Indeed, visualizations of the real flow field reveal an extremely complicated three-dimensional motion, with an irregular interface, billows, mixing, and instabilities. The accurate numerical simulation of this flow from the full set of governing equations (the Navier-Stokes system) requires weeks of number-crunching on powerful computer arrays. On the other hand, there are "mathematical models" for the gravity current, whose derivation is based on a long line of assumptions such as hydrostatic pressure, sharp interface, Boussinesq system, thin layer, idealized release conditions. This simplified set of equations enables us to determine the behavior of the averaged variables entirely from analytical considerations and/or numerical solutions that require insignificant CPU time.
The lecture gives a brief presentation of some typical models and solutions. We show that: (a) Qualitatively, the simplified theory is able to provide the governing dimensionless parameters and the salient features of the various flow regimes; and (b) Quantitatively, the simple models predict velocities of propagation which agree with experiments and full Navier-Stokes simulations within a few percent, typically within the range of the experimental errors. We argue that the gravity-current analysis can be considered a test-case for the methodology of flow-field modelling: the fact that simple models give useful predictions is a result of well-selected physical components. The implementation of this conclusion in the selection of reliable tools for practical applications is discussed.

Brief Biography of the Speaker: Ungarish is presently George Farkas Professor in the Department of Computer Science at the Technion, Israel Institute of Technology, Haifa. His research is focused on modelling, simulation and interpretation of fluid dynamic problems. He graduated Cum Laude in Aeronautical Engineering at the Technion, and did his DSc at the same institute in Applied Mathematics on the simulation and modelling of rotating fluids. He continued his work on similar problems at MIT in the department of Applied Mathematics as a Rothschild and Bantrell post-doc (with H. P. Greenspan) and lec- turer. He has held numerous visiting positions including at MIT, University of Cambridge DAMTP, Technical University Vienna, Institut Polytechnique de Grenoble, University of Witwatersrand at Johannesburg, University of Florida at Gainesville, and National Taiwan University at Taipei.
Ungarish is an authority in modelling and investigation of motion of complex fluids in the presence of gravity, centrifugal and Coriolis forces. He made fundamental contributions to the understanding, modelling and simulation of spin-up processes (of suspensions, stratified fluids, and magnetohydro- dynamical fluids), the Taylor column effect, and propagation of gravity currents and intrusion, in particular for stratified and non-Boussinesq systems (a topic of high relevance to environmental flows like propagation of pollutants, volcanic ash clouds, oil slicks over the sea surface, and similar phe- nomena). He published numerous research papers on these topics in prestigious journals, contributed the chapter on gravity currents in the recent "Handbook of Environmental Fluid Dynamics" (edited by H. J. Fernando, CRC Press, Taylor and Francis Group, 2012), and wrote two well-received books: "Hydrodynamics of Suspensions: Fundamentals of Centrifugal and Gravity Separation," Springer- Verlag, 1993; and "An Introduction to Gravity Currents and Intrusions," CRC Press, Taylor and Francis Group, 2009.

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Plenary Lecture 5

Features of the Universe Simulators Based on the Variability of Time Measurement Standards

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Abstract: The proposed approach is based on the combination of differential equation reflecting linear measurement standards variability and of the Hubble Law used for new Universe simulators development, describing gravity and inertia as manifestations of reaction forces. Also this approach on the one hand permits us to predict some important features of the Universe, such as spontaneous growth of distance between two resting objects detected by an observer at one of these objects, and on the other hand it gives us new interpretation of known facts, such as galaxies scattering, constancy of any solid body linear dimensions in time, as well as constancy of mass of stable physical objects. Presented are results and conditions of gravity control experiments based on the developed models.

Brief Biography of the Speaker: Vitaly Groppen graduated from the North-Caucasian Institute of Mining and Metallurgy, Russia in 1967. In the 1960s he worked as an Assistant Professor at the Department of Industrial Electronics in the North-Caucasian Institute of Mining and Metallurgy, Vladikavkaz, North Ossetia, Russia. In 1973 he graduated from postgraduate courses in the Institute of Control Science of Russian Academy of Sciences (Moscow, 1970 – 1973) and worked as the Head of Computing Centre of North-Caucasian Institute of Mining and Metallurgy (1973 – 1980) and as an assistant (1973 – 1976) and as Docent (1976 -1988) at the Department of Mathematics in the same institution. In the 1980s he continued as Senior Specialist of the Data Processing Department in the Dresden Technical University (German Democratic Republic, Dresden, 1980), and in the Leipzig Technical Higher School (German Democratic Republic, Leipzig, 1985). Since 1987 until 1989 he is Professor and Head of the Department of Mathematics in the North-Caucasian Institute of Mining and Metallurgy, North Ossetia, Russia, but from 1989 until now – founder and head of the Automated Data Processing Department in the same Institution. In the 1990s he was a visiting Lecturer in the Catalonia Technical University (Barcelona, Spain, 1990) and in the LG Research Centre (Seoul, Republic Korea, 1995). Since 1999 he is member of European Mathematical Society and since 2008 he is the Director of the Scientific-Research Institute of Applied and Theoretical Informatics (Vladikavkaz, North Ossetia, Russia). His research interests are focused on mathematical modeling, astronomy, physics, optimization theory and its' applications, graphs theory, discrete programming, theory of games, taxonomy, solutions making theory, computer aided images processing, optimal program codes design. He is the author of 125 papers, 5 patents and 7 monographs.

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