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Special Issue on
Advanced Controls And Signal Processing in Active And Robotic Systems

Foreword by the Guest Editor

For quite some time the idea about this special cross-disciplinary issue has been both puzzling as well as troubling me until finally I came to a positive conclusion. To my joy, Prof. Dr. Katica R. (Stevanović) Hedrih, Madam Editor-in-Chief of *Facta Universitaties Series on Mechanics, Automatics Control and Robotics*, embraced this idea frankly and not only devoted her efforts and time but also her passionate co-operation in all respects. Furthermore, to even greater joy of mine, a number of distinguished colleagues as well as young researchers have embraced the idea too. They all co-operated with me on this special issue with patience, for which I remain indebted to them for life. Here it is now this special issue before the competent research communities for final evaluation. For indeed their words are the final ones.

This special issue begins with the article "Nanorobots for Microfactories to Operations in the Human Body and Robots Propelled by Bacteria" by Professor Sylvain Martel form Ottawa, Canada. This article is focused on the exploitation of the properties at the nanoscale that enables novel nanorobotic-based instrumented platforms and techniques. Some unique interdisciplinary examples from his research laboratory are described thus providing certain insights about the possibilities and the huge potentials of nanorobotics with main application areas in medicine and bioengineering. These also include supporting the new robotic platforms for micro- and nano-manufacturing and high-throughput automatic operations at the nanoscale. For several applications where specifications cannot be met using modern technologies, especially at such small scales, a highly interdisciplinary approach integrating biological components in engineered systems becomes an essential part of the development process, which opens a new prospect to nanorobotics. This article is based on his plenary talk at the 2007 IFAC Workshop on Technology Transfer to Developing Countries (DECOM 2007) in Cesme, Turkey.

Next article "The Interrupt of Mascot Robot Systems Embedded in RT Middleware Based on Fuzzy Logic" comes from the renowned "Hirota Laboratory" of Tokyo Metropolitan University, Japan. In this article, young Hai An Vu and Professor Kaoru Hirota along with their collaborators propose a novel control method based on fuzzy priority measure and fuzzy selection criterion in order to solve the interrupt problem in Mascot Robot System. Fuzzy-logic based computational intelligence appeared indispensable because fuzzy priority measure defines the priorities of interrupted instructions in order to optimize responsiveness of the system. The fuzzy selection criterion based on the fuzzy priority measure is used to determine the appropriate interrupted instruction for the next processing. The method has been embedded in Robot Technology Middleware, which is used to construct the communication environment among robots in Mascot Robot System. Five kinds of Eyeball robot's emotions, different in execution time, are used in the experiments on the real system. The fuzzy interrupt processing method improves the responsiveness of the system by more than 18.5% with an acceptable delay time of less than 0.32 seconds. In part this contribution is based on Professor Hirota's plenary lecture at the 2008 IEEE Intelligent Systems in Varna, Bulgaria.

A category of active hybrid technological systems with embedded intelligence characterize the current industrial developments and the article "Robust Adaptive Control of Mechatronic Systems Employing ANN Emulation of Nonlinear Functions" by Professor Yuanwei Jing, Shenyang – P.R. of China, and his multi-national team of co-authors proposes an artificial neural network based nonlinear synthesis of such systems. This new synthesis solution is aimed at the class of mechatronic nonlinear systems possessing similarity property as composite hybrid

plants, and it employs of both high-order neural networks and math-analytical results. Via an adequate compatible use of the structural feature of composite similarity systems and neural networks, the representation issue of uncertainty interconnections and subsystem gains by on-line updating the weights has been solved. This synthesis does guarantee the real stability in closed-loop, yet it does require skills to obtain larger attraction domains for higher magnitude operation. A version on the preliminary results of this international research collaboration appeared at Neurel 2006 IEEE Workshop in Belgrade, Republic of Serbia.

My distinguished colleagues and friends Rainer Palm, from Germany, and Boyko Iliev, from Sweden have contributed the next article entitled "Learning the Grasps for an Artificial Hand by Time Clustering and Takagi Sugeno-Modelling". The focus of this paper is in the learning of grasp primitives for a five-fingered anthropomorphic robotic hand via programming-by-demonstration and fuzzy modelling. In this approach, a number of basic grasps is demonstrated by a human operator wearing a data glove which continuously captures the hand pose. The resulting fingertip trajectories and joint angles are clustered and modelled in time and space so that the motions of the fingers forming a particular grasp are modelled in a most effective and compact way. Classification and learning are based on fuzzy clustering and Takagi-Sugeno modelling. The presented method allows for learning, imitating, and recognizing the motion sequences forming the specific grasps needed. An earlier version of this research was presented at the 2006 World Congress on Computational Intelligence in Vancouver, Canada.

The subsequent article is authored by Marina Kolesova, Aleksrandr Polyakov and Mihail Kalinin from Sebastopol National Technical University and its earlier version was presented at the DECOM- IFAC 2007. It is entitled "Quantitative and Qualitative Estimations of the Manipulator End-effector Trajectory Planning by Synergetic Criterion". In this work from several viewpoints the planning task of end-effector's trajectory in two dimensional workspace for model of an anthropomorphous, two-link, planar, manipulator with revolute joints is studied. The set of solutions by criterions of the minimum torques-change, the minimum total work, and also by a new criterion of the minimum error of a linear synergy are received. There are made their relative quantitative and qualitative estimations. The criterion of the minimum error of a linear synergy is proved from the biomechanical point of view. It is shown that task of a trajectories planning at its using has solutions, which correspond to set of experimental data and in general are characterized by kinematic and dynamic invariance, peculiar for free movements of the human arm. The numerical solutions of task are received by making use of the Jacobi orthogonal polynomials for various directions of end-effector movements towards the target and for two variants of manipulator links parameters. The early version of this research was presented at the 2007 IFAC Workshop on Technology Transfer to Developing Countries in Cesme, Turkey.

An innovated but fundamental application of the celebrated phase plane method to nonlinear dynamical systems possessing coupled nonlinearity triggers, which is entitled "Phase Plane Method Applied to the Optimal Control in Nonlinear Dynamical Systems with Triggers of Coupled Singularities", is contributed by Katica R. Stevanović- Hedrih, from Nis, Republic of Serbia. This paper analyses the controllability of motion of conservative or no conservative nonlinear dynamical systems in which triggers of coupled singularities exist or appear. First the paper presents a short review of the author's previous published results containing series of the special cases of the optimal control in nonlinear dynamical systems possessing triggers of coupled singularities important for engineering applications. It is shown that the phase plane method is useful for the analysis of nonlinear dynamics of conservative and no conservative systems with one degree of freedom of control strategies and also shows the way it can be used for controlling the relative motion in rheonomic systems having equivalent scleronomic conservative or no conservative system. For the system with one generalized coordinate described by nonlinear differential equation of nonlinear dynamics with triggers of coupled singularities, the functions of system potential energy and conservative force must satisfy some conditions defined by a Theorem on the existence of a trigger of coupled singularities and the separatrix in the form of number eight. Task of the defined dynamical conservative system optimal control is: by

using controlling force acting to the system, transfer initial state of the nonlinear dynamics of the system into the terminating final state of the nonlinear dynamics in the minimal time for that optimal control task. Some research results of fascinating nonlinear dynamics of a heavy material particle along circles with coupled rotations with many different properties of nonlinear dynamics and optimal control of this dynamics are presented. Parts of scientific results of this paper were presented at the 14th International Workshop on Dynamics & Control be held on May 28–June 2, 2007 in Zvenigorod near Moscow, Russia, organized by academician Felix Chernousko and also the 2nd International Symposium on Nonlinear Dynamics, 27-30 October 2007, in Shanghai, P. R. of China, organized by Professor Jo Huan He, as well as in the IFNA International Conference of Hybrid Systems and Application, May 22-26, 2006, The University of Louisiana Lafayette, LA, US organized by Professors V. Lashmikantham and A. Vatsala.

In the subsequent article entitled "High-Rise Buildings under Earthquake Excitation: Stabilization by Sliding-Mode Control" the international team of Georgi M. Dimirovski and his co-authors, coming from R. of Macedonia, P. R. of China and R. of Serbia, have addressed a special but rather important class of active systems. Namely, controlling the dynamics of high-rise buildings either to ameliorate the damage or to prevent their destruction when subject to an earthquake excitation has been subject of extensive research for quite some time. All known control designs have advantages and disadvantages as well as operating limits. The application of sliding-mode control to controlling earthquake induced vibrations of a multi-story structural system as an active seismic compensation plus base isolation has been investigated. The achieved performance has been compared to the one of traditional industrial controls, and the relevant conclusions have been drawn. Results of simulation experiments, carried out using El Centro earthquake acceleration, have shown that the sliding mode control can decrease significantly displacements of the floors. An early version of this research was reported at the 2006 IFAC Symposium on Mechatronics in Heidelberg, Germany.

By means of article "Using Binocular Stereovision for Calculating Motion References for a Mobile Manipulator by Levent Cetin and Erol Uyar from Izmir, Turkey, the reader's attention is shifted towards mobile robotics. This paper is focused on the design and application of a stereo setup that is mounted on a mobile manipulator. This setup is utilized to generate reference points for mobile manipulator, dynamically. Tasks, 3D recovery and feature extraction, are accomplished in camera reference frames then they are transformed to robot coordinate frame. Recovered position data is converted to manipulator pose with two-stage algorithm: an iterative approach for positioning and inverse kinematics calculations for orientation requirement. A computer application of this algorithm is developed and tested for position control of mobile manipulators with active vision. The earlier version of this research was reported at 2007 IFAC Workshop on Technology Transfer to Developing Countries in Cesme, Turkey.

In the subsequent article "Neuro-fuzzy controllers and applications to autonomous robots" Pavle Boskoski and Mile Stankovski from Skopje, Macedonia, have made a further step forward in the design of fuzzy-neural controllers dedicated to achieve autonomous operation of mobile robots. This work presents an analysis of the neuro-fuzzy controllers and the algorithms for their derived generation. The generated neuro-fuzzy controllers are then used for optimal control of an autonomous robot (e.g. Khepera) in an unknown environment, which is different than the one used for the training the controller. The combination of neural networks with fuzzy logic offers the opportunity for resolving the difficulties of proper generation of fuzzy controller. This works covers the some of the algorithms for generation of fuzzy controllers by employing neural networks. The preliminary results of this research were reported at 2007 IFAC Workshop on Technology Transfer to Developing Countries in Cesme, Turkey.

In the article "Sensor Fusion using Dempster-Shafer Theory of Evidence in Autonomous Robot Navigation" *A*ytaç Gören and his co-authors from Izmir, Turkey, have constructed an experimental model of an autonomous mobile robot and by applying Dempster-Shafer theory of evidence to data from the sensors. It is aimed to achieve more reliable sensor data. Dempster-Shafer evidence theory is selected because of its advantages over Bayesian theory, which was experimentally proved to be superior. Mobile robot is equipped with an embedded PC, microprocessors, cameras, encoders and

ultrasonic sensors in order to study on data processing and performance of different control algorithms. However, this part of the research does not include the performance differences of control algorithms. Uncertainties in ultrasonic sensors caused by the unpredictable reflection from environments make them less reliable, and this has been overcome by applying Dempster-Shafer theory. The preliminary results of this research were reported at 2007 IFAC Workshop on Technology Transfer to Developing Countries in Cesme, Turkey.

The subsequent article authored by Vladislav Yu. Rutkovsky and his team of collaborators from Moscow, Russia, do take the reader into the active systems in Astronautical space technology. Their article is entitled "Mathematical Model of Flexible Spacecraft and physically relizable adaptive-control for its orientation". They have studied spacecrafts with flexible construction. The angular motion equations decomposition and procedures of the control systems design are suggested. Some problems of stabilization processes dynamics of such kind control objects are investigated. Essential flexibility of the construction, variations of the mathematical model parameters and disconnected character of the hand-wheels control actions of the orientation system are taken into account. Physically realizable adaptive attitude control system providing robustness with respect to the elastic oscillations is suggested. Kalman estimations of the elastic modes are used. The instants of the control action switching are chosen with regard to the condition of the dominant mode optimal phase. Some issues along the lines of this research have been reported at the 2008 World Congress of the IFAC in Seoul, Korea.

Next, in the article "Homing Air-defence Missile Systems Using a Novel Fuzzy-logic Mode of Fire Control" Saso Gelev and his co-authors from Skopje, Republic of Macedonia, have provided a novel computational-intelligence solution for an aerospace active system such as air-defence missile fire control. The problem of shooting targets in the air is rather complex task, in which every missile system for air defence is responsible for fire control. In this paper we present a novel approach and mode for fire control in air-defence systems based on homing missiles. A device for calculation of the launching zone is used for intelligent estimation whether the target has entered the launching zone. The proposed novel approach makes essential use a fuzzy reasoning, a fuzzy-rule knowledge base for target's velocity, to calculate the launching zone immediately upon the first detection of a target. Namely, it uses pre-defined launching zones for different flying regimes and different velocities of potential targets, and the data are stored into a look-up table along with the associated pass angles and flying times to the launching zone border. The preliminary results of this research were reported at 2007 IFAC Workshop on Technology Transfer to Developing Countries in Cesme, Turkey.

The next article "Optimized Sensor Allocations for a Maglev Suspension System" by Konstantinos Michail, Argyrios C. Zolotas, Roger M. Goodall from Loughborough, United Kingdom, takes the reader back on Earth and in such an industrial environment as transportation is. This paper discusses a systematic approach for selecting the minimum number of sensors for an Electromagnetic suspension system that satisfies both optimized deterministic and stochastic performance objectives. The performance is optimized by tuning the controller using evolutionary algorithms. Two controller strategies are discussed, an inner loop classical solution for illustrating the efficacy of the evolutionary algorithm and a Linear Quadratic Gaussian structure particularly suited on sensor optimization. Some issues along the lines of this research have been reported at the 2008 World Congress of the IFAC in Seoul, Korea.

In the subsequent article by Tsz Ming James Hui and his co-authors from Institute of Industrial Research of the University of Portsmouth, United Kingdom, which is entitled "Parameter Estimation for Online Condition Monitoring of Robotic Machines" addresses the delicate issue of active intelligent systems for monitoring robotic machines. This paper proposes a novel learning approach to online condition monitoring of robotic machines. The real-time learning process comprises three stages, domain knowledge defining, random learning and ordinal learning. Domain knowledge defining abstracts the model of a robotic machine; random learning and ordinal learning stages train the parameters of the abstract model with random data selection and ordinal data selection, respectively. Simulation results have proved that the proposed method is efficient and feasible for online fault diagnosis of robotic machines. Some issues along the lines of this research have been reported at the 2008 World Congress on Computational Intelligence in Hong Kong, China.

In the article "Reference Tracking versus Path-following for a One-link Flexible Robot Manipulator" Pedro Pires and his co-authors from Technical University of Lisbon, Portugal, have addressed to the topic of ongoing research towards controlling flexible manipulation robots. This paper details two control approaches for a flexible manipulator system, where the non-minimum phase problem is treated. In the first approach, we use the motion planning technique. It searches for proper output trajectories with polynomial form, in order to cancel the effects of the unstable zeros. The second approach is called Path-Following with internal model control. Its primary objective is to steer a physical object to converge to a geometric path, and its secondary objective is to ensure that an object's motion along the path satisfies a given dynamic specification. Some issues along the lines of this research have been reported at the 2008 World Congress of the IFAC in Seoul, Korea.

The subsequent article "Subspace Based Frequency Analysis of a Smart Acoustic Structure" by Tamara Nestorović and Ulrich Gabbert from Bochum and Magdeburg, Germany deals with the delicate issues of another kind of active systems, namely the acoustic ones. The aim of this paper is to perform a frequency analysis for a smart acoustic structure with integrated piezoelectric material based on the model obtained through the subspace identification procedure. In this way the relevant Eigenfrequencies can be identified and used in the subsequent structural control design phases in order to avoid resonant states. Structural model is obtained in the state-space form, which enables a straightforward comparison of the identification results with numerical modelling results. Subspace identification procedure is performed for an acoustic enclosure consisting of a piezoelectric plate surrounded by an acoustic box. An experimental setup with the acoustic box and the dSPACE system was used for the identification. Experimentally identified frequency responses show a good agreement with the frequency responses obtained from the finite element model.

Next in the article "Neurodynamical Classifier Based on Differential Geometry" authored by Tijana T. Ivancevic and her collaborators form Adelaide, Australia studied another, combined soft-computing and math-analytical, active recognition system. A new model for a neurodynamical classifier is proposed. The classifier is viewed as a generalized bi-directional associative memory (GBAM) and is described in the language of differential geometry. GBAM is a tensor-field system resembling a two-phase biological neural oscillator in which an excitatory neural field excites an inhibitory neural field, which reciprocally inhibits the excitatory one. GBAM equations have been directly implemented in the computer algebra system 'Mathematica' and tested on two different sets of data related to detection of breast cancer. The GBAM classifier outperformed other neural classifiers.

Finally, article "An ANFIS approach to approximation of Electromagnetic Field around Overhead Power Transmission Lines" by Jasna Radulović and Vesna Ranković from Kragujevac, R. of Serbia, presents yet another active recognition system applied to a long persisting industrial problem. This paper presents a novel approach based on the use of adaptive network-based fuzzy inference systems (ANFIS) to estimate electric and magnetic fields around an overhead power transmission line. There are many numerical methods for electric and magnetic field estimation in the surround of power transmission line, but usually it takes substantial execution time, especially when high accuracy of obtained solutions is required. An ANFIS used for simulation of this problem was trained using the results derived from the previous research performed by the authors of this paper. It is proved that proposed approach ensure satisfactory accuracy and time efficiency, and can be a very useful alternative for such investigations.

Indeed the idea about this special cross-disciplinary issue grew in me since the conference keynote talk by Professor Vukobratović on Active in Advanced Engineering and Robotic Systems at DECOM-IFAC 2003 in Istanbul – Istanbul Technical University, further enhanced by Professor Šiljak's talk on Dynamic Graphs and Complex Systems at IFNA Hybrid Systems & Applications 2006 in Lafayette – University of Louisiana. And I could not have it otherwise but to make it materialise. Furthermore, I felt it should materialise in a scientific journal published in the Republic of Serbia, the native country of both these beloved and esteemed teachers of mine.

It is my very special privilege and great honour now to dedicate this special issue to extraordinary personalities of Miomir K. Vukobratovic and Dragoslav D. Siljak, Academicians of SANU, from whom I have been fortunate to learn so much, in recognition of their outstanding

fundamental contributions, respectively. These I would dare to summarize by means of a few selected publications of theirs, respectively:

Professor Miomir K. Vukobratović

– ***Legged Locomotion Robots and Anthropomorphic Mechanisms***, IMP Belgrade, 1975, also published in Japanese by Nikkan Shimbun, Tokyo, 1975, in Russian by MIR, Moscow, 1976, and in Chinese by CAS, Beijing, 1983.

– ***Dynamics of Robots*** (in Japanese), Nikkan Shimbun Ltd, Tokyo, 1978.

– ***Scientific Fundamentals of Robotics, Volume 1-7,*** *monograph series,* Springer-Verlag, Berlin, 1982-1989 (each volume along with one of his best doctoral students).

– "When Were Active Exosceletons Actually Born", *Intl. J. of Humanoid Robotics*, vol. 4, no. 3, pp. 459-487, 2007.

Academician Miomir Vukobratović
Head and Founder
Robotics Laboratory, Mihailo Pupin Institute

– ***Dynamics and Robust Control of Robot-Environment Interaction,*** Volume 2 of Monograph Series New Frontiers in Robotics, World Scientific Publishing, Singapore, 2009.

Professor Dragoslav D. Šiljak

– ***Nonlinear Systems***, John Wiley & Sons, New York, 1969.

– ***Large-Scale Dynamic Systems***, North-Holland, New York, 1978, reprinted in 2007 by Dover.

– ***Decentralized Control of Complex Systems***, Academic Press, Boston, MA, 1991.

– "Dynamic Graphs", *Nonlinear Analysis – Hybrid Systems*, vol. 2, pp. 544-567, 2008.

At this moment I would like to admit, over three decades by now I have progressed in part due to their inspiring feedback communications to my questions or requests to which they both have answered always. Nonetheless, I would have called them my beloved teachers anyway solely for their personal human dimensions that taught me how to become a good teacher and colleague.

Academician SANU Dragoslav D. Šiljak
B & M SWIG University Professor
Department of Electrical Engineering
Santa Clara University

Lastly but not least, I would like to express my deep appreciation to Professor Katica R. (Stevanović) Hedrih, Madam Editor-in-Chief, for her tireless co-operation during more than a year of time that was instrumental for this special issue to appear regardless various difficulties encountered.

Guest Editor

Prof. Dr. Georgi M. Dimirovski
Foreign Member of the Academy of Engineering Sciences of Serbia
February – April, 2009 in Skopje, Macedonia, and Istanbul, Turkey.

Guest Editor - Georgi Marko Dimirovski

Dr Georgi Marko Dimirovski

Dr Georgi Marko Dimirovski was born on 20.12.1941 in Greece, in village Nestorion – Nesram in Aegean Macedonia. Currently, he is a Research ("life-time") Professor of Automation & Systems Engineering at SS Cyril & Methodius University of Skopje, Republic of Macedonia, and an invited Professor of Computer Science & Information Technologies at Dogus University of Istanbul, Republic of Turkey. Also, he is a guest-professor on the graduate studies at Istanbul Technical University (Aeronautical Engineering) and at Dokuz Eylul University of Izmir (Mechatronics Engineering) teaching on part-time basis. He is a Foreign Member of the Academy of Engineering Sciences of Serbia in Belgrade. He was awarded his PhD in ACC by University of Bradford, UK, in 1977 and had obtained his MSc in EEE from University of Belgrade, Rep. of Serbia, and Dipl.-Ing. in EE from SS Cyril & Methodius University of Skopje, Rep. of Macedonia– then both within former S.F.R. of Yugoslavia – in 1966 and 1974, respectively. After spending three years in industry He joined the academia in 1969. At University of Bradford, in 1979 he held a postdoctoral fellow position and has been a Visiting Professor in 1984, 1986 and 1988, respectively. He has been a Visiting Scientist to University of Wolverhampton in 1990 and 1992. Prof. Dimirovski was a Senior Research Fellow & Visiting Professor of Free University of Brussels, Belgium, in 1994, and also of Johannes Kepler University of Linz, Austria, in 2000. He has been awarded grants for 7 national projects by Ministry of Education and Science of R. of Macedonia: 5 in automation and control of industrial processes, and 2 in complex decision and control systems. During the last three decades, he paid longer or shorter term academic visits with seminars to universities in: Aalborg, Ankara, Belgrade, Bradford, Bochum, Brussels, Coimbra, Covilha, Duisburg, Grenoble, Hannover, Istanbul, Izmir, Kaohsiung (TW), Linz, Lisbon, Ljubljana, London, Maribor, Nis, Portsmouth, Sarajevo, Sevastopol, Shenyang (CN), Sofia, Split, Valencia, Wien, Wolverhampton, and Zagreb. He took part in European Science Foundation's Scientific Programme on Control of Complex Systems (COSY) 1995-99 under the leadership of Professors Karl J. Astroem and Manfred Thoma and served on the Steering Committee too. His research fellow and his graduate students participated along. He supervised successfully 2 postdoctoral, 15 PhD, and 29 MSc as well as more than 250 graduation students' projects, and advised a number of graduate students at NEU of Shenyang within the framework of his academic co-operation with Professors Yuanwei Jing and Jun Zhao there. Prof. Dimirovski served on PhD evaluation juries and/or panels for several universities including Bradford and Wolverhampton in the UK, Izmir in Turkey, Ljubljana in Slovenia, Chennai in India, Zagreb in Croatia, Sofia and Varna in Bulgaria, and Craiova in Romania. He was editor of six (6) volumes of the IFAC and one (1) volume of the IEEE Proceedings Series. Internationally, he has contributed 5 invited theme papers (chapters) in research monographs and published more than 40 journal articles as well as more than 250 conference papers in proceedings series of the IFAC and the IEEE alone. He served on the editorial boards of the journals Proceedings of Institution of Mechanical Engineers Pt. I J. of Systems & Control Engineering (UK), Automatika (former SFR of Yugoslavia), and Information Technologies & Control J. (Bulgarian Union of Automation and Informatics, Sofia), and was Editor-in-Chief of J. of Engineering (MK). Currently, he serves on Editorial Boards of Facta Universitatis J. of

Electronics & Energetics (University of Nis, Serbia), J. of Electrical & Electronics Engineering (University of Istanbul, Turkey), and J. of Control Engineering & Applied Informatics (Poltechnica University of Bucharest, Romania). Dr Dimirovski regularly reviews for a number of archival journals refereed in SCI and/or SCI-Expanded. In 1985, he founded the Institute of Automation & Systems Engineering at Faculty of Electrical Engineering of SS Cyril & Methodius University. He initiated and founded in 1981 the ETAI Society – Macedonian IFAC NMO, and was elected its first President. In 1996 he joined Dr Goce Arsov in founding the IEEE Republic of Macedonia Section, and in 2002 he joined Dr Okyay Kaynak in founding the IEEE Computational Intelligence Chapter of Turkey too. He has developed a number of undergraduate and/or graduate courses in areas of control and automation as well as others in robotics, in applied numerical, fuzzy-system and neural-network computing, and in operations research at his home university and at universities in Bradford, Istanbul, Izmir, Linz, and Zagreb, respectively. During 1985-1991, he served three terms as the President of Yugoslav Association for ETAN, then Yugoslav IFAC NMO. During 1988-1993, he served the European Science Foundation on the Executive Council and in other capacities too. He served the International Federation of Automatic Control (IFAC) in capacities of the Vice-Chair of TC 9.3 on Developing Countries during 1996-2002 and the Chair, during 2002-05, as well as the Chairman of Coordination Committee CC9 and member of the Technical Board of the IFAC (TB) during 2005-08. At present, he serves his second term on the IFAC TB and as the CC9 Chair during triennium 2008-2011. He has served on the IPC's for many IFAC, IEEE, ECC and WAC conferences, and for others too. He was Co-Chairman of the IFAC SWIIS 2000 and of the IFAC DECOM-TT 2001, 2003, 2004, 2007, and of the IFAC CEFIS 2007 as well as the Technical Program Chair of the 2003 IEEE CCA and 2010 IEEE SMC, also of the 1993 and 2003 International AAS ETAI symposia. *BiSvP!*

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