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Mathematics and Computers in Science Engineering

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# NEW ASPECTS OF SYSTEMS

Heraklion, Crete Island, Greece, July 22-25, 2008

Proceedings of the 12th WSEAS International Conference on SYSTEMS

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## **Preface**

This book contains the proceedings of the 12th WSEAS International Conference on SYSTEMS which was held in Heraklion, Greece, July 22-24, 2008. This conference aims to disseminate the latest research and applications in Systems Theory, Dynamical Systems, Control Systems, Control Engineering, Decision Support Systems, Hierarchical Control Systems, Aerospace Systems, Multidimensional Systems, Multivariable systems, Hybrid Systems, Systems Techniques for Wireless Applications, Computational and Applied Mathematics and other relevant topics and applications.

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Finally, we cordially thank all the people of WSEAS for their efforts to maintain the high scientific level of conferences, proceedings and journals.

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## CEREMONY for Prof. SIFAKIS

Opening by the Deputy Minister of National Defence of GREECE  
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(Biochemical Engineer, M.Sc and Economics, M.Sc.)



<http://www.plakiotakis.gr>

Born in 1968 in Sitia, in the prefecture of Lasithi on the island of Crete. Plakiotakis studied chemical engineering at the University of Wales and obtained a Master's degree in biochemical engineering at London University with an MBA from the City University Business School of London. He worked at Eurocontrol, an inter-country Organisation that regulates Air Circulation and the flight safety in Europe. He is a member of the New Democracy Party since 1987. He was an active member of New Democracy's Student Movement (DAP) and in 1999 became Vice-president of the Local Committee of N.D. in Sitia (Crete). From 1998 to 2002 he acted as Municipal Advisor in Sitia. On January 2001 he was appointed as a permanent member of the Committee of Tourism by the President of the Hellenic Republic. He is a member of the Association of graduates of Biochemical Engineering at the University of London, as well as at the City University Business School.

### **Parliamentary- Governmental Activity:**

- Member of Parliament's Special Permanent Committee of Protection of the Environment.
- New Democracy's Assistant Supervisor of Tourism and member of the Parliamentary Delegates of Production and Trade, Protection of Environment and Orthodoxy.
- He was elected MP of Lasithi with the N.D. in 2004 and in 2007.
- On 19 October 2007 he was appointed Deputy Minister of Defense.

## KEYNOTE SPEAKER – TURING AWARD 2007

### Embedded Systems – Scientific Challenges and Work Directions



**Prof. Joseph Sifakis**  
**Turing Award 2007,**

**<http://www.acm.org/press-room/news-releases/turing-award-07/>  
1 hour Keynote Lecture (CONFERENCE ROOM 1),  
Wednesday, July 23, 16:00-17:00**

**Nobel of Computing:**

**<http://www.cmu.edu/homepage/practical/2008/winter/nobel-of-computing.shtml>**

**Also: <http://www-verimag.imag.fr/~sifakis/>**

**Abstract:** Embedded systems are components integrating software and hardware that are jointly and specifically designed to provide given functionalities, which are often critical. They are used in a very wide array of application areas - including transport, consumer electronics / electrical appliances, energy distribution, manufacturing systems, etc. Designing embedded systems requires techniques taking into account extra-functional requirements regarding optimal use of resources such as time, memory and energy while ensuring autonomy, reactivity and robustness. Jointly taking into account these requirements raises a grand scientific and technical challenge: extending Computer Science with paradigms and methods from Control Theory and Electrical Engineering. Computer Science is based on discrete computation models, which are by their nature are very different from the analytic models used in other engineering disciplines, because they do not encompass physical time and resources. We discuss the main aspects of this

challenge and their associated research directions for different areas such as modelling, programming, compilers, operating systems and networks.

**Biography:** Joseph Sifakis is CNRS researcher and the Founder of Verimag laboratory (<http://www-verimag.imag.fr/>), in Grenoble, France. He studied Electrical Engineering at the Technical University of Athens and Computer Science at the University of Grenoble.

Verimag is a leading research laboratory in the area of critical embedded systems. It developed the underlying theory and technology for the SCADE tool, used by Airbus for the design and validation of its critical real-time systems, and is becoming a de facto standard for aeronautics. Verimag has a lasting and strategic collaboration with ST Microelectronics, France Telecom R&D, and Airbus, through which numerous results on validation and testing have been transferred.

Joseph Sifakis is recognized for his pioneering work on both theoretical and practical aspects of Concurrent Systems Specification and Verification. He contributed to emergence of the area of model-checking, currently the most widely-used method for the verification of industrial applications. His current research activities include component-based design, modeling, and analysis of real-time systems with focus on correct-by-construction techniques (<http://www-verimag.imag.fr/~sifakis/>).

Joseph Sifakis has broad experience with industry, notably through joint projects with partners such as Astrium, the European Space Agency, France Telecom, ST Microelectronics and he has also been active for many years in consulting.

Joseph Sifakis is the Scientific Coordinator of the European Network of Excellence ARTIST2 on Embedded Systems Design. (<http://www.artist-embedded.org/>). This network gathers 35 of the best European teams in the area, and aims to produce innovative results for cost-effective design of dependable embedded systems. It will also promote innovative methods safe and secure systems, notably through cooperation with key European industrial partners such as Thalès, Airbus, Ericsson, Philips, and ST Microelectronics.

Joseph Sifakis is the chair of "Chamber B" (Public Research Organisations) of ARTEMISIA, which is the Industrial Association within the ARTEMIS European Technology Platform on Embedded Systems (<http://www.cordis.lu/ist/artemis/>).

Joseph Sifakis is the director of the CARNOT Institute "Intelligent Software and Systems" in Grenoble. Joseph Sifakis is a member of the editorial board of several journals, co-founder of the International Conference on Computer Aided Verification (CAV) and a member of the Steering Committee of the EMSOFT (Embedded Software) conference.

Joseph Sifakis has received with Ed Clark and Allen Emerson for their contribution to Model Checking, the Turing Award for 2007 (<http://awards.acm.org/homepage.cfm?srt=all&awd=140>). He is also the recipient of the CNRS Silver Medal in 2001.

## Keynote Lecture I

### Distributed Estimation Using Wireless Sensor Networks



**Professor Georgios B. Giannakis**  
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**Abstract:** Envisioned applications of wireless sensor networks (WSNs) include surveillance, monitoring and tracking tasks. These motivate well decentralized estimation and smoothing of deterministic and (non)stationary random signals using (possibly correlated) observations collected across distributed sensors. In this talk we present state-of-the-art algorithms for consensus-based distributed estimation using ad hoc WSNs where sensors communicate over single-hop noisy links. The novel framework reformulates basic estimation criteria such as least-squares, maximum-likelihood, maximum a posteriori, and linear mean-square error, as decomposable, constrained, convex optimization problems that are amenable to distributed solutions. The resultant distributed estimators are provably convergent to their centralized counterparts and robust to communication noise. Besides stationary, the framework encompasses adaptive filtering and smoothing of non-stationary signals through distributed LMS and Kalman filtering.

**Brief Biography of the Speaker:** G. B. Giannakis received his B.Sc. in 1981 from the Ntl. Tech. Univ. of Athens, Greece and his M.Sc. and Ph.D. in Electrical Engineering in 1983 and 1986 from the Univ. of Southern California. Since 1999 he has been a professor with the Department of Electrical and Computer Engineering at the University of Minnesota, where he now holds an Endowed ADC Chair in Wireless Telecommunications. His general interests span the areas of communications, networking, signal processing, estimation and detection theory -- subjects on which he has published more than 270 journal papers, 450 conference papers, two research monographs and two edited books. Current research focuses on wireless networks, complex-field and space-time coding, ultra-wideband and cognitive radios, cross-layer designs and wireless sensor networks. He is the (co-) recipient of six best paper awards from the IEEE Signal Processing (SP) and Communications Societies (1992, 1998, 2000, 2001, 2003, 2004) and also received the SP Society's Technical Achievement Award in 2000 as well as the EURASIP Technical Achievement Award in 2005. He is an IEEE Fellow since 1997, a Distinguished Lecturer for 2007-08, and has served the IEEE in various editorial and organizational posts



## Keynote Lecture II

### Tyflos : A Wearable System-Prototype for Assisting Visually Impaired



**Dr. Nikolaos G. Bourbakis**

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**Abstract:** *Human eyes receive more than 75% of the total information accessible to the human senses.* “There are approximately 45 million blind individuals world-wide according to the World Health Report. Vision loss can be very traumatic, leading to frustration and depression. According to the American Foundation for the Blind (AFB), the rate of unemployment among legally blind individuals of working age residing in the United States (58%) is much greater than that of individuals with no functional limitations (18%). Employment opportunities and independence are scarce for visually impaired individuals. This is unfortunate in view of the fact that ingenious devices [IEEE Spectrum] and information technology (IT) strategies can be developed to help people overcome these barriers and to pursue educational opportunities that will allow them to become productive members of society.” In this talk technological efforts are presented that have the same goal assisting and increasing the visual impaired people’s independence in their working and living environment, and reducing their social neglect. In particular, the research effort (called Tyflos) is presented here that is an IT- based wearable system-prototype. It consists of a pair of dark glasses on which two tiny vision cameras, an ear speaker and a microphone are attached. The cameras are connected with a portable computer that carries intelligent software programs. The cameras, under the user’s command, capture images from the surrounding and convert them via software programs into audio or vibrations. The current versions of Tyflos is used as 1) a reader by reading books or the blind user via audio conversion and 2) a navigation by converting 3D images into vibrations for navigation.

**Brief Biography of the Speaker:** Nikolaos G. BOURBAKIS (IEEE Fellow) received his PhD in computer engineering and informatics in 1983. He currently is the Associate Dean for Engineering Research, a Distinguished Professor of Informatics and the Director of the ATR Center at WSU. He has directed several research projects (Applied AI, Image Processing & Machine Vision, Visual Autonomous Navigation, Information Security, Bio-Informatics, Biomedical Engineering) funded by government and industry, and he has published near 300 papers in International refereed Journals, Conference proceedings and book-chapters. Previous working places: SUNY, IBM, UP, GMU. He is actively involved as an Associate Editor in several IEEE and International Journals and General Chair in numerous International IEEE Conferences. He is the EIC of the Artificial Intelligence Tools Int. Journal (WSP) and the new upcoming Bioinformatics Engineering Journal. He is an IEEE Computer Society Distinguished Speaker, and NSF University Research Programs Evaluator, an IEEE Computer Society Golden Core Member. He has received several high prestigious awards, some of them are: IBM Author recognition Award 1991, IEEE Computer Society Outstanding Contribution Award 1992, IEEE Outstanding Paper Award ATC 1994, IEEE Computer Society Technical Research Achievement Award 1998, IEEE I&S Outstanding Leadership Award 1998, IEEE ICTAI 10 years Research Contribution Award 1999, IEEE BIBE Leadership Award 2003, ASC Recognition Award 2005.

## Keynote Lecture III

### Algorithms for Rendering Depth of Field Effects for Synthetic Image Generation and Computational Photography



**Dr. Brian A. Barsky**

Professor of Computer Science

Affiliate Professor of Optometry and Vision Science

Member of Joint Graduate Group in Bioengineering, UCSF/UCB

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**Abstract:** Depth of field refers to the swath through a 3D scene that is imaged in acceptable focus through an optics system, such as a camera lens. It is a vitally important component of real photographs, and is useful as a tool for drawing the viewer's eye to the important part of the image. Depth of field is equally important for computer-generated images. This talk will provide an explanation of the phenomenon of depth of field and a survey of a variety of techniques to render depth of field effects in computer graphics, with particular attention devoted to the trade-offs between image quality and algorithm efficiency. Algorithms to render highly accurate depth of field effects, such as distributed ray tracing or the accumulation buffer, are sampling methods that use large numbers of samples, with high computational cost. Sampling is inherently slow because it effectively requires rendering the scene many times, which multiplies the render time by a potentially large factor. Faster algorithms are based on a post processing approach, which operates in image space. Post process methods operate on 2D images along with depth information, rather than working with a full 3D object representation as the sampling methods do. Consequently, post process methods struggle to accurately simulate the underlying optical process, and tend to suffer from artifacts or avoid those artifacts at a large cost. The talk will include an analysis of the nature of these artifacts.

**Brief Biography of the Speaker:** Brian A. Barsky is Professor of Computer Science and Affiliate Professor of Optometry and Vision Science at the University of California at Berkeley. He is a member of the Joint Graduate Group in Bioengineering, an interdisciplinary and inter-campus program, between UC Berkeley and UC San Francisco. He was a Directeur de Recherches at the Laboratoire d'Informatique Fondamentale de Lille (LIFL) of l'Université des Sciences et Technologies de Lille (USTL). He has been a Visiting Professor of Computer Science at The Hong Kong University of Science and Technology in Hong Kong, at the University of Otago in Dunedin, New Zealand, in the Modélisation Géométrique et Infographie Interactive group at l'Institut de Recherche en Informatique de Nantes and l'Ecole Centrale de Nantes, in Nantes, and at the University of Toronto in Toronto. Prof. Barsky was a Distinguished Visitor at the School of Computing at the National University of Singapore in Singapore, an Attaché de Recherche Invité at the Laboratoire Image of l'Ecole Nationale Supérieure des Télécommunications in Paris, and a visiting researcher with the Computer Aided Design and Manufacturing Group at the Sentralinstitutt for Industriell Forskning (Central Institute for Industrial Research) in Oslo. He attended McGill University in Montréal, where he received a D.C.S. in engineering and a B.Sc. in mathematics and computer science. He studied computer graphics and computer science at Cornell University in Ithaca, where he earned an M.S. degree. His Ph.D. degree is in computer science from the University of Utah in Salt Lake City. He is a Fellow of the American Academy of Optometry (F.A.A.O.). He is a co-author of the book *An Introduction to Splines for Use in Computer Graphics and Geometric Modeling*, co-editor of the book *Making Them Move: Mechanics, Control, and Animation of Articulated Figures*, and author of the book *Computer Graphics and*

Geometric Modeling Using Beta-splines. He has published 120 technical articles in this field and has been a speaker at many international meetings. Dr. Barsky was a recipient of an IBM Faculty Development Award and a National Science Foundation Presidential Young Investigator Award. He is an area editor for the journal Graphical Models. He is the Computer Graphics Editor of the Synthesis digital library of engineering and computer science, published by Morgan & Claypool Publishers, and the Series Editor for Computer Science for Course Technology, part of Cengage Learning. He was the editor of the Computer Graphics and Geometric Modeling series of Morgan Kaufmann Publishers, Inc. from December 1988 to September 2004. He was the Technical Program Committee Chair for the Association for Computing Machinery / SIGGRAPH '85 conference. His research interests include computer aided geometric design and modeling, interactive three-dimensional computer graphics, visualization in scientific computing, computer aided cornea modeling and visualization, medical imaging, and virtual environments for surgical simulation. He has been working in spline curve/surface representation and their applications in computer graphics and geometric modeling for many years. He is applying his knowledge of curve/surface representations as well as his computer graphics experience to improving videokeratography and corneal topographic mapping, forming a mathematical model of the cornea, and providing computer visualization of patients' corneas to clinicians. This has applications in the design and fabrication of contact lenses, and in laser vision correction surgery. His current research, called Vision-Realistic Rendering is developing new three-dimensional rendering techniques for the computer generation of synthetic images that will simulate the vision of specific individuals based on their actual patient data using measurements from a instrument a Shack-Hartmann wavefront aberrometry device. This research forms the OPTICAL (OPTics and Topography Involving Cornea and Lens) project.

## Plenary Lecture I

### Electromagnetic Low Frequency Radiation from Natural Phenomena - Data Analysis and Modelling



**Professor Ernst D. Schmitter**  
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GERMANY

**Abstract:** Can severe weather conditions, volcanic eruptions or even earthquakes be predicted from monitoring and analyzing electromagnetic radiation especially in very and ultra low frequency ranges? What signatures in this frequency range leave solar wind, solar flare eruptions or gamma ray bursts from distant stars within the earth's magnetosphere and ionosphere? The propagation properties of very low, extremely low and ultra low frequency radiation (VLF/ELF/ULF, i.e. 30 kHz down to some milliHz) within the earth's magnetosphere, ionosphere and lithosphere allow to deal with these questions and a lot of research has been done during the last decades. In some cases the generating physical process is obvious – as for example VLF spheric signals from lightnings. In other cases reliable modelling and confirmation is due yet - as with electromagnetic earthquake precursor signals. This survey will try to mediate some aspects of the advanced data analysis and data modelling procedures used to gain information out of the received signals despite of a usually very noisy background. Fourier- and wavelet transform based as well as statistically based features are used as input to neuro-fuzzy classifiers together with physical process models to form hybrid approaches to these complex systems.

**Brief Biography of the Speaker:** Dr. Schmitter is professor for mathematics and software technology at the University of Applied Sciences Osnabrueck, Germany since 1990. He is a member of the faculty of Engineering and Computer Sciences and teaches courses on applied mathematics, simulation (for example Finite-Element-Methods) and data analysis. He wrote several books in the computational intelligence area and published papers on data and signal analysis and modelling topics applied to material sciences and geophysics.

## Plenary Lecture II

### Application of Adaptive Cerebellar Model Articulation Controller in Control Problem



**Prof. Chih-Min Lin**

Chairman and Professor

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**Abstract:** Based on biological prototype of human brain and improved understanding of the functionality of the neurons and the pattern of their interconnections in the brain, a theoretical model used to explain the information-processing characteristics of the cerebellum was developed independently by Marr (1969) and Albus (1971). Cerebellar model articulation controller (CMAC) was first proposed by Albus. CMAC is a learning structure that imitates the organization and functionality of the cerebellum of the human brain. That model revealed the structure and functionality of the various cells and fibers in the cerebellum. The core of CMAC is an associative memory which has the ability to approach complex nonlinear functions. CMAC takes advantage of the input-redundancy by using distributed storage and can learn nonlinear functions extremely quickly due to the on-line adjustment of its system parameters. CMAC is classified as a non-fully connected perceptron-like associative memory network with overlapping receptive-fields. It has good generalization capability and fast learning property and is suitable for on-line application of control systems. This talk introduces several CMAC-based adaptive control systems; these control systems combine the advantages of CMAC identification, adaptive control and robust control techniques. In these systems, the on-line parameter training methodology, using the gradient descent method and the Lyapunov stability theorem, is proposed to increase the learning capability. Moreover, the applications of these systems in control problems are demonstrated. Simulation results illustrate that the introduced CMAC-based control systems can achieve favorable control performance.

**Brief Biography of the Speaker:** Prof. Chih-Min Lin is currently a Professor and the Chairman of the Department of Electrical Engineering, Yuan-Ze University, Taiwan. He also serves as the Committee Member of National Science Council, Control Branch; Chinese Automatic Control Society; Taiwan Fuzzy System and Science Society; and Taiwan Systems Engineering Society. During 1986-1992, he was with the Chung Shan Institute of Science and Technology as a Deputy Director of system engineering. He joined the faculty of the Department of Electrical Engineering, Yuan-Ze University, Taiwan, in 1993. During 1997-1998, he was the honor research fellow in the University of Auckland, New Zealand. He has served as the Deputy Chairman of IEEE Control Systems Society, Taipei Chapter in 1999-2000, now he is an IEEE Senior Member. Prof. Lin's research interests include fuzzy neural network, cerebellar model articulation controller, control system and systems engineering. He has published 84 journal papers and 120 conference papers. He has been awarded with the outstanding research professor and chair professor. He has given several plenary lectures and invited talks and served as the committee member in several international conferences. Now he also serves as the editorial board of 4 international journals.

## Plenary LectureIII

### on Dynamical Systems Describing Tumor Growth under Novel Therapies



**Professor Urszula Ledzewicz**

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#### Co-Author

**Professor Heinz Schattler**

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**Abstract:** In this talk dynamical systems arising in biomedicine describing various treatments of cancer will be discussed. Mathematical models for cancer treatments have a long history, but with the development of medicine new challenges in modeling and the analysis of these models are appearing. Here novel cancer treatments and the mathematical models that describe their dynamics as systems of nonlinear ordinary differential equations will be presented. The focus primarily will be on mathematical models for tumor anti-angiogenesis. The importance of this novel treatment is that by targeting the cells of the vascularization of the tumor rather than the tumor itself, it is not prone to drug resistance and as such has been a topic of active research both in medicine and mathematical biology. In the talk a class of mathematical models for anti-angiogenesis will be analyzed. The nonlinear dynamics in these models illustrates the growth of the primary tumor volume and its corresponding vasculature as well as the effect of the control functions representing anti-angiogenic treatment on this growth. Following the analysis of this system with constant doses of the drug, the optimal control problem of how to schedule an a priori given amount of angiogenic inhibitors so as to minimize the primary tumor volume will be considered. Examples of optimal protocols resulting from the analysis will be given. Then, following medical research on so-called combination therapies, the model will be augmented to include the effect of traditional chemotherapy on the system. Due to the multi-control aspect, even with simplified dynamical equations, this becomes a challenging problem mathematically and some initial results about the structure of optimal controls will be presented.

**Brief Biography of the Speaker:** Urszula Ledzewicz received her Ph. D in 1984 from the University of Lodz, Poland. Since 1986 she has been holding academic positions in the United States, first as a visiting faculty at Louisiana State University, Baton Rouge, and then at Southern Illinois University, as a tenured faculty in the rank of the Full Professor since 1995. Her research area is primarily control theory and optimization, but in more recent years she became interested in applications of the methods of optimal control and systems theory to biomedicine. Currently her main direction of research includes analysis of systems describing dynamics of cancer growth under various treatments like chemotherapy or anti-angiogenesis. She is a member of five editorial boards including Discrete and Continuous Dynamical Systems, Series B, and Mathematical Biosciences and Engineering and author or co-author of close to 100 publications in refereed journals and proceedings of international conferences. She was invited to present lectures at various mathematical and engineering oriented conferences as well as was a member of the organizing committees or co-organized sessions or mini-symposia at several of them like IEEE Conferences on Decision and Control (CDC), Mathematical Theory of Network and Systems (MTNS) or World Congress of Nonlinear Analysts (WCNA). For her research she was awarded several grants from the National Science Foundation, NATO and her university.

## Plenary LectureIV

### Dissipation Normal Forms and Further Applications of Lyapunov-Tellegen's Principle



**Prof. Milan Stork**

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**Abstract:** Almost in any field of science and technology some sort of stability problem can appear. Instability and chaos are certainly the most important phenomena which should be treated before any other aspect of reality will be attacked. Hence it is not very surprising that a broad variety of approaches to the problem of stability, instability and analysis of chaotic phenomena exists. Many of the most popular techniques in the field of stability and chaos are in a certain sense related to the work of A.M.Lyapunov and can be seen as energy oriented. The Tellegen's theorem is one of the well known forms of energy conservation statement in the field of electrical engineering. The most important feature of Tellegen's approach is the fact that the energy conservation principle holds without any regard to physical nature of constituent network elements. This is the key idea of the proposed approach to problems of dissipativity and chaos. The first situation arises if an energy function  $E[x(t)]$  of a given system is known in a mathematical form. In such example the time evolution of internal energy along any system motion can be described, and an energy monotonicity test can be used. In the proposed lecture a physically motivated signal-system-theoretic approach, based on a generalisation of the well known Tellegen's principle of electrical circuits will be presented. Two fundamental concepts are of crucial importance in the proposed approach. The first one is the concept of strongly non-linear power-informational interactions, and the second one is the notion of state space energy vector, inducing the system state-space topology. All computations, including numerical solutions of differential equations, were done using MATLAB.

**Brief Biography of the Speaker:** Milan Stork received the M.Sc. degree in electrical engineering from the Technical University of Plzen, Czech Republic at the department of Applied electronics in 1974 and Ph.D. degree in automatic control systems at the Czech Technical University in Prague in 1985. In 1997, he became as Associate Professor and in 2007 professor at the Department of Applied Electronics and Telecommunication, faculty of electrical engineering on University of West Bohemia in Plzen, Czech Republic. He has numerous journal and conference publications. He is member of editorial board magazine "Physician and Technology". His research interest includes analog/digital linear and nonlinear systems, control systems, signal processing and biomedical engineering, especially cardiopulmonary stress tests systems.

## Plenary Lecture V

### Controllability and observability of multi-time linear PDE systems



**Professor Constantin Udriste**  
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**Abstract:** Since the obstruction of complete integrability conditions (path independent curvilinear integrals) is very strong, the control problems for multi-time first order PDEs were studied only in the discrete context. Now, to preserve the geometrical character of the problem, we present a continuous approach for the controllability and observability properties of multi-time completely integrable linear PDEs systems (holonomic evolution), overcoming the extant mathematical prejudices regarding the importance of a multi-time evolution. Our geometrical arguments show that each basic theorem has a correspondent in the case of single-time linear controlled ODEs system. The main results include controllability criteria and the equivalence between controllability of a PDEs system and the observability of the dual PDEs system. All of these show that the passing from controlled single-time evolution to the controlled multi-time evolution is not trivial. Changing the geometrical language, the case of nonholonomic evolution can be recovered easily from our theory.

**Brief Biography of the Speaker:** Constantin Udriste was born in Turceni, Gorj, Romania on January 22, 1940. He earned his professor title from University of Timisoara in 1963 and his PhD from University Babes-Bolyai from Cluj-Napoca in 1971. Now he is Full Professor of Mathematics and Dean of the Faculty of Applied Sciences at University Politehnica of Bucharest. Also it is President of Balkan Society of Geometers. Udriste has served on many advisory committees and editorial boards, and was the main organizer of over 10 International Mathematical Meetings. He is author and contributor of over 40 books, over 200 articles to mathematical journals and over 200 papers to mathematical meetings. Topics: group of motion, properties of the tangent bundle, almost coquaternion metric manifolds, variational calculus on Riemannian manifolds, Finsler-Lagrange-Hamilton manifolds, Riemannian convexity and optimization, magnetic dynamical systems, geometric dynamics and optimal control, the theory of spatial mechanisms, solar tower concentrator. A person of incredible energy and enthusiasm, Udriste has trained 12 PhD students, many of whom are now faculty members. Udriste has been the recipient of the following honors and awards: Dragomir Hurmuzescu Prize, Academy of Romania, 1985; Award for Distinguished Didactic and Scientific Activity, Ministry of Education and Instruction of Romania, 1988; Correspondent Member of the Academia Peloritana dei Pericolanti, 1997-; Member Research Board of Advisors, ABI, 1999-. Prize COPIRO - 2000 for Exact Sciences; Premio Anassilaos International 2002, Arte Cultura Scienze.



## Plenary Lecture VI

### Advances in Brain Research through Systems Science and Engineering Methods



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**Abstract:** This plenary talk will present research advances in neurotechnology that are aiming to improve the quality of life of patients suffering from neurological disorders. We will focus on epilepsy as a typical severe disorder. Enabling technologies will be discussed that begin with intracranial monitoring techniques, such as IEEGs, and the analysis of signals to determine precursors to an epileptic seizure. The intent is to detect but primarily to predict in advance the seizure initiation. Upon detection/prediction, an electrical signal is transmitted to the areas of the brain suspected as the seizure source in order to terminate the seizure before it affects the patient. We will describe clinical results of an implantable device currently under development to implement the monitoring, signal analysis and intervention methods.

**Brief Biography of the Speaker:** George Vachtsevanos is a Professor Emeritus of Electrical and Computer Engineering at the Georgia Institute of Technology. He was awarded a B.E.E. degree from the City College of New York in 1962, a M.E.E. degree from New York University in 1963 and the Ph.D. degree in Electrical Engineering from the City University of New York in 1970. He directs the Intelligent Control Systems laboratory at Georgia Tech where faculty and students are conducting research in intelligent control, neurotechnology and cardiotechnology, fault diagnosis and prognosis of large-scale dynamical systems and control technologies for Unmanned Aerial Vehicles. His work is funded by government agencies and industry. He has published over 240 technical papers and is a senior member of IEEE. Dr. Vachtsevanos was awarded the IEEE Control Systems Magazine Outstanding Paper Award for the years 2002-2003 (with L. Wills and B. Heck). He was also awarded the 2002-2003 Georgia Tech School of Electrical and Computer Engineering Distinguished Professor Award and the 2003-2004 Georgia Institute of Technology Outstanding Interdisciplinary Activities Award.

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