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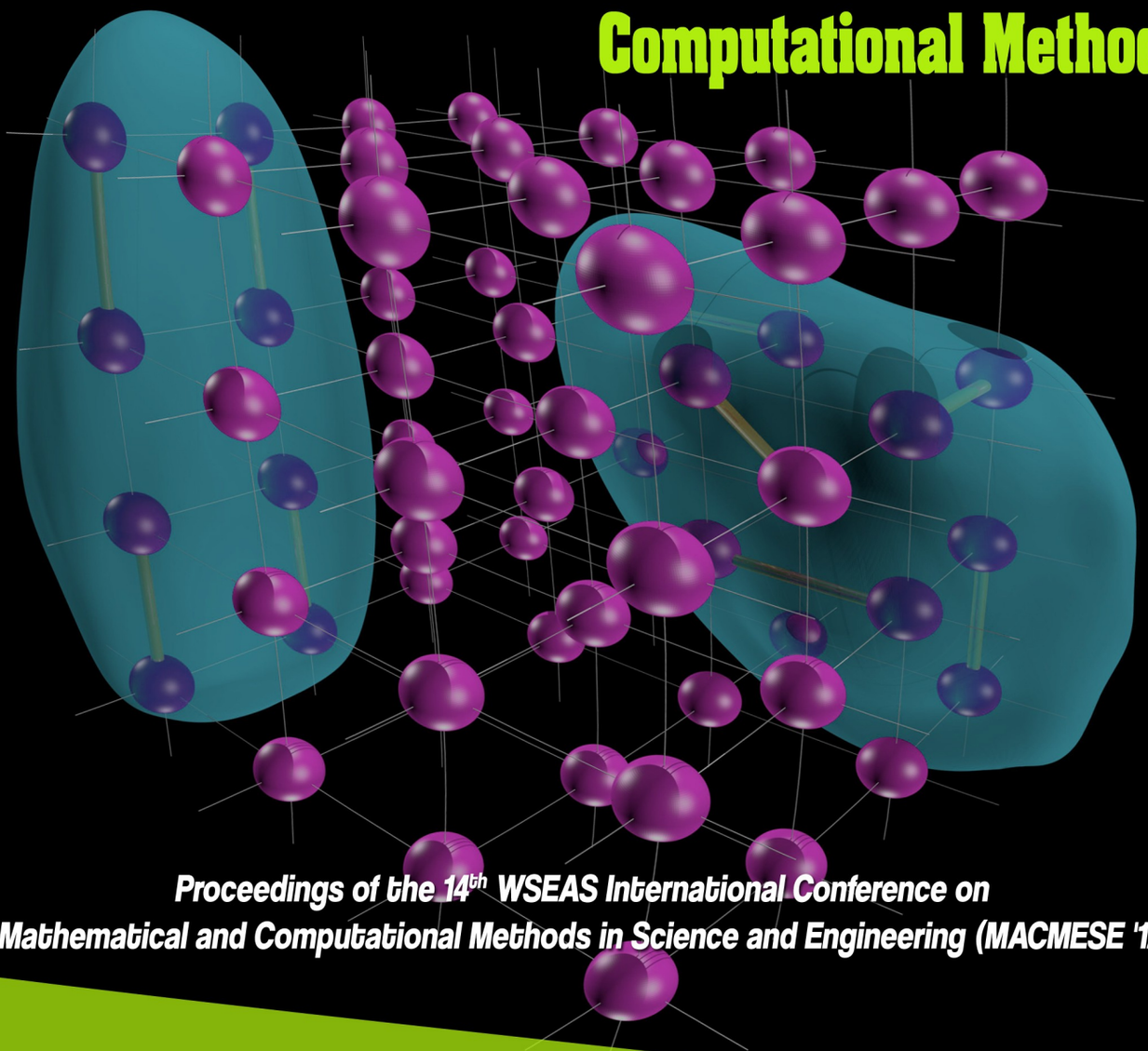

Proceedings of the 14th WSEAS International Conference on Mathematical and Computational Methods in Science and Engineering (MACMESE '12)

Sliema, Malta, September 7-9, 2012

Mathematics and Computers in Science and Engineering Series | 4

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Preface

This year the 14th WSEAS International Conference on Mathematical and Computational Methods in Science and Engineering (MACMESE '12) was held in Sliema, Malta, September 7-9, 2012. The conference provided a platform to discuss new mathematical methods and computational techniques or applications of known mathematical methods and computational techniques (i.e. differential equations, FEM, BEM, variational calculus, stochastic systems, cellular automata, wavelets, integral equations, universal approximants, optimization and search, clustering and density estimation, filtering and state estimation, linear and non-linear time series, simulation techniques, neural networks, fuzzy logic, evolutionary computing, orthogonal transforms, wavelets, forecasting etc) with participants from all over the world, both from academia and from industry.

Its success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of this conference are published in this Book that will be sent to international indexes. They will be also available in the E-Library of the WSEAS. Extended versions of the best papers will be promoted to many Journals for further evaluation.

Conference such as this can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Discrete Mathematic Diagnosis Models of Complex Manufacturing Systems

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Abstract: Fault detection is a crucial and challenging task in the automatic control of complex systems, e.g. in flexible manufacturing systems (FMSs) as a representative class of discrete event systems (DESs).
A discrete event system approach to the problem of failure diagnosis is presented.
We propose a systematic procedure for detection of failure events using diagnoses implemented with stochastic coloured Petri nets (SCPN). An analytical approach for the availability evaluation of cellular manufacturing systems (as basic components of FMS's) is presented, where a FMS is considered operational as long as its production capacity requirements are satisfied.
The approach is used to evaluate transient and steady-state performance of alternative designs based on an industrial example.
The property of diagnosability is introduced in the context of the failure diagnosis problem, e.g. in the context of the availability of the DES.
We bring a DES approach to the problem of failure diagnosis of FMSs because most of them are modelled by DESs, and because continuous variable dynamic systems can often be viewed as DESs at a higher level of abstraction, respectively when their trajectories are determined by meaningful accumulations of dynamics e.g., are determined by events.
The states of the discrete event model reflect both the normal and the failed status of the system components, while the failure events form part of the event set.
We present a systematic procedure for detection and isolation of failure events using diagnosers. Therefore we model FMSs with stochastic coloured Petri nets (SCPNs).
The diagnoser is a SCPN which models the FSM. This model performs detection and isolation of failures (failure information and occurrences of failures can be detected by inspecting the states of the SCPN model), and it also permits the verification of the diagnosability properties of the system (e.g., permits the estimation of the reliability of the system). In our assumption the availability of a production cell i (i=1, 2…., n, where n is the total number of part cells in the FMS) is calculated with a Markov chain that includes the failure rates, repair rates, and coverability of the respective devices in the production cell i.
The colour domains of transition in the SCPN model which loads cell i, in the Markov chain, include colours that result in a value between 0 and 1, and the biggest value designates the cell which will transmit data further on according to the system throughput.

Brief Biography of the Speaker: • Academic Positions: Assoc. Professor Ph.D. Eng., Dept. of Automatics and Computers, Faculty of Electrical Engineering and Computer Science, "Stefan cel Mare" University of Suceava, Romania.
• Fields of Scientific Activities: Discrete Event Systems, Complex Measurement Systems, Reliability and Diagnosis of Control Systems, Environmental Management.
• He published 11 books, 12 patents and over 160 scientific papers in conference proceedings and journals.
• Honor Member of the Romanian Society of Electrical & Control Engineering - Member of the Romanian Technical Experts Corp.
• Technical Expert of the Romanian Ministry of Justice.
• President of the Romanian Society of Electrical & Control Engineering, Suceava Branch.
• He is a member of the editorial boards of several international scientific journals and conferences of control systems and electric engineering science. He was designated chairmen at 21 international conferences.

Plenary Lecture 2

Rapid Prototyping and Volumetric Data Processing

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Abstract: Rapid prototyping is a new technique for producing 3D physical objects. volumetric data are very often used in engineering and medical applications. Surface extraction methods for rapid prototyping differ from methods for visualization. This paper presents a pragmatic approach for generating data for rapid prototyping systems enabling production of physical models.
In visualization systems only a surface is usually generated regardless to the restrictions of the actual rapid prototyping systems, while in visualization it is necessary to accept physical properties of the physical rapid prototyping systems. CAD/CAM systems mostly rely on general tetrahedral meshes, while medical or industrial CT and MRI data are organized in structured rectangular regular meshes. This type data structures enables fast and robust data processing for visualization, while for the rapid prototyping more interaction of a user is needed.
The model representations based on a surface representation, mostly triangular meshes, or on volumetric data require very memory for storing and processing and therefore a specific techniques have to be used to reduce computational time and memory requirements for actual 3D printing of the object.

Brief Biography of the Speaker: Prof. Vaclav Skala is a Full professor of Computer Science at the University of West Bohemia, Plzen and VSB-Technical University Ostrava, Czech Republic. He received his ING.(equivalent of MSc.) degree in 1975 from the Institute of Technology in Plzen and CSc. (equivalent of Ph.D.) degree from the Czech Technical University in Prague in 1981. In 1996 he became a full professor in Computer Science. In 1997 the Center of Computer Graphics and Visualization (CCGV) was formally established and since then he is the Head of the CCGV in Plzen.
Prof.Vaclav Skala is an associate editor of The Visual Computer (Springer), Computers and Graphics (Elsevier), member of the Editorial Board fo Machine Graphics and Vision (Polish Academy of Sciences) and the Editor in Chief of the Journal of WSCG. He is a member of international program committees of prestigious conferences and workshops. He is a member of ACM SIGGRAPH, IEEE and Eurographics Association.
Prof.Vaclav Skala has published over 200 research papers at conferences and research journals. His current research interests are computer graphics and visualization, mathematics, especially geometrical algebra, algorithms and data structures.

Plenary Lecture 3

Simultaneous Perturbation Optimization Method for Adaptive Control

Professor Yutaka Maeda
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Abstract: The simultaneous perturbation optimization method is a stochastic gradient method which uses only values of an objective function to find a optimal point of the function. The optimization method was introduced by J. C. Spall. Y. Maeda also independently proposed a learning rule using the simultaneous perturbation and reported a feasibility of the learning rule. At the same time, the merit of the learning rule was demonstrated in the hardware implementation of neural networks. Convergence conditions of the method in framework of the stochastic approximation are also shown by Spall.
The most important advantage of the simultaneous perturbation method is its simplicity. The simultaneous perturbation can estimate the gradient of a function using only the two values of the function. Therefore, it is relatively easy to implement as an optimization method, compared with the other gradient types of optimization methods. Moreover even if the function is not differentiable partly, we can apply the method.
This paper presents a parameter adjustment rule using simultaneous perturbation for Model reference adaptive control system (MRACS). Using the simultaneous perturbation method, we can construct a rule without the sensitivity derivatives of an objective plant. This feature is beneficial when properties of the plant are unknown or changing. We apply the proposed method to control a two-link flexible arm. The motion control of the arms is considered.

Brief Biography of the Speaker: Yutaka Maeda received the B.E., M.E. and D.E. (Doctor of Engineer) degrees in Electronic Engineering from Osaka Prefecture University in 1979, 1981 and 1990, respectively. He joined KANSAI University, Faculty of Engineering in 1987, where he is a Dean and Professor of the Faculty of Engineering Science, Kansai University. Moreover he is also a Trustee of Kansai University.
He was a Visiting Researcher in Electrical and Computer Engineering Department, University of California at Irvine, USA in 1995. He has established the Electronic Control Laboratory in Kansai University. The laboratory is producing promising graduates for many industrial fields. Recent research interests in this laboratory are in the areas of soft computing; artificial neural networks, fuzzy theory for robot control, moreover, he is also interesting in the control theory and signal processing related to the simultaneous perturbation optimization. He is also author of about 80 papers in international journals and conference proceedings, and book chapters.

Plenary Lecture 4

Statistic Models of Surface Roughness for Machined Soft Steels Metallized Coatings

Professor Mihaiela Iliescu
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Abstract: Metallized coatings do represent special solution for ensuring wear resistance, good lubrication or, high corrosion protection characteristics of parts submitted to severe “working” condition. Some of the materials used in metallizing are represented by special alloyed steels. Usually, the resulted coatings need further machining, by turning or grinding. So, their surface roughness do represent an important parameter to be known or, rather, estimated by the values of process parameters values. This paper presents applied statistics methods used for determining surface roughness models as function of turning process parameters, such as: cutting speed, feed and depth, cutting tool wear and nose radius. The metallized materials studied are, conventionally called “soft steels”, due to their micro-hardness values, about 300-350 HV0.05.

Brief Biography of the Speaker: Has graduated in 1989, “POLITEHNICA” Institute of Bucharest, ROMANIA.
While 1989 – 1991 worked as engineer – in the Design Department of Romanian Peripheral Equipment Factory, FEPER
Since 1991 has been teaching in “POLITEHNICA” University of Bucharest, ROMANIA – Manufacturing Department, in 2004, became Associate Professor. The Doctoral Thesis, in 2000 was about “Quality and Machinability of Thermal Sprayed Layers”.
Teaches courses, advises students research and works into the fields of: Applied Statistics in Engineering; Manufacturing Technologies; Injection Moulding; Customized Products Manufacturing.
Is a scientific researcher or project manager, in about 30 Research Projects and Grants.
First-author or, co-author, of about
- 120 studies and papers - published in International/National Conferences, Sessions, Workshops, Platform Meetings etc;
- 12 books on Applied Statistics, Manufacturing Technology, Geometrical Precision Inspection.
Member of some professional associations, as Plastics Industry Producers Association – ASPAPLAST, ROMANIA, Rapid Manufacturing Association – RAPIMAN; has some international awards as: Best Innovation Award - at Brussels INNOVA Fair, 2007, Golden Medal – in INVENTIKA –2008, Bucharest, Romania.
Has papers presented in WSEAS Conferences, in 2008, 2009 and, also published in WSEAS Journals. Was invited Plenary Speaker in WSEAS Conferences, like Venice – November, 2008 ; Cambridge – February, 2009; Baltimore – November 2009; Lisbon – November 2010, Catania – November, 2011.
Has performed organizing activities for WSEAS Conferences in Bucharest, in June (2008 and 2010) and, specially, in November, 2008 – when was General Chairman.

Plenary Lecture 5

Agent based Modeling of Diffusion of Information across Investors in Financial Markets: How to Model it

Professor Filippo Neri
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Abstract: Financial markets are prototypical instances of complex systems where the many interactions among the innumerable participants contribute to the formation of the price of the financial assets that are there traded. In the talk, we will describe how an artificial intelligence technique, agent based modeling, could be used to take into account the diffusion of information among investors and how several approximations of the real phenomena could be modeled. During the talk we will also show and comment about the empirical findings obtained.

Brief Biography of the Speaker: Prof. Filippo Neri is currently with the Dept. of Computer Information Systems, Faculty of Information and Communication Technology, University of Malta. Prof. Filippo Neri is currently Editor in Chief of WSEAS Transactions on Systems. Prof. Filippo Neri has wide experience in the area of artificial intelligence, machine learning, and software agent simulation. He had the opportunity to work both in academic and industrial environments including Ericsson's and Unlever's R&D centers and across three countries in the European Union (Italy, Ireland and UK). He has studied and visited at several important academic institutions including Carnegie Mellon University, MIT, Imperial College London, University of Milano, University of Torino. He is a Marie Curie Fellow and a ADI associate, the Italian PhD association. Finally he has served in the program committees and as reviewer at several international conferences and he is author of more than 50 internationally reviewed publications.

Plenary Lecture 6

The Nature of Instabilities in Blocked Media and Seismological Law of Gutenberg-Richter

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Abstract: This paper studies properties of a continuum with structure. The characteristic size of the structure governs the fact that difference relations do not automatically transform into differential ones. It is impossible to consider an infinitesimal volume of a body, to which we could apply the major conservation laws, because the minimal representative volume of the body must contain at least a few elementary microstructures. The corresponding equations of motions are the equations of infinite order, solutions of which include, along with sound waves, the unusual waves propagating with abnormal low velocities, not bounded below. It is shown that in such media weak perturbations can increase or decrease outside the limits. The variance of structure sizes plays a double role. The intensity of instabilities decreases due to dispersion, thereby stabilizing the media, while the frequency range of unstable solutions expands, and disasters can occur at very low frequencies. The equation of equilibrium is not satisfied at any point in the medium. It is true only at an average. Hence there is a possibility to have a lot of micro-dynamic acts, in spite of static macroscopic state in average. This paper describes some of the conditions under which the possible occurrence of usual wave motion in media in the presence of certain dynamic phenomena. The number of complex roots of the corresponding dispersion equation, which can be interpreted as the number of unstable solutions, depends on the specific surface cracks and is an almost linear dependence on a logarithmic scale, as in the seismological law of Gutenberg-Richter.

Brief Biography of the Speaker: Sibiryakov Boris was born in 1939 in Leningrad (Sankt-Petersburg). In 1961 graduated Leningrad University in special engineer-geophysics. In 1971 Sibiryakov Boris have got degree candidate of physics and mathematics in special “Theory of elasticity and plasticity”. In 1986 I have got degree as senior research worker. In 1987 Sibiryakov Boris has got State Praise Winner of USSR for papers in the field of multi-wave seismic. In 1989 I have got a degree of doctor of physics and mathematics in special geophysics. In 1999 Sibiryakov Boris has got degree as professor of Novosibirsk University. He is a participant of 11 International conferences in geophysics and mesomechanics. During 1998-2000 Sibiryakov Boris was a visiting professor in Brazil (Petrobras Company, Unibersity of state Para).In 1999 he was a visiting professor at the Hertz University in Karlsruhe (Germany). In 2008 he was as participant of international workshop “Seismology and Tribology «at the Berlin polytechnic Institute. During 1996-1997 Sibiryakov Boris was a member of expert Council of Fund of fundamental researches of Russia.

Plenary Lecture 7

Mathematical Laws of Psychological Dynamics

Professor Alin Gilbert Sumedrea
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Abstract: The psychological dynamics is governed by strong structures meant to support psychological functionality and by weak structures which are involved in the activation of consciousness. Is it possible to describe mathematically the psychological dynamics of the person? The strong structures present the characteristics of repeatability, measured by constants or recurrences. The weak structures are endowed with specific mechanisms meant to record the tensional effort. In the same time, the psychological dynamics of the person is governed by local and global conservation laws, taking into account Noether's theorem. The emotional mechanisms, having an important role in the preservation of tensional states, convert the psychological energy into a potential one. Moreover, the emotion manifests itself as a memory of the tensional state. The tensional dynamics of the person is generated by the selection of those strategies – required by the psychological challenges – which minimize regret and amplify pleasure. I have the strong conviction that unaltered functionality of the psychological dynamics is governed by the preservation of certain ancestral constants which are deeply involved in the adaptation of the person to the inquiring environment. One of these constants is the need for psychological stimulation of the person, which has an important role in the unconscious psychological excitation or inhibition of people positioned in a certain area of proximity. The mechanisms of the psychological instances generate psychological dynamics. The human behaviour as a consequence of the parallel functioning of psychological instances is in fact a recipe of variable dosages between psychopathy and depression! The plenary presentation proposes a theory of mathematical psychology, capable of explaining the right functionality of psychological instances and psychological dysfunctions.

Brief Biography of the Speaker: Alin Gilbert SUMEDREA, Ph.D in Psychology (1998), Ph.D in Statistics (1993), is Professor at the Faculty of Social-Human Sciences, Lucian Blaga University of Sibiu, ROMANIA. He is also Head of the Psychological Research Centre, Sibiu, ROMANIA. The scientific activity is represented by 60 published scientific papers and 9 books. Research activity: 17 finalized research projects. He was director for 5 research projects. Current research interests include: Applications of differential geometry in psychology; Mathematical modelling of psychological processes.

Plenary Lecture 8

QFD in Software Development: A New Perspective

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Abstract: The well-known opinions of several authors have suggested that the quality improvement programs based on a TQM (Total Quality Management) philosophy may be able to meet the needs for quality oriented development in software engineering. In software engineering the software development process is based on a type of lifecycle. No matter the type of lifecycle used for a certain software application development, the starting and crucial point is always the correct and thorough capture of the client's requirements. From the techniques and methods that improve the quality of requirements including the client participation we focused on QFD (Quality Function Deployment), considering that QFD is a requirements engineering approach that focuses on quality. So, during the first phase of the software lifecycle the client requests are captured and processed by the software analysts' team. The results are a first category of inputs for the built QFD model. From the next phase, that is the design phase, results the quality characteristics of the software product. These are the second category of inputs for the QFD model. The correlations between the quality characteristics are identified in the coding phase. These correlations reflect the degree of interdependence between the software modules. In the testing phase there are determined the accomplishment degrees of the requests by the quality characteristics depending on the functionality of the achieved modules. In the end, the delivery and maintenance phase of the software product, there is achieved the comparative analysis with other similar software products both from the point of view of the client and from the technical point of view. Based on this QFD model there can be computed how much the achieved software product meets the expressed or explicit needs of the client. According to the continuous improvement principle, the QFD model is very useful in identifying the quality characteristics that must be improved in order to satisfy as much as possible the client's requests, this way making it possible to obtain versions of the software product that meet the efficiency criteria. This QFD built model additionally provides a simulation environment based on an own original mathematical model that link the degree of requirements' accomplishment to the global software improvement, by means of quality characteristics. All the above phases are presented as a software engineering specific template, particularized on a web application example, called M.O.V.E. (My Online Virtual Environment). Having established the use of QFD in software lifecycle, we introduce a 3D spiral meta-model for software development based on the Juran's quality spiral and on the Boehm's spiral model. This model consists of several levels, each level actually representing subversions of the software product. We introduce an index that measures the "step" between two versions. This index represents the importance of both the quality characteristics and the clients' requirements.

Brief Biography of the Speaker: Monica Leba: Received a BSc in System Control and Applied Informatics Engineering in 1998, a MSc in Information Systems and Technologies in 2007 and gained a PhD in System Control in 2002. She joined in 1999 the University of Petrosani. In 2008 became Associated Professor of System Control Engineering. She is member of IFAC (International Federation of Automatic Control), Technical Committee 3.1. Computers for Control. She is coordinator of the LLP-Erasmus program at the University of Petrosani from 2007. She was Invited Lecturer at the University of Clausthal – Germany, University of Nancy – France and University of Malaga – Spain. Her general research interests are in applied informatics, algorithms design, modelling and simulation, computer and system control engineering. She took part and coordinated about 20 national and international research projects and grants and published about 80 papers, part of them in WSEAS conferences. She also presented two plenary lectures in WSEAS conferences in Corfu, Greece, October, 2008 and in Istanbul, Turkey, June, 2009. Andreea Ionica: Graduated the University of Petrosani as engineer (1992), as economist (2002) and PhD in Industrial Engineering (2004). She got a postgraduate degree in Enterprises' Economy and Administration from Institut National Polytechnique de Lorraine, France (1998). She also graduated the course of Human Resources Management (1999). She is currently Associated Professor in the Management Department at University of Petrosani where she teaches mainly in the areas of Management and Quality Management. Her research interests include: Quality Management Systems (QMS), TQM implementation, the study of customer - supplier relationship in the

context of the QMS implementation. She activates in the field of quality management systems, being auditor and Quality Management Representative at the University of Petrosani. In the period 2010-2012 she coordinates a Grundtvig project with partners from Turkey, Romania, Nederland, Belgium and Germany. She participated as coordinator or member in about 10 national and international research projects and grants and published about 100 paperses.

Plenary Lecture 9

Optimal Control on Lie Groups: Theory and Applications

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Abstract: The talk starts with a general formulation of Pontryagin's Principle in a form which emphasizes the geometric content of this principle. From this general form a version will be derived which is tailor-made for control problems on Lie groups. Such problems arise in many engineering applications (spacecraft attitude control, robotics, automated vehicle steering, quantum spin systems). Examples will be presented in which the differential geometric and Lie theoretic approach allows the derivation of explicit solutions in situations where classical engineering approaches (like computations in coordinates) fail or are unncesserily cumbersome.

Brief Biography of the Speaker: Karlheinz Spindler studied Mathematics, Mechanics and History at the Technical University Darmstadt in Germany. He earned his doctorate in Mathematics for work in the structure theory of Lie algebras. Subsequently, he was a Visiting Assistant Professor at Louisiana State University in Baton Rouge (USA). After his return to Germany, he worked for five years in the aerospace industry and was based at the European Space Operations Centre in Darmstadt. Since 1997, he has been a professor for mathematics and data processing at the University of Applied Sciences in Wiesbaden. He was instrumental in designing, planning and implementing a new line of study in Applied Mathematics which he is currently heading. His research interests are in control theory and parameter estimation.