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Prof. Tudor Sireteanu, Director of Institute of Solid Mechanics of Romanian Academy, ROMANIA
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AUTOMATION & INFORMATION: THEORY AND ADVANCED TECHNOLOGY

Recent Advances in Electrical Engineering
A Series of Reference Books and Textbooks

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Proceedings of the 9th WSEAS International Conference on AUTOMATION and INFORMATION (ICAI'08)

Bucharest, Romania, June 24-26, 2008

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Preface

This book contains the proceedings of the 9th WSEAS International Conference on AUTOMATION and INFORMATION (ICAI'08) which was held in Bucharest, Romania, June 24-26, 2008. This conference aims to disseminate the latest research and applications in Circuits and Systems, Network Theory and Applications, Wireless Communication, Radar Systems, Mobile Communications, Optoelectronics , Telecommunication Systems, Intelligent Databases, Machine Learning, Knowledge Representation, Real Time Systems, Information fusion and other relevant topics and applications.

The friendliness and openness of the WSEAS conferences, adds to their ability to grow by constantly attracting young researchers. The WSEAS Conferences attract a large number of well-established and leading researchers in various areas of Science and Engineering as you can see from **http://www.wseas.org/reports**. Your feedback encourages the society to go ahead as you can see in **http://www.worldses.org/feedback.htm**

The contents of this Book are also published in the CD-ROM Proceedings of the Conference. Both will be sent to the WSEAS collaborating indices after the conference: **www.worldses.org/indexes**

In addition, papers of this book are permanently available to all the scientific community via the WSEAS E-Library.

Expanded and enhanced versions of papers published in this conference proceedings are also going to be considered for possible publication in one of the WSEAS journals that participate in the major International Scientific Indices (Elsevier, Scopus, EI, ACM, Compendex, INSPEC, CSA .... see: www.worldses.org/indexes) these papers must be of high-quality (break-through work) and a new round of a very strict review will follow. (No additional fee will be required for the publication of the extended version in a journal). WSEAS has also collaboration with several other international publishers and all these excellent papers of this volume could be further improved, could be extended and could be enhanced for possible additional evaluation in one of the editions of these international publishers.

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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Plenary Lecture I

From Model-Based Strategies To Intelligent Control Systems

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Abstract: The paper presents the evolution of control systems and trends in the field of integrated computer, communication and cognitive sciences for control applications. There are selected and presented the most efficient control strategies used in complex process control, as well as the limitations of model-based approaches in cases implying complex, non-linear and uncertain process models. In this context are presented some trends in robust identification and design of adaptive control systems with high level of robustness. There are analyzed the concepts for autonomous control of complex systems by integrating intelligent methodologies. Some aspects of hybrid intelligent control are considered and are also presented some new directions of research towards creating a new generation of control systems. The paper includes also a presentation of the evolution of computer controlled applications and a new paradigm – C4 – is analyzed from concept to application. Therefore, it is illustrated the transition from C2 to C4 paradigm in the context of integrating computers, communication and cognition in control. Finally, there are presented advanced control techniques for manufacturing, including intelligent agents, leading to large Intelligent Manufacturing Systems. Some trends in control of complex systems are presented, including multi-agent technology and hybrid systems formalism.

Brief Biography of the Speaker: Prof. Ioan Dumitrache, graduated the Faculty of Energetics, University "Politehnica" of Bucharest (UPB), Romania, 1962, Polytechnic Institute from Worcester, SUA, 1969, Fullbright Fellow-1971 and has a Ph.D. in Technical Physics (UPB, 1970). Since then his research and teaching activities covered an large area of automatic control techniques, electronic control, genetic algorithms, advance control algorithms, intelligent control systems, intelligent control of industrial robots, concurrent engineering. He is the author of more then 250 published papers, editor of 14 books as: Intelligent Manufacturing Systems 1995, Supplementary Ways for Improving International Stability 1998, Large Scale Systems: Theory and Applications 2001 and contributed to more then 20 books in these fields. Doctor Honoris Causa of „Politehnica" University of Timisoara-2000, University of Pitesti-2001, University of Craiova-2001, "Aurel Vlaicu" University din Arad, Grigore Moisil Award and "Man of the Year" Medal– from the Association of Economic Informatics – INFOREC - 2001 and rector at POLITEHNICA University of Bucharest (2002-2004). He is a President of Romanian Society of Technical Automation and Information, The IFAC, IEFE, IEEE IPC member over 30 conferences, member in Consultative Comity at Ministry of Technology and Research (1991-present), member in Governmental Council of European Science Foundation (2003- present), member in Governmental Council of JRC-European Commission, President of the National University Research Council and Corresponding Member of Romanian Academy.

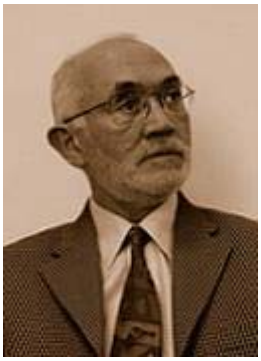
Plenary Lecture II
Advanced front-end electronics to extend the pulse height spectroscopy range well beyond the ADC analog input range

Professor Gh. Pascovici
Institute of Nuclear Physics,
University of Cologne, GERMANY
E-mail: gp@ikp.uni-koeln.de

Abstract: Using innovative front-end electronics developed for a 36_fold segmented High-Purity Germanium detectors we were able to significantly extend the range of spectroscopic measurements well beyond the fast pipe-line ADC limit. To do that above a certain threshold we are switching automatically from a standard pulse height analysis to a Time_over_Threshold [TOT] method (Wilkinson like) and combined we obtain an unprecedented intrinsic dynamic range as large as 100 dB. To achieve that performance the structure of the front-end electronics consists of a very low noise and very high dynamic range charge-sensitive preamplifier followed by a passive pole-zero cancellation circuit including a highly accurate Fast_Reset circuit controlled by a fast comparator and zero crossing detector. A differential buffer Gain/ Anti-Aliasing stage is used to pass the signal to a 14 bit 100MHz pipe-line ADC. With a thick HP-Germanium detector we could extend the initial dynamic range measured with a standard pulse height spectroscopic method from 3 keV - 10 MeV to 3 keV - 170 MeV (equivalent gamma energy, measured with large pulser signal). The intrinsic energy resolution (i.e. electronic noise) is 900 eV @ 30 pF detector capacity. The energy resolution above the comparator threshold measured with the present TOT method is below 0.08 % @ 100 MeV (equivalent gamma energy i.e. pulse signals with amplitudes about 10 times higher than the ADC analog input range). The measured energy resolution is in very good agreement with analytical calculation and with inter-comparison measurements with normal pulse height mode only and reduced electronic gain. The new time-variant circuit technique, proposed for nuclear pulse spectroscopy, permits a substantial improvement of the energy measurement dynamic range. This technique can be directly used in many other experimental pulse spectroscopic methods where the sensor is in a first approximation an equivalent capacitance.

Brief Biography of the Speaker: Gheorghe Pascovici graduated in 1965 the Polytechnic Institute, Bucharest Faculty of Electronics and Telecommunications in the field of Engineering Physics. From 1965 to 1989 he worked as scientific researcher at the Institute of Atomic Physics and from 1989 to 1993 as Director General of the Institute of Atomic Physics and Ministry Secretary of State he coordinated the Romanian National Research Program in the field of physics and applied physics. Since 1994 he is with Institute of Nuclear Physics, University of Cologne, Germany coordinating the nuclear electronics department. He received the PhD degree in Nuclear Electronics field in 1976 from the Institute of Atomic Physics, Bucharest. Fields of interest: - experimental nuclear structure physics, - nuclear instruments and methods mainly front end electronics in nuclear spectroscopy, both gamma and charged particles, - pulsing systems for Cyclotron and Tandem particle accelerators. Key results: - Main coordinator of the nuclear electronics design for the Miniball Array of Segmented HP-Ge Detectors (CERN), worldwide first large array of detectors implementing a digital solution (DGF) in the field of high resolution gamma spectrometry, - Development of the front end electronics for the core signals in the frame of AGATA Project (Advanced Gamma Tracking Array, EU Collaboration) and - for charged particles in the frame of LYCCA Project (GSI Collaboration). He is co-author of more then 100 publications in peer-review journals in the field of nuclear spectroscopy and nuclear instruments and methods.

Plenary Lecture III
Applications of Neural Networks in Mobile Robots Navigation



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Abstract: Artificial Neural Networks (ANN) and in particular cellular Neural Networks (CNN) are valuable tools, widely used today in autonomous mobile robot navigation. Obstacles detection in unknown working environment, path finding and trajectory planning, mobile robot collectivities cooperation, are the main applications where ANN and CNN have successfully proved their huge potential. In the present paper, original results in all the above mentioned fields will be presented. In the first part of the paper, a solution using ANN for obstacles detection in unstructured environment, bioinspired from the echo locator of the bats, is presented. The rest of the paper is entirely devoted to applications implemented using CNN. Different methods for path finding to the target and trajectory planning, for a single robot and mobile robot collectivities, are analyzed and the obtained results are reported.

Brief Biography of the Speaker: Prof. Virgil TIPONUT received the M.Sc. in 1968, in Electrical Engineering/Computer Science, and the Ph.D. degree in Electronic Engineering and Telecommunications, in 1981, both at the POLITEHNICA University of Timisoara, Romania. Since graduation he is with POLITEHNICA University of Timisoara and curently he is a professor at Electronic and Telecommunication Faculty, responsable for teaching in embedded systems, smart transducers and neural networks. His research interests include bioinspired systems, with application in mobile and rehabilitation robotics and some closed related areas: smart transducers, neural networks and fuzzy logic, biomedical engineering, embedded systems. He has published more than 100 papers in national and international Journals and Conference Proceedings, authored 10 books and 10 text books, and holds 21 patents. He conducted more than 25 research and development projects, grants and contracts in the field of embedded systems, robotics and smart transducers. Prof. Tiponut has been involved in setting up national and international conferences as a reviewer and/or member of organizing committee or board of sections. He was a visiting professor at universities from USA, Germany, Ireland and Schotland. He is a member of the IEEE Society (CAS, EMB, RA), WSEAS Society, member of the Society of Electronic Engineers from Romania and corresponding member of the Academy of Technical Science from Romania.

Plenary Lecture IV
Some approaches concerning autonomous mobile robot control

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Abstract: Vehicles, which operate more or less autonomously, are included in the large family of robots. The autonomy is tightly related with the use of sensors for environment perception. The mobile robots are actors on which there can be implemented strategies that belong to applied artificial intelligence. A little wheeled robot equipped with infrared sensors is our actor. On it there are applied some strategies to obtain the reactive behaviour for unforeseeable obstacles avoidance. The reactive function is a mapping on the perceptual states set with values in the action set. A rule base perception action is obtained. The building of this is tackled using a genetic algorithm as well as by reinforcement learning.To the mobile robot equipped with this ability the navigation skill is attached so that it is able to navigate from a start point to a goal one by dead reckoning by odometry. A control system based on two microcontrollers running in parallel and changing messages between each other is the hardware on which the control strategies are applied. Some results obtained by simulation of the developed strategies are presented.

Brief Biography of the Speaker: Senior researcher Sergiu-Boris Cononovici graduated as an engineer from the Polytechnic Institute Bucharest, the Faculty of Electronics and Telecomunications. He received his PhD degree in the Theory of Mechanisms and Machines from the Institute of Physics and Materials Technology in Bucharest in 1979. He joined the Institute of Solid Mechanics of the Romanian Academy in 1967. From 1979 he has been involved in research on robotics and between 1979 and 2000 he was, as robotics project coordinator, at the head of the Robotics Group. In 1985 the Central Institute of Physics Bucharest awarded his research team a prise for the first Romanian industrial painting robot. His research interests include robot control systems, sensor based control, applied artificial intelligence, fuzzy control, genetic algorithms, autonomous mobile robots. Starting with 1996 he has been president of the Bucharest branch of the Romanian Society for Robotics (ROMSIR).

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Plenary Lecture V
Predictive control strategies for image based visual servoing of robot manipulators

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Abstract: There is significant motivation to provide robot manipulators with improved autonomy using image based visual servo (IBVS) control. In classical approach, an image Jacobian matrix maps image space errors into errors in Cartesian space. Then, a simple proportional control law can be applied guaranteeing local convergence to a desired set point. This control strategy can not deal with delays due to image acquisition and processing and nonlinear constraints such as joint limits and actuator saturation or visibility constraint. In this paper, an IBVS control architecture based on model predictive control (MPC) is presented considering the direct dynamic model of the robot as a Virtual Cartesian Motion Device (VCMD), its joint and torque limits, the camera projection model and the visibility constraint. Considering the VCMD and camera models, the plant model of the visual servo open-loop was derived and, based on it, two predictive control strategies were developed. First, the control approach uses the Generalized Predictive Controller (GPC) to improve accuracy along trajectories in Cartesian space by employing information on the future reference. The second strategy is a predictive control algorithm based on EPSAC (Extended Predictive Self Adaptive Controller) which can take into account the nonlinearities of the plant model. The effectiveness of the predictive control strategies are successfully validated by simulations and with real-time experiments on a 6 DOF industrial robot manipulator.

Brief Biography of the Speaker: Corneliu Lazar received his M.Sc. degree in electrical engineering from The Technical University of Iasi in 1976. In 1991 he received Ph.D. degree in automatic control from the same university. Since 1997 he has been a Professor of Control Engineering in The Department of Automatic Control and Applied Informatics at Technical University of Iasi. His research interests include control engineering, predictive control and visual servoing systems. He is a member of IEEE.

Plenary Lecture VI
Numerical Algorithms for Analysis and Synthesis of Distributed Parametersystems in Engineering

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Abstract: In practical engineering analysis and synthesising the best engineering solution to a given design problem are of great interest. This lecture presents numerical algorithms for analysis and synthesis of distributed-parameter systems with direct applications in electrical engineering. The algorithms are developed in the context of the finite element method both for conventional and advanced computers. Many works in the professional literature present the algorithms for analysis and synthesis of the systems described by the partial derivative equations. In our work we present a general class of distributed-parameter systems with emphasis on continuos parabolic – elliptic problems in a two-dimensional space. Optimisation methods have been efficiently developed and applied to electromagnetics and mechanics. Unfortunately, the methods developed always deal with single systems. The reality is the coupled problems exist and are complex because of the critical design parameters are in both systems. Our paper is structured in two parts: Analysis of distributed parameter systems, Synthesis of distributed parameter systems using both boundary and distributed (internal) commands. The most popular approach for the solution of an optimal control problem utilises the variational calculus for the development of necessary conditions for optimality. We consider constrained problems and Lagrange's multipliers method. Since the necessary optimality conditions are distributed, their use in the development of numerical algorithms requires that they be discretized both in space and time. The finite element method is an attractive alternative to the well-known finite difference method for numerical analysis and synthesis of many problems that arise in engineering and science. The lecture demonstrates the applicability of the finite element method to numerical simulation of the distributed parameter systems with emphasis on the engineering problems. The optimal command is found by gradient techniques for constrained problems. We use sensitivity analysis that proved to give a proper design in terms of computational efficiency. For large-scale systems we apply the domain decomposition techniques. The decomposition is guided by physical considerations in the context of the finite element method. Finally, we consider some practical examples from engineering, with emphasis on coupled models for magneto-thermal and electro-heating applications. We present some numerical experiments where we try to compute the solution of a problem with a desired level of accuracy and at the same time minimising the computational resources.

Brief Biography of the Speaker: The speaker is an Assoc. Professor at the Computer Engineering and Communications Department, Faculty of Automatics, Computers and Electronics, University of Craiova, Romania. He has a BSc and MSc in Automatics from the University of Craiova, Romania. He has a Ph.D. in Automatics from the University of Ploiesti, Romania. Also, he has a BSc and MSc in Mathematics from the Natural Sciences Faculty, University of Craiova, Romania. He was director of the research projects supported by international grants at University of Houston (USA)- 6 months (Fulbright Grant), at the University of Coimbra, Portugal – 9 months (NATO grant), at the Polytechnics of Milano, Italy- 4 months (a CNR-NATO grant). In 2004 he was invited at the Mathematics Department, University of Trento, Italy, for 2 months. Ion Cârstea published 10 books in the area of programming languages, advanced computers and CAD of the electromagnetic devices. He is the co-author of the book FINITE ELEMENTS in WSEAS Press, 2007. He is the author of more than 130 papers in revues, scientific journals and international conference proceedings. He is a reviewer for several WSEAS International Conferences and was a member in many international scientific committees. In the year 2007, he was Plenary speaker and chair at the WSEAS Conferences from Arcachon (France) and Venice (Italy). His research interests include parallel algorithms for numerical simulation of the distributed-parameter systems, software products for coupled and inverse problems in engineering, domain decomposition method in the context of the finite element method.

Plenary Lecture VII

Identification in Sensor Networks

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Abstract: In the last years sensor networks have proved their huge viability in the real world, even if their resources in terms of energy, memory, computational power and bandwidth are strictly limited. One of the important problems related to the usage of wireless sensor networks in harsh environments is the identification of the states of the physical variables in the field based on the measurements provided by the sensors. The sensor networks allow the usage of the multivariable estimation techniques in distributed systems. The paper presents a short survey of some identification techniques and some characteristics of the sensor networks. Some examples of applications of modeling of distributed systems in sensor networks and identification based on multivariable identification with auto-regression and neural networks are presented.

Brief Biography of the Speaker: Constantin Volosencu graduated in 1981 "Traian Vuia" Polytechnic Institute of Timisoara, as an engineer in automatics and computers. He is doctor in control systems from 2000, and Professor since February 25, 2008. He has interests in linear control systems, fuzzy control, neural networks, control of electrical drives, modeling, identification and simulation and sensor networks. He is the author of 9 books, over 80 papers published in journals and conference proceedings, manager of over 30 research projects. Constantin Volosencu worked for 9 years in the mechanical industry, were he developed control equipments for a large scale of machineries, which are the objects of 27 patents.

Plenary Lecture VIII
A Survey of Some Automotive Integrated-Starter-Generators and their Control

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Abstract: Integrated starter generator (ISG) uses one machine to replace conventional starter and alternator onboard vehicles and provides greater electrical generation capacity and improves the fuel economy and emissions. The main requirements of the ISG control are to ensure: the necessary cranking torque as starter in the most unfavorable conditions; a constant output voltage irrespective of the input speed (typically between 600 and 8000 rpm) and load, as generator; a high efficiency as generator in the speed range of 600…4000 rpm that corresponds both to I4 and V8 engines; an acceptable cost. The idea is not new, but needs a high complexity control system because of the differences between motoring and generating regimes, so that only modern motors and high-developed power electronics and digital signal processors made it practically possible.
This presentation reviews the challenges and opportunities brought by the integration of the internal combustion engine and ISG into a single power unit. The structure evolution, material enhancement, and major design challenges are discussed. The electric motors types that are suited to play the role of an ISG are mostly the alternating current motors and their control algorithms are analyzed and exemplified.

Brief Biography of the Speaker: Dorin-Dumitru Lucache received the M.S. and Ph.D. degrees from the "Gh.Asachi" Technical University of Iasi, Romania, in 1986 and 2001, respectively, both in electric engineering. He received also the M.S. in Mathematics and Bussines Administration from the "A.I.Cuza" University of Iasi, Romania, in 1994 and 2007, respectively. From 1986 to 1992, he worked as project engineer in the Land Works Execution and Exploitation Industry, Iaşi, Romania and as research engineer in the Building-Resistance National Research Institute, Iaşi, Romania. Beginning 1992 he becomes a member of the "Gh.Asachi" Technical University of Iasi, Romania, currently acting as Assoc.Professor and Scientific Secretary of the Faculty of Electrical Engineering. He is a Member of IEEE, of AGIR (General Association of Engineers of Romania) and of CETR (Technical Experts Council of Romania). He was chairman of some sections in national and international conferences and organizing committee chairman of three international conferences held in Iasi, Romania and Chisinau, Rep. Moldavia. Research fields of interest: permanent-magnet electric machines, magnetic bearings, electric lighting and heating, mild-hybrid electric vehicles, motion control. Author/ co-author of more than 80 scientific papers, published in scientific journals and/or presented at international/national conferences and 2 books published in Romania. Coordinator/ member of the executive team of over 12 research and education grants, at national level.

Plenary Lecture IX
Adapting a Blowdown Type Wind Tunnel for Ground Effect Simulation Tests

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Abstract: In the paper are shortly presented the main results of some researches performed by the author regarding the adapting of an intermittent (blowdown type) wind tunnel for testing models of terrestrial (road transportation) vehicles, (air) vehicles with ground effect, or which evolve in the ground proximity (the cases of aircraft take-off running and lift-off), as well as for aircraft half models testing (the so called "reflection-plane testing"). This new obtained installation includes a large series of automatic systems (mechanical, measuring and driving), which must accomplish all the envisaged testing requirements. The essential advantage of this kind of solution, with respect to that of a continuous closed (usually nonpressurized) wind tunnel adapting, consists in obtaining much larger values of the test Reynolds number, given by the correspondingly higher values of the stagnation pressure (in the blowdown wind tunnel settling chamber). So far, as we know, nowhere in the world has been considered the problem of adapting a pressurized intermittent type wind tunnel to aerodynamic tests with correct ground effect simulation. The main part of this adaptation is the moving belt mechanical system (considered to be installed at the floor of the modified wind tunnel three-dimensional transonic test section), whose task is to assure the elimination of the velocity nonuniformity effect, introduced by the boundary layer on the respective wall of the wind tunnel, without any irreversible alteration of the geometry and kinematics of the installation above.

Brief Biography of the Speaker: Senior researcher Richard Selescu graduated as an engineer from the Polytechnic Institute Bucharest, the Faculty of Mechanics, Department of Aircraft Engineering in 1970. He is working in the National Institute for Aerospace Research "Elie Carafoli'' – INCAS, Department of Aerodynamics, at the Trisonic Wind Tunnel Laboratory. He received his PhD degree in Aerodynamics and Fluid Mechanics at the Aerospace Engineering Faculty of the "Politehnica" University Bucharest in 1999. Among the research fields of interest, he approached the analytic modeling in aerodynamics, fluid mechanics and magnetofluid dynamics. Thus, he introduced the following nomenclature: the isentropic surfaces and a 2-D velocity quasi-potential function on these surfaces (in fluid mechanics); a new physical quantity - the MHD vector and its vector lines (in magnetofluid dynamics); the tronconical flow (in the supersonic aerogasdynamics); the similarity depth for satisfying the gas-hydrodynamic analogy (in the supercritical hydrodynamics).

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