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Mathematical Methods for Information Science & Economics

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- *Proceedings of the 3rd European Conference for the Applied Mathematics and Informatics (AMATHI '12)*
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Keynote Lecture 1

Kronecker Power Series in Quantum Mechanical Probabilistic Evolution Approach: Managing Arbitrariness in Spectral Issues of the Propagation Superoperator

Professor Metin Demiralp
Resigned Principal Member of Turkish Academy of Sciences
Istanbul Technical University
Informatics Institute Istanbul
TURKEY
E-mail: metin.demiralp@gmail.com

Abstract: Recently we have started to use Kronecker power series instead of the multivariate Taylor series, in the formulation of the "Probabilistic Evolution Approach (PEA)" to ODEs, Quantum Expectation Value Dynamics, and, Classical Statistical Mechanics within the perspective of Liouville equation, density and partition functions. The basic idea has been to expand the unknown entities in terms of Kronecker powers of a vector describing the system under consideration. This system vector is either composed of the temporally varying unknowns in the case of ODEs or certain operators' expectation values varying in time for the other cases. The Kronecker powers of the state vector (or their expec tation values in the case of Quantum Mechanics or Classical Statistical Mechanics) have been considered as the basis set elements and certain ODEs for each of them have been constructed. The result in all cases (for ODEs, Quantum Expectation Values, Statistical Mechanical Expectation Values) was a first order linear homogeneous infinite vector ODE with generally initial value impositions, such that the coefficient matrix (we call "Evolution Matrix) for this infinite explicit vector ODE was a constant infinite square matrix. The formal analytical solution of this infinite vector ODE can be obtained and requires the evaluation of an exponential matrix varying in time whose proportionality coefficient is the Evolution Matrix. This evaluation is facilitated when the evolution matrix (which is in upper block Hessenberg form most generally) becomes block triangular because of certain limitations in the system. Triangularity makes the spectral analyses quite simple. Beyond that, the case of multinomiality where the Evolution Matrix has the main diagonal and its few upper neighbor diagonals as the nonvanishing substructures, enables to use the finite order block recursions to get solution to PEA equations.
The case of conicality is the simplest form of the multinomiality and corresponds to two term block recursions whose solutions can be analytically constructed as infinite series of the initial values of the Kronecker powers of the state vector or its expectation values. In fact all multinomial cases can be converted to two term block recursions via appropriate order reductive manipulations.
What we have told above is somehow the review of the last year developments of the "Probabilistic Evolution Theory" and it will be kept sufficiently comprehensive but, at the same time, sufficiently short during the presentation. The remaining part is completely new and based on recently developed issues. The Kronecker powers of the state vector(s) contain certain number of identicalities or linear dependences as the price of the brevity in the relevant multivariate representation. These can be in fact reflected to the Kronecker power series coefficients as certain level of arbitrarinesses. These arbitrarinesses can be expressed in terms of certain flexible parameters which can be determined as what we want to obtain, of course, within certain limitations.
A special emphasis will be given on the commutator algebra over the state vector's Kronecker powers. The propagation superoperator acting on an operator to give the time variant exponential function image of the operator's commutator with the Hamiltonian. The construction of certain eigenoperators of the propagation superoperator will be explained in the perspective of the Kronecker power series and the management of the arbitrariness appearing there.

Brief Biography of the Speaker: Metin Demiralp was born in T¨urkiye (Turkey) on 4 May 1948. His education from elementary school to university was entirely in Turkey. He got his BS, MS degrees and PhD from the same institution, ÿIstanbul Technical University. He was originally chemical engineer, however, through theoretical chemistry, applied mathematics, and computational science years he was mostly working on methodology for computational sciences and he is continuing to do so. He has a group (Group for Science and Methods of Computing) in Informatics Institute of ÿIstanbul Technical University (he is the founder of this institute). He collaborated with the Prof. Herschel A. Rabitz's group at Princeton University (NJ, USA) at summer and winter semester breaks during the period 1985–2003 after his 14 month long postdoctoral visit to the same group in 1979–1980. He was also (and still is) in

collaboration with a neuroscience group at the Psychology Department in the University of Michigan at Ann Arbour in last three years (with certain publications in journals and proceedings).
Metin Demiralp has more than 90 papers in well known and prestigious scientific journals, and, more than 200 contributions to the proceedings of various international conferences. He gave many invited talks in various prestigious scientific meetings and academic institutions. He has a good scientific reputation in his country and he was one of the principal members of Turkish Academy of Sciences since 1994. He has resigned on June 2012 because of the governmental decree changing the structure of the academy and putting politicial influence possibility by bringing a member assignation system. Metin Demiralp is also a member of European Mathematical Society. He has also two important awards of turkish scientific establishments.
The important recent foci in research areas of Metin Demiralp can be roughly listed as follows: Probabilistic Evolution Method in Explicit ODE Solutions and in Quantum and Liouville Mechanics, Fluctuation Expansions in Matrix Representations, High Dimensional Model Representations, Space Extension Methods, Data Processing via Multivariate Analytical Tools, Multivariate Numerical Integration via New Efficient Approaches, Matrix Decompositions, Multiway Array Decompositions, Enhanced Multivariate Product Representations, Quantum Optimal Control.

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Plenary Lecture 1

Petri Nets Saliency Models of Multiple Biological Sequences

Associate Professor Calin I. Ciufudean
"Stefan Cel Mare" Universtity of Suceava
Faculty of Electrical Engineering and Computer Science
Department of Automatics and Computers
ROMANIA
E-mail: calin@eed.usv.ro

Abstract: In medicine, computational biology, pattern recognition, string editing and data compression, to name a few research areas, large amounts of data are extracted, pre-processed, selected and classified in order to perform the diagnosis. The classical visual analysis of such a quantity of data is no longer possible, therefore computers are involved in this process and thus, automated systems that recognize biological features have been in use for several years.
There is a strong demand for the development of such automated algorithms and devices, due to the improved video and biological computation techniques that avoid the possibility of the analyst missing/misreading information. Within heuristic approaches there are a number of methods for identifying important input features. Such methods are considered saliency ones mainly due to the fact that they can intuitively model and simulate the mechanisms and signals used in computational biology. Recently, the general problem of selecting a parsimonious salient feature set for computational biology has retained a great deal of interest.
One may notice that non-salient features may reduce the diagnosis accuracy and even make it a NP-hard problem considering that, as the number of features grows, the number of training samples grows exponentially. In order to reduce the size of the extracted input feature samples we focus on determining the longest common subsequence (LCS) for a set of multiple string-sequences in an operation for a wide range of applications in the areas mentioned above.
This presentation is focused on the improvement of the automated medical diagnosis based on biological feature (BF) selection and classification, as we know that biological features represent patterns of important information. Medical diagnostic can be improved if the pattern is comprised by most of the significant biological features. In our study, common sequence measures were employed to determine the saliency of a wide range of applications in the area of medicine, computational biology, as well as string editing, pattern recognition and genetics etc. We assume that an important common sequence salience measure is to find the longest common subsequence (LCS) for a set of n sequences. In order to perform this hard task, we use discrete event formalism, respectively Petri nets and we propose an algorithm for reducing the size of the digraphs.
An interesting application to the ECG signals will demonstrate that salient input features effectively aid the diagnosis process.

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 8 books and over 120 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 23 international conferences.

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Plenary Lecture 2

One Hexagonal Systolic Array Synthesized on the Adaptable Algorithm

Professor Dragan Randjelović
Department of Police sciences
Scientific field-Information technologies
Academy for criminalistic and police studies
Zemun, Serbia
E-mail: dragan.randjelovic@kpa.edu.rs

Abstract: In this paper is discussing definitions and procedures for parameters determination of systolic arrays (SA-s) which are suitable for regular 3-nested loop algorithms(this type of algorithm has calculations given by homogeneous linear relations in nested loops of index variables) implementation and between these especially defined special class so called adaptable algorithms. Namely, if we want to choose the most suitable SA for this adaptable algorithms, it is good to know their characteristics in advance, before their design and synthesis. In literature, we can find definitions of big number of space-time characteristics (objective functions) SA-s and their determination procedures and the authors choose his own procedure.
Objective of this paper is to consider one of time parameters, flow period of processor, in notation tp, and reciprocal dependency between time and space characteristics. Obtained results are illustrated trough the example of two rectangular matrix multiplication as one typical adaptable algorithm and especially its realization with one hexagonal SA for projection direction =[111]T which enables calculation of high dependability.

Brief Biography of the Speaker: Dragan Randjelovic born in 1953 in Niš, Serbia.
Married with Ratomirka has two sons Milan and Miloš. He graduated from the University of Niš, Faculty of Electronic Engineering, Serbia in 1977. as MsC - electronic engineer in the field of Informatics and Automation. From 1980. until 1996. he worked in Development Research Institute of Electronic Industry Corporation in Niš as researcher then laboratory manager and general manager of Factory of computers. In this period he finished second degree of education as Magister of Science in the field of Applied Mathematics at Faculty of Electronic Engineering, University of Niš,Serbia in 1984. also He taked his exams for planning engineer specialized in the field of informatics and automation in1991. He is assistant from 1997. until 1999. at the University of Priština, Faculty of agriculture, Serbia . After he finished his doctoral education as Doctor of Mathematical Sciences, Faculty of Science University of Prishtina, Serbia, in 1999. he worked as docent from 2000. until 2004. and associate professor at University of Priština, Faculty of agriculture, Serbia . From 2009. and today he is associate professor in Academy for criminalistic and police studies , Belgrade, Serbia. His focus are in systolic arrays as parallel computer architecture, multiple criteria decision and digital forensics. He is author of about 100 scientific titles from wich more than 70 published in international journals and conference proceedings.

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Plenary Lecture 3

Evolutionary Algebraic Prediction of Short Time Series

Professor Minvydas Ragulskis
Research Group for Mathematical and Numerical Analysis of Dynamical Systems
Faculty of Fundamental Sciences
Kaunas University of Technology
Lithuania
E-mail: minvydas.ragulskis@ktu.lt

Abstract: An overview on the new class of short-term time series forecasting methods based on the identification of skeleton algebraic sequences is given in this presentation. The concept of the rank of the sequence and the algebraic complexity of the observation are exploited to detect the base fragment of the time series and to extrapolate the model of the process into future. Evolutionary algorithms are used to remove the noise, to identify the skeleton algebraic sequence and to balance the forecast with the smoothed moving average estimate of the time series. The fitness functions exploited in the proposed forecasting technique are independent neither on the determinant of the Hankel matrix, nor on the error metrics. Numerical experiments with an artificially generated and real-world time series are used to illustrate the functionality of the proposed techniques. The proposed forecasting methods are especially effective when the time series is short and there are not always sufficient data to train evolutionary models.

Brief Biography of the Speaker: Minvydas Ragulskis graduated from Kaunas University of Technology, Department of Applied Mathematics, Lithuania in 1989. He received his Ph.D. degree in 1992 and took the position of the assistant professor at the Department of Mathematical Research in Systems, Kaunas University of Technology in 1997. Since 1999 he took the position of the associated professor, since 2002 – the position of full professor at the same department.
He is the founder and the head of the Research Group for Mathematical and Numerical Analysis of Dynamical Systems (www.personalas.ktu.lt/~mragul). Four graduate students under his supervision have successfully defended their doctoral thesis; four graduate students study under his supervision at this moment. He is author of more than 80 papers in international journals and conference proceedings, and invited book chapters. He serves as a reviewer for numerous international journals and is a member of editorial boards of several journals. His research interests include nonlinear dynamical systems and numerical analysis.

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Plenary Lecture 4

Reduction Method for the Solution of Weakly Singular Integro-Differential Equations

Professor Iurie Caraus
Faculty of Mathematics and Informatics
Moldova State University
Chisinau, MOLDOVA
E-mail: ciurie.caraus@gmail.com

Abstract: Approximation of functions of a complex variable by various finite-dimensional aggregates is an important problem not only in constructive function theory and approximation but also in the justification of direct approximate methods for functional equations. This problem has been well studied for the case of functions defined on standard contours (a straight line segment, the unit circle, and so on). In the case of an arbitrary closed smooth contour Γ in the complex plane, the problem is less studied. It should be noted that conformal mapping from the arbitrary smooth closed contours to the unit circle does not solve the problem. Moreover, it makes more difficulties:
• The coefficients, kernel and right part of the transformed equation lose their smoothness;
• The power of smoothness appears in convergence speed of collocation method. So that the evaluations of convergence speed will depend from particular contour;
• The numerical schemes of researched methods become more difficult. The singularity appears in new kernel and we are not able to use the numerical schemes of mechanical quadrature method because of a singularity for new kernel.
We suggest the numerical schemes of the reduction method over the system of Faber-Laurent polynomials for the approximate solution of weakly singular integro- differential equations defined on smooth closed contours in the complex plane. We use the cut-off technique kernel to reduce the weakly singular integro- differential equation to the continuous one. Our approach is based on the Krykunov theory and Zolotarevski results.
We obtain the theoretical justification in Generalized Holder spaces.

Brief Biography of the Speaker: From 1996 Dr. Iurie Caraus started working at the Faculty of Mathematics and Informatics, Moldova State University.
From 2004-2011, Dr. Iurie Caraus was Associate Professor at the Faculty of Mathematics and Informatics, Moldova State University, Chisinau.
In 1998 he obtained PhD in Numerical Mathematics.
Visiting Universities
• October 2010- July 2011, Fulbright Scholar, Department of Mathematics, NC State University, Raleigh, USA;
• August 2010-September 2010,University of Boudreaux1, France;
• August 2009-August 2010, PostDoc, Center of Mathematics and Application, Lisbon, Portugal;
• May 2007-August 2008, Visiting Researcher, Department of Computer Science, Leuven, Belgium;
• April 2006-June 2006 Junior Visiting Researcher, Department of Mathematics and its Applications, Central European University, Budapest, Hungary;
• February 2005- August 2005 Visiting Researcher, Department of Mathematics and Informatics, University of Trieste, Trieste, Italy;
• 15.09.04-14.12.04 Visiting Researcher, Technische Universitat;
• Faculty of Mathematics, Chemnitz, Germany, DAAD scholarship;
• January 2003-April 2003 Visiting Researcher, NC State University, Department of Mathematics, Raleigh, USA.
Fields of Scientific Interests Collocation Methods, Cauchy Singular Integral Equations, Finite Elements Methods, Optimization, Information Security, Mathematical Economics
Publications: more than 40 articles in journals and proceedings, 3 didactical materials

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Plenary Lecture 5

Robust Video Object Detection and Tracking Techniques

Professor Tudor Barbu
Institute of Computer Science
Romanian Academy, Iasi branch
Romania
E-mail: tudbar@iit.tuiasi.ro

Abstract: Video object detection and tracking represents an important computer vision domain that has been vividly researched in the last decades. It has promising applications in numerous important fields, such as video compression, video surveillance, human-computer interaction, video indexing and retrieval, medical imaging, traffic monitoring, augmented reality and robotics. Obviously, it consists of two closely related processes. The first one, video object detection involves locating an image object in theframes of a video sequence, while the second one, video tracking, represents the process ofmonitoring the video object spatial and temporal changes during the moviesequence, including its presence, position, size and shape.While an object detection algorithm identifies image objects in video frames, an object tracking procedure must solve the temporal correspondence problem that is the task of matching the target object in successive frames.
Numerous video detection and tracking technologies have been developed inrecent years. Object detection can be performed through various approaches, such as:region-based image segmentation, background subtraction, temporaldifferencing, active contour modelsand the generalized Hough transforms.Video tracking techniques are based on Kalman filtering, Hidden Markov Models, optical flow, template matching, mean-shift trackingand contour tracking.Objecttracking is often a time consuming process due to the amount of data contained by video streams. Also, video tracking represents a difficult process, becausevarious factors such as abrupt object motion, object occlusions or camera motion. There are various types of tracking, depending on the target object character (static or moving) and the camera (fixed or moving).
We approached the object detection and tracking domain in our previous works, developing some robust detection and tracking techniques for both static camera and moving camera videos. Thus, we proposed several automatic temporal-differencing based moving object detection approaches for fixed camera video sequences. The object tracking was performed using template matching and various object featuring methods. We used HOG-based, normalized cross-correlation based and 2D Gabor filtering based features for this purpose. Also, we considered video tracking approaches which are able to track successfully both the static and moving objects, in both static-camera and moving camera videos. Thus, we developed a novel semiautomatic object tracking technique based on an improved N-Step Search algorithm and a HOG-based feature extraction. Human detection and tracking, representing an important sub-domain of object detection and tracking, is also widely approached in our research.

Brief Biography of the Speaker: Dr. Tudor Barbu is currently Senior Researcher II at the Institute of Computer Science of the Romanian Academy, in Iasi, Romania. He is the coordinator of the Image and Video Processing and Analysis research collective of the institute and also member of the leading Scientific Council of this institute. Mr. Barbu has a PhD degree in Computer Science, awarded by the Faculty of Automatic Control and Computers of the University “Politehnica” of Bucharest.
He has a remarkable research profile. In the last decade he published two books and four book chapters as single or main author. Also, dr. Tudor Barbu published more than 65 articles in prestigious international journals and volumes of international scientific events (conferences, symposiums and workshops). His prolific scientific activity also includes more than 35 research reports, elaborated with the institute research team coordinated by him or related to various research projects. His scientific publications have got over 70 citations, according to Google-Academic.
In recent years he also coordinated various research directions in 6 projects based on contracts/grants. Dr. Tudor Barbu received also several awards for his research results, the most important being the Romanian Academy Prize “Gheorghe Cartianu”, in the Information Science and Technology domain, awarded on December 18, 2008. He is member of several conference scientific committees and also member of scientific and technical committee and editorial review boards of some journals. He is the Editor in Chief of a book. His main scientific areas of interest are: digital media (audio, video and image) signal processing and analysis, pattern recognition, computer vision, multimedia information storage, indexing and retrieval, and biometric authentication using voice, face and digital fingerprint recognition.

Plenary Lecture 6

Exploring The Effects Of Task Difficulty and Team Diversity on Team Creativity: A Multi-Agent Simulation Approach

Professor Kun Chang Lee
SKK Business School and Department of Interaction Science
Sungkyunkwan University
Seoul 110-745, South Korea
E-mail: kunchanglee@gmail.com

Abstract: There is no single organizational structure that is highly effective for all organizations. In order to be effective, the organization needs to tailor its activities to the environment in which is it located. Based on contingency perspectives, this study is focused on investigating effective ways to design team diversity and maximize team creativity according to the level of task difficulty. Considering the organizational team member as an agent, the study employed a multi-agent simulation method to understand the progress of creative manifestation, by observing the exploration and exploitation activity of team members with the passage of time. The results suggest that managers differentiate strategies of team diversity according to task difficulty. In the case of a difficult task, managers need to increase team diversity so that their teams can maximize team creativity through rigorous exploration and exploitation. It is desirable to maintain an average level of team diversity when performing an easy task.

Brief Biography of the Speaker: Dr. Kun Chang Lee is a full professor of MIS at SKK Business School at Sungkyunkwan University, South Korea. He also holds a WCU (World Class University) professor position at Department of Interaction Science at the same university. He received his PhD degree in MIS from KAIST (Korea Advanced Institute of Science and Technology). He is on the editorial board at several international journals such as Online Information Review (SSCI), Scientia (SCIE), Journal of Universal Computer Science (SCIE), and Information (SCIE). He conducted as a guest editor at Decision Support Systems. Now he is organizing special issues in Online Information Review (SSCI), Electronic Commerce Research and Applications (SSCI), and Computers in Human Behavior (SSCI), all of which are going to publish in 2012-2013. He has presented his papers regularly in a number of prestigious international conferences like HICSS (Hawaii International Conference on System Sciences), AMCIS (Americas Conference on Information Systems), and ICIS (International Conference on Information Systems). Professor Lee is an internationally recognized authority on decision support, ubiquitous computing, intelligent systems, and creativity science. His publication records include over 150 articles in scholarly and professional journals. Refer to http://academic.research.microsoft.com/Author/957772/kun-chang-lee for more details on Professor Lee's academic records. He has contributed to a number of international conferences as a program committee member; it includes CONTEXT (International and Interdisciplinary Conference on Modeling and Using Context), ACIIDS (Asia Conference on Intelligent Information and Database), WORLDCOMP (World Congress in Computer Science, Computer Engineering, and Applied Computing), UCMA (International Conference Ubiquitous Computing and Multimedia Applications), UBICOMM (International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies), PACIS (Pacific Conference on Information Systems), IASTED International Conference on Artificial Intelligence and Applications, International Conference on Intelligent Systems and Control, International Conference on Ubiquitous Information Management and Communication, IASTED International Conference on Computational Intelligence, International Workshop on Improved Mobile User Experience (IMUx), and IADIS International Conference on Information Systems, among others. Since 2006-2009, he initiated collaborative researches on intelligent decision makings with Waseda University, Japan. He is frequently invited by many companies to help direct the development of intelligent decision support systems and to deliver lectures on decision making to their executives. Last year, he was invited by Harvard Kennedy School as Rajawali visiting fellow to conduct researches on creativity and organize seminars on the related issues. He is the recipient of numerous research funds from Korean Government to continue his studies on creativity, and ubiquitous decision support systems. Dr. Lee is capable of integrating intelligent techniques and behavioral research framework to create a new paradigm of researches on complexity and creativity. In line with this motif, he has recently adopted using multi-agent simulations and brain informatics, obtaining a number of pioneering results that seem useful and meaningful in terms of both practical and academic sense. As for introducing his pioneering works to practitioners working at banking industry, he gave lectures to staffs and faculties at The World Bank, Washington D.C., US.

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