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Marina V. Shitikova

Advances in Mathematics and Statistical Sciences

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Proceedings of the 3rd International Conference on Mathematical, Computational and Statistical Sciences (MCSS '15)

Dubai, United Arab Emirates, February 22-24, 2015

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Keynote Lecture 1

Gamma Function Expansions For Analytic Solutions of Infinite Linear Recursions: Polynomial Coefficient Cases

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Abstract: Infinite linear recursions arise in many branches of sciences and engineering. The constant coefficients case can be handled by using a very powerful theory while the other cases where the variable coefficients are on the scene may necessitate case-specific methods to get analyticality. Amongst these variable coefficient cases, the linear recur- sions having polynomial coefficients play an important role in the handling of cases truely encountered in practice. In literature, factorial series take important places for such prob- lems. However, it is better to extend the case from factorial series to more amenable tools. To this end a series of certain Gamma functions can be used quite efficiently. This series representation takes out the rapid growth of the unknown as the recursion index tends to go to infinity and converts the problem to another linear recursion whose characteristics are milder than the original one. Thus it becomes possible even to numerically solve the resulting recursion especially by using certain truncating algorithms.
In this presentation the exemplification of the cases will be focused on the cases appearing in quantum mechanics. We have quite recently shown that a very useful formula over the expectation value of an algebraic function multiplication operator can be used to evaluate the eigenstates of an autonomous quantum system. To this end, the utilization of an appropriately chosen basis set enabled to get an infinite linear recursion. We have shown that this recursion can give not infinite series but finite sum of Gamma functions for quantum hydrogen-like systems and quantum harmonic oscillator.
The quantum states of an harmonic oscillator are composed of only discrete energy eigenvalues and there is no continuos spectrum corresponding to scattering phenomena. We have proven that the use of Gamma function expansion produces all of these possible states. It gives the energies of the system and also the expectation value of the position operator. These expectation values however reveal the eigenfunctions of the system Hamiltonian.
The quantum states of a hydrogen-like system is different. The energy spectrum of the system is composed of both discrete and continuous states. Discrete spectrum corresponds to the cases where the two particles composing the system move in a bounded manner. Whereas, the continous cases break down the boundedness of the particles by leading us to scattering phenomena. The abovementioned gamma function expansion again finds the energy values correctly and reveals the true eigenfunctions via the position integer power expectation values.
The presentation will discuss these types of issues as the time period permits.

Brief Biography of the Speaker: Metin Demiralp was born in Türkiye (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, ˙Istanbul 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 ˙Istanbul 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 100 papers in well known and prestigious scientific journals, and, more than 230 contributions together with various keynote, plenary, and, tutorial talks 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.

Plenary Lecture 1

Soliton-Like Solutions in the Problems of Vibrations 2f Nonlinear Mechanical Systems: Survey

Professor Marina V. Shitikova
Co-author: Yury A. Rossikhin
Research Center on Dynamics of Solids and Structures
Voronezh State University of Architecture and Civil Engineering
Voronezh Russia,
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Abstract: Free vibrations of one-degree-of-freedom, two-degree-of-freedom, as well as multiple-degree-of-freedom nonlinear systems are analyzed and reviewed. In all vibrational systems under consideration, the vibratory regime goes over into the aperiodic motion under certain conditions, in so doing irreversable process of energy exchange from its one type to another type takes place. The solutions describing such processes are written in an analytical form and involve the functions, which are in frequent use in the theory of solitons and play an important role in the theory of vibrations.

Brief Biography of the Speaker: Marina V. Shitikova is a Soros Professor of the Department of Structural Mechanics and a leading Researcher of the Research Center of Dynamics of Solids and Structures at Voronezh State University of Architecture and Civil Engineering in Russia. She received her MEng in Civil Engineering in 1982, a PhD degree in Structural Mechanics in 1987 from Voronezh Civil Engineering Institute, a DSc degree in Solid Mechanics in 1995 from the Institute for Problems in Mechanics, Russian Academy of Sciences and a Professorship in 1995 from Voronezh State University of Architecture and Civil Engineering. Since 1994, she has been an Associate Member of the Acoustical Society of America, since 1995 she has been a Member of the EUROMECH, GAMM, the ASME International, and Russian Association “Women in Science and Education”. She has published more than 200 papers dealing with structural mechanics, vibrations, wave dynamics, and acoustics. Her biography has been included in Who's Who in the World, Who's Who in Science and Technology, 2000 Outstanding Scientists of the 20th Century. She received a Commemorative Medal "1997 Woman of the Year" from the American Biographical Institute. In 1998 she was awarded the Russian President Fellowship for Outstanding Young Doctors of Sciences. Since 2009 she is the Head of the Department of International Education and Cooperation at Voronezh State University of Architecture and Civil Engineering. She was a Fulbright Fellow at Rice University, Houston, Texas in 2007-2008 and a Visiting Professor in different universities.

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Plenary Lecture 2

Equitability and Dependence Measures

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Abstract: Reshef et al. (Science, 2011) proposed the concept of equitability that measures of dependence should satisfy: treating all types of functional relationships, linear and nonlinear, equally. To this end, they proposed a novel measure, the maximal information coefficient (MIC). Recently, Kinney and Atwal (2014) showed that MIC is in fact not equitable under a strict mathematical definition, while recommending the self-equitable mutual information (MI). We propose a new equitability definition to select among the many self-equitable measures. The copula correlation (Ccor), based on the L_1-distance of copula density, is shown to be equitable under all equitability definitions. We also prove theoretically that Ccor is much easier to estimate than MI. Simulations and real data analyses are used to illustrate advantage of equitable measures in feature selection.

Brief Biography of the Speaker: Adam Ding received his Ph.D. degree from Cornell University and has been a faculty member with the Mathematics Department of Northeastern University afterwards. He previously hold visiting faculty positions in Harvard University and University of Rochester. He has conducted research on statistical methodology and applications in biostatistics, engineering and finance. He has published numerous papers in Journal of American Statistical Association, Journal of the Royal Statistical Society Series B, Biostatistics, Biometrics, Biometrika, etc. His current research focus includes nonlinear dependence measures, cybersecurity, survival analysis.

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Plenary Lecture 3

Relation of Temporal Probability Density Functions: An Application in Finance

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Abstract: Relation of signals can be observed in several aspects, from traveling waves to the dynamics of stocks and exchange rates. The relation may be applied to predict the incoming wave provided that the information (signal(s) or the wave measurement(s)) at several points up-steam is already known. Based on such relation, dynamics of stocks or exchange rates may be predicted by another known dynamics.
Signals of waves or such dynamics of stocks or exchange rates often consist of the so called ripples or noises. These signals may be represented in a form of temporal density functions (t-pdf's). The moving average of the t-pdf is the trend of the signal, where the noise of ripple is filtered. The temporal variance represents the characteristic of the noise. The larger and more serious the noise, the larger the variance. In this talk, a relation of temporal probability density function is considered. A method to obtain a linear relation of two signals is proposed. Applications in the dynamics of exchange rates are discussed.

Brief Biography of the Speaker: He got Doctor degree in Applied Analysis and Mathematical Physics, University of Twente, the Netherlands in 2002. He served as a Lecturer in Department of Mathematics, Universitas Halu Oleo, Kendari Indonesia. In 2010 he was promoted to Professor of Industrial and Applied Mathematics at the same university. His main research areas are focused on Partial Differential Equations and applications. For the case of diffusion equation, he has applied it for modeling of wood drying in an industry. Currently, he has been working on the relation of fundamental solution type with temporal probability density function of stock, currency and index dynamics.

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Plenary Lecture 4

Change Detection in Dependent Processes with Applications to Photovoltaic Image Data

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Abstract: Many present day data are sequentially observed discrete-time processes, i.e. they represent data streams where the data associated to the nth time instant is available with negligible delay. The problem to design and study monitoring procedures which aim at detecting changes in the structure of the process has recently received substantial and growing interest. We provide an overview of recent advances in the construction of methods for change detection and their asymptotic distribution theory, which allows us to construct detection procedures with well-defined nominal statistical properties. A powerful and elegant mathematical approach is to establish limit theorems by showing that the detection algorithm of interest, often motivated by a statistical method of estimation applied to a specific distributional model, is induced (or can be approximated) by a smooth functional of a basic stochastic process such as the partial sum process or the characteristic process. In this way, one can obtain asymptotic results that hold true for rich nonparametric classes of time series. We discuss in greater detail applications to photovoltaic image data as arising from EL imaging.

Brief Biography of the Speaker: Ansgar Steland received the M.Sc. and Ph.D. degrees in mathematics from the University of Göttingen, Germany, in 1993 and 1996, respectively. He held positions as an assistant at the Technical University of Berlin, Berlin, Germany, as a consultant in industry, as a postdoc at the European University Viadrina of Frankfurt/Oder, Germany, and as a lecturer at the Faculty of Mathematics at the Ruhr-University Bochum, where he also led the statistical consulting services. Since 2006, he has been a Professor at RWTH Aachen University, Germany, where he holds the Chair of Stochastics at the Institute of Statistics. Dr. Steland has been member of several societies, headed the Department of Mathematics from 2010 to 2012, acts as the chair of the Society for Reliability, Quality and Safety, and also chairs the Working Group of Change-Point Analysis of the German Statistical Society. His current research interests are in nonparametric regression, signal and change-point detection, sequential analysis and quality control, applications to photovoltaics, empirical stochastic processes, econometrics, and time series analysis.

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