Editors: Imre J. Rudas, Azami Zaharim,
Kamaruzzaman Sopian, Jiri Strouhal

# Recent Researches in Communications, Electronics, Signal Processing & Automatic Control

- Proceedings of the 11th WSEAS International Conference on Electronics, Hardware, Wireless and Optical Communications (EHAC '12)
- Proceedings of the 11th WSEAS International Conference on Signal Processing, Robotics and Automation (ISPRA '12)
- Proceedings of the 4th WSEAS International Conference on Nanotechnology (NANOTECHNOLOGY '12)

Cambridge, UK, February 22-24, 2012

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**Preface**

This year the 11th WSEAS International Conference on Electronics, Hardware, Wireless and Optical Communications (EHAC '12), the 11th WSEAS International Conference on Signal Processing, Robotics and Automation (ISPRA '12) and the 4th WSEAS International Conference on Nanotechnology (NANOTECHNOLOGY '12) were held in Cambridge, UK, in February 22-24, 2012. The multiconference provided a platform to discuss electronics, hardware engineering, wireless and optical communications, network technologies and architectures, signal, sound and image processing, robotics, automatic control, nanocircuits etc. with participants from all over the world, both from academia and from industry.

Its 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 this multiconference 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.

A multiconference such as this 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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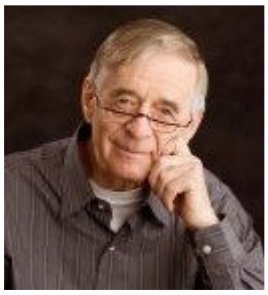
## Plenary Lecture 1

# Phase Diversity Principal for Mitigation of Channel Effects in Mobile Communication Systems

**Professor Motti Haridim and Professor Michael Bank**
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**Abstract:** There exist several methods for mitigating the impact of channel conditions on signal integrity. These methods increase both the transmitting power and redundancy. In this paper we review the known Phase Diversity method proposed by Walter Bruch for mitigating phase distortions in the PAL TV systems, and discuss its applications in modern wireless communications such as MIMO systems based on the Alamouti algorithm. We'll present the implementation of this method in FBS systems, which allow for elimination of Doppler Effects on OFDMA signals without pilot signals.

**Brief Biography of the Speaker:** Motti Haridim received his M.Sc. in electrical engineering from the University of Washington in 1986 and in his Ph.D in electrical engineering.E. from Technion Israel (1992). Since 1994 he has joined HIT- Holon Institute of Technology. During 2002-2008 Prof. Haridim was the head of the Dept. of Communication Engineering at HIT. His research activities focus mainly on the physical layer of communication systems, including optical communications, RF communications, and antennas. He has published over 80 papers on theoretical and applied aspects of antennas, RF communications and optical communications. Prof. Haridim acts as a consultant in RF communication systems and antennas to several large Israeli companies.

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## Plenary Lecture 2

# Efficient Biclustering Algorithms and Their Applications to Multidimensional Biological Data Analysis

**Professor Hong Yan**
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**Abstract:** Clustering algorithms have many useful applications in signal processing and pattern recognition. In conventional clustering methods, we classify objects in terms of all features available and measure the similarity between two objects using a distance metric. In biclustering, we detect coherent patterns in both object and feature directions and we are interested in data consistency, such as simultaneous downward or upward changes of a subset of features for a subset of objects, rather than the distances among all objects for all features. Biclustering is naturally more difficult than clustering computationally and is often considered intractable mathematically. We have recently developed hyperplane based methods for the detection of a class of biclusters in a high-dimensional signal space. Our methods provide a unified model for several types of biclusters and can be implemented using efficient signal processing algorithms. We have also found an interesting link between biclustering and the spectral graph theory. We have applied our biclustering methods to disease diagnosis and drug therapeutic effect assessment using DNA microarray gene expression data. For example, we are able to identify biclusters of a subset of genes that co-express under a subset of conditions. These biclusters are useful for the identification of caner types and sub-types. We have also implemented biclustering algorithms on the field-programmable gate array (FPGA) for fast computation. In this seminar, the recent work of our research group on biclustering methods and their applications will be presented.

**Brief Biography of the Speaker:** Hong Yan received his Ph.D. degree from Yale University. He was Professor of Imaging Science at the University of Sydney and is currently Professor of Computer Engineering at City University of Hong Kong. His research interests include image processing, pattern recognition and bioinformatics, and he has over 300 journal and conference publications in these areas. Professor Yan was elected an IAPR fellow for contributions to document image analysis and an IEEE fellow for contributions to image recognition techniques and applications.

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## Plenary Lecture 3

# Algebraic Solutions to Scheduling Problems in Project Management

**Associate Professor Nikolai Krivulin**
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**Abstract:** The problem of scheduling a large-scale set of activities is a key issue in project management. There is a variety of project scheduling techniques developed to handle different aspects of the problem, ranging from the classical Critical Path Method and the Program Evaluation and Review Technique marked the beginning of the active research in the area in 1950s, to more recent methods of idempotent algebra. This algebra, which deals with vector semimodules over idempotent semirings, finds expanding application as a promising modeling and solution tool in applied mathematics, computer science, and operations research. The progress in the area is mainly due to the fact that many complicated problems that are actually nonlinear in the ordinary sense become linear and so more tractable when translated into the language of the algebra.
We describe a computational approach to project scheduling problems, which offers a useful way to represent different types of precedence relationships among activities in a project as linear vector equations and inequalities written in terms of an idempotent semiring. As a result, many issues in project scheduling reduce to solving computational problems in the idempotent algebra setting, like linear equations and the eigenvalue-eigenvector problem. We start with a brief introduction to idempotent algebra including main definitions, notation, and basic results that underlie subsequent applications. Furthermore, actual problems in project scheduling are considered. We show how to formulate the problems in terms of idempotent algebra, and present related algebraic solutions. To illustrate the application of the results, numerical examples are given.

**Brief Biography of the Speaker:** Nikolai Krivulin received a university degree in applied mathematics and operations research in 1983 from St. Petersburg State University. He got his Ph.D. degree in 1990 and D.Sc. degree in 2010 both in applied mathematics from the same university. In 1983 he joined the Computer Center at St. Petersburg State University as a system software engineer, and in 1985 started his Ph.D. study. In 1987 he joined the Faculty of Mathematics and Mechanics at this university as an Assistant Professor, and became an Associate Professor there in 1990. From 1999 to 2002 he was the head of the Department of Information Management at the Graduate School of Management of the same university.
He is currently an Associate Professor of the Department of Statistical Modelling at St. Petersburg State University. His research interests include theory and applications of idempotent algebra, modelling and performance evaluation of queueing systems, methods of optimization, computational statistics and computer simulation. Nikolai Krivulin is an author and coauthor of more than 70 publications including papers published in reviewed journals and conference proceedings, books chapters, textbooks, and a monograph. He is a grantee of national and international foundations, including the Russian Foundation for Basic Research, the Russian Foundation for Humanities Research, the NATO Science Foundation, the USIA and Eurasia Foundation (USA), and the Royal Society (UK). He was a member of program and organizing committees of international conferences on mathematics, computer sciences, and information technology. He is a member of St. Petersburg Mathematical Society, AMS, and SIAM.

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## Plenary Lecture 4

# Attitude Dynamics and Control of Multi-Rotor Spacecraft and Roll-Walking Robots

**Associate Professor Anton V. Doroshin**
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**Abstract:** The problem of rigid bodies' systems dynamics and its practical engineering applications such as attitude motion and control of multi-rotor spacecrafts (gyrostats-satellites, dual-spin-spacecrafts, spacecrafts with systems of momentum wheels and control moment gyros) and robotics are very important for modern science and, especially for space flight mechanics. Despite classical analytical research results this problem is still far from complete due to the existence of complicated non-linear regular and chaotic phenomena.
In the framework of the indicated problem we describe the following points: deriving exact and approximated analytical solutions, the analysis of the attitude motion under an influence of external and internal disturbances, research into chaotic behaviors of the SC, study of the attitude motion of the SC with variable parameters (time-dependent mass-inertia parameters), investigation into attitude reorientations of the SC and multi-rotor roll-walking robots.
Firstly, we consider the attitude motion of the dual-spin spacecraft with time-dependent moments of inertia (with an active solid-propellant rocket engine) on the base of special method of the phase trajectories' curvature analysis. Secondly, we conduct the dynamics simulation of the gyrostats in a resistant environment at presence of chaotic attractors (Lorenz, Rossler, Newton–Leipnik, and Sprott systems). In the third place we examine the heteroclinic dynamics of the dual-spin spacecraft on the base of analytical solutions for heteroclinic orbits in the space of the SC angular moment components. With the help on Melnikov's method we show the system motion chaotization and possibility of the SC chaotic tilting motion. Finally, we present a multi-rotor drive system, which can be used for the attitude control of the spacecraft and a roll-walking motion of the multi-rotor robot. This multi-rotor system contains a large number of rotor-equipped rays. It allows using spinups and captures of conjugate rotors to perform compound motion of the multi-rotor spacecraft and the walking robot attitude reorientation.

**Brief Biography of the Speaker:** Anton V. Doroshin received his Ph.D. degree in theoretical mechanics from the Samara State Aerospace University in 2002. He is the Head of the Educational Programs Department and an Associate Professor of the Department of Flight Dynamics and Control Systems at Samara State Aerospace University (National Research University). His research interests include space flight dynamics and dynamical systems theory. He is especially concerned with the analysis of non-linear regular and chaotic dynamical systems, attitude dynamics and control of dual-spin spacecrafts, gyrostats and multi-rotor rigid bodies systems. He is the author of numerous publications in these areas. Also Dr. Doroshin is the head of the several research projects and grants of the Russian Foundation for Basic Research, the Russian Federation Presidential Program for young scientists and leading scientific schools of Russian Federation, International Soros Science Education Program. In 2010 he was awarded the Medal of Russian Academy of Science (Direction: Machinery, Mechanical Science and Control Systems). Also he is a member of International Association of Engineers.

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## Plenary Lecture 5

# Industrializing Carbon Nanotechnology

**Professor Mark J. Schulz**
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**Abstract:** The industrial revolution of the 1800's was underpinned by iron, copper, and aluminum materials. The electronics revolution in the 1900's was based on silicon and semiconductor materials. Then the composite materials revolution began replacing metals later in the 1900's. While the materials developed in these revolutions have been effective, they are now hitting the wall in terms of meeting the performance requirements for current machines, structures, and electronic devices. Metals are too heavy and they corrode and fail by fatigue, silicon electronics is reaching its limit of miniaturization, and current composite materials are brittle and poor thermal and electrical conductors. In the 21st century, carbon materials are being synthesized at the nanoscale and are providing properties that greatly exceed those of traditional materials. Carbon nanoscale materials are also being scaled up to form macro-scale materials with properties that are becoming competitive with existing materials. But overall, producing consistent high quality nanoscale materials and scaling them up to produce macroscale materials with breakthrough properties has not been achieved. Nanotechnology has been going on for about fifteen years. This is a short time compared to the early industrial revolutions that took 50 – 100 years to develop. Still, progress toward industrializingnanotechnology is too slow.Unless this issue of scalability and consistency is addressed, the major benefits of carbon nanotechnology may never be realized. Now is the time for a large internationally coordinated effort directed toward improving material quality and scalability and to transition carbon nanotechnology from science to industrialization. This talk will discuss approaches for Industrializing Carbon Nanotechnology with the vision to collaborate and power an industrial revolution in carbon nanotechnology for the 21st century. The goal of the nanotechnology industrial revolution will develop scalable nanostructured carbon materials, transformative devices, and recyclable materials and systems with breakthrough performance to replace traditional materials.
Four science thrust areas will be discussed where research efforts are particularly needed: ST-1 CNT Synthesis Chemistry, Post treatments; ST-2Superlong, High Quality CNT Arrays, andNanosphere Chains; ST-3 Graphene Synthesis; and ST-4 Substrate and Reactor Engineering.Synthesis of nanoscale materials is the most important science thrust andembodies all of the promise and challenges of nanotechnology. A critical priority in developing scalable nanotechnology is to develop technology that allows transitioning from nanotubes and graphene flakes to 3-D structures and systems. This talk will discusssynthesis of carbon nanotube arrays or forests, why carbon materials have defects, why nanotubes stop growing, why yarn does not achieve the strength of nanotubes, and how to scale up the properties of graphene. The importance of carbon nucleation and growth is fundamental in terms of engineering because it may enable manufacturing the strongest and most electrically conductive materials in the world.
Similarly, four technology thrust areas will be discussed where research efforts are particularly needed: TT-1 Energy Systems; TT-2 Nanomedicine Devices; TT-3Space Industrialization; and TT-4 Composite Materials. Medicine is an area that can benefit tremendously from carbon nanotechnology.Implantable electronics, biomedical fiber that is electrically conductive, pliable, and stronger than steel, biosensors, and tissue scaffolding are near-term applications. Carbon will be the only material available to build non-metallic tiny electric motors and solenoids that will work inside the body. And close collaboration between the medical community and engineers will provide solutions doctors and biologists can't see alone. Putting these kinds of devices in the hands of physicians would produce mind-boggling advances, like science fiction come alive. Energy harvesting and generation using carbon nanostructured materials is expected to revolutionize the way electricity is produced including improved solar cells, fuel cells, and hydrogen production and storage. CNT arrays, ribbon, and yarn will replace copper and metals for power distribution, to build carbon electronics, superinductors, electrical fiber, and supercapacitors. Ultra-high magnetic field densities >5 T and

forces that can tear materials apart theoretically can be produced using nanotube electromagnetics. An all carbon electric motor may be 60% lighter than conventional motors. The carbon industrial revolution should also include Space Industrialization with advisement from leaders like Stephen Hawking at Cambridge. There's plenty of carbon in the universe along with energy for growing CNTs, and vacuum is suitable for post processing and spinning yarn. Space nanotechnology may be the only way to manufacture large structures like a space elevator ribbon and large solar panels to provide enough clean energy for the world. The carbon industrial revolution has a high probability of success because samples of super-strong CNT yarn and highly conductive graphene have already been demonstrated.

**Brief Biography of the Speaker:** Mark J. Schulz is a Professor of Mechanical Engineering and director with Dr. Vesselin Shanov of the NanoWorld Laboratories at the University of Cincinnati. He is also one of the deputy directors of the National Science Foundation's Engineering Research Center for Revolutionizing Metallic Biomaterials. Mark's research focus is in the area of smart materials and nanotechnology. The Nanoworld Laboratories synthesize carbon nanotube forests and process the forests into intermediate materials such as nanotube ribbon, yarn, and sheet. The intermediate materials are a new kind of structural and electronic "raw material" that is used to build smart materials and devices for engineering and medical use. Mark is also Chief Scientistat General Nano (GN) LLC, a start-up company in Cincinnati, OH (http://generalnanollc.com). GN commercializes UC discoveries including carbon nanotube material called Black CottonTM which isa new material for engineering and medicine.

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## Plenary Lecture 6

# Mechanics of Nanoelectromechanical Systems

**Professor K. M. Liew**
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**Abstract:** In the past decade, nanomechanics has been emerging as a new researching domain that excited a considerable interest in the condensed-matter and materials research communities. Due to the difficulty in the theoretical and experimental investigations of nanostructures, numerical modeling and simulation play an important role in capturing their fine behavior and revealing their delicate properties. The particularity of nanostructure brings a challenge to the conventional computational method. For example, a simple nanostructure, such as a MWCNT, involves thousands of atoms that lead to too many degrees of freedom, and atom-based modeling method, such as molecular dynamic, consumes a huge amount of computational time. This fact also stimulated the exploration and development of the new computational techniques in the computational nanomechanics, such as continuum modeling and multiscale methods. This talk will address the applications of continuum and molecular dynamics models for modeling of carbon nanotubes. Numerical discretization of these continuum models and the developed multiscale computational scheme will be discussed.

**Brief Biography of the Speaker:** Professor Liew jointed the City University of Hong Kong in 2005 as a Chair Professor of Civil Engineering. Currently he is the Head of the Department of Civil and Architectural Engineering. He was formerly a tenured professor at Nanyang Technological University, Singapore. His research activities encompass nano-mechanics, materials modeling, multi-scale analysis, and large-scale simulation and visualization. In recent years, he and his research group have been actively involved in the theoretical research of nanomaterials, in particular CNTs, by employing molecular dynamics and continuum approaches, and multiscale method. He has published over 550 journal articles. He is a Fellow of ASME and IMechE. His current h-index is over 40 and he is cited by the Institute for Scientific Information (ISI) as one of the highly cited researchers in engineering.

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## Plenary Lecture 7

# Nanopackage Designs Based on Nanosized Mosaic Metal Oxides: Capturing and Monitoring Hazardous and Radioactive Agents

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**Abstract:** Environmental pollutions due to the toxic gases, elements and pathogenic species are a serious problem with harmful effects on plants, animals, and human health. Achieving proper designs of nanosensors for highly sensitive and selective detection and removal of extremely hazardous materials is one of the crucial issues in our laboratory. Our main interest is not only to make nanotechnological designs-based nanomaterials but also to reduce the production cost and to expand their potential on-site and real-time measurements. El-Safty and Co-workers designed of nanopackages-based mesocage mosaic, core/double-shell, nanosheets, hollow sphere and nanowires metal oxides for capturing and monitoring toxic agents to protect human health and improve the environmental quality. However, we developed rapid easy-handling and cheap nanosensors for visual detection and removal of toxic metals from water and wastewater treatment systems, which are major public health challenges in world wide. Our optical mesoporous sensors show ability to create simultaneous designs for complete removal of extremely toxic metals such as As(V), Hg (II), Cd(II), Pb(II), Cr(VI), Zn(II) ions and etc.., with indoor and outdoor responses, and with revisable, selective and sensitive recognition of these toxic metals. Toward the challenging subject of radiaoactive monitoring and separation after the recent disaster of the nuclear plants at Fukushima Diaichi, JAPAN (March, 11, 2011), El-Safty and co-workers developed simple processing and captors-based nanomaterials for separation of the radioactive of Iodine (131I2), strontium (85Sr), cesium (137Cs), cerium (144Ce) and cobalt (60Co) in aqueous and marine water. Our technology is not only enabled the ultra-trace concentrating collection of 137Cs, 85Sr and 131I2 radio-elements but also led to decreasing capacity, and managing of these radioactive elements. Moreover, the nanocapture material can be repeatedly recycled. Significantly, the color of the nano-capture material changes when the radio-element is adsorbed. Therefore, it is possible not only had to be captured the element effectively but also to be used to detect radioactive elements by visualization. Recently, we have successfully fabricated nanopackage gas sensors. The patterned design based on nanosized WO3, Co2O3, SnO2 and NiO oxides enabled the detection of extremely toxic nitrogen dioxide and volatile organic compounds VOCs. The principal design of the nanopackages relies on the enhancement of total-volume-exposure of sensing materials to the analytic gases. The key component of this design is that the gas nanosensors can offer ultra-sensitive and selective detection of nitrogen dioxide at a low level concentration among carbon monoxide, and VOCs, such as acetone, benzene, and ethanol. We expected this nanopackage sensors can revolutionize the consumer and industrial market in environmental pollution monitoring, transportation, security, defense, space missions, energy, agriculture, and medicine.

**Brief Biography of the Speaker:** Sherif A. El-Safty obtained his Ph.D. in 2000 under supervision of Professor John Evans, School of Chemistry, Southampton University, UK. He was appointed as a Lecturer at Chemistry Department, University of Tanta, Egypt. In 2005, he became an Associate Professor in the same University. From 2001 to 2007, he was granted several positions to work at National institute of Advanced Industrial Science and technology (AIST), Sendai-Japan as JSPS Post-doctor, AIST Research Scientists, JSPS Visiting Professor, respectively. In 2008, He became a Senior Researcher at National Institute for Materials Science (NIMS), Japan, leading an independent group of nano-dynamic materials designs (NDMD) that actively support the goal of the nano-technological materials for environmental cleanup system. Concurrently, he has appointed as Professor at Waseda University, Japan, in major Nanoscience and Nano-Engineering in 2010. His research interests focus on the Multiple Nano-dynamic Designs that provide efficient, one-site, broad range processes in the same time. These processes are in demand for security monitoring in the global world. He developed various nanomaterials with advanced geometrical morphologies, such as high ordered mesoporous monoliths, mesoporous nanosheets, meso-/macro- porous nanorods, nanotubes, nanowires, hollow spheres and nanocomposites for environmental monitoring and cleanup systems. He established low cost extraction system based on nanoscale HOM (High-Order-Mesoporous Monolith) materials of rare earth metals from urban concentrate as secondary resources in Japan. He successfully designed simple, easy-to-use, and

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reliable nanocaptors for decontamination of radioactive elements in Fukushima Diaiichi, Japan from water and wastewater. His research work had received increasing interests from the international/national scientific communities, in addition to be highlighted in the public and scientific Newspapers, Magazines and NHK Television for several times.

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