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MULTIVARIATE ANALYSIS

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Proceedings of the 2nd WSEAS International Conference on Multivariate Analysis & its Application in Science and Engineering (MAASE '09)

Istanbul, Turkey, May 30 - June 1, 2009

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Preface

This year the 2nd WSEAS international conference on multivariate analysis and its application in science and engineering (MAASE '09) was held in Istanbul, Turkey. The Conference remains faithful to its original idea of providing a platform to discuss multivariate Taylor series, multivariate orthogonal polynomial series, representations in Cartesian product type Hilbert spaces through orthogonal and/or polynomial basis sets, high dimensional model representation and its varieties 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 indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

A 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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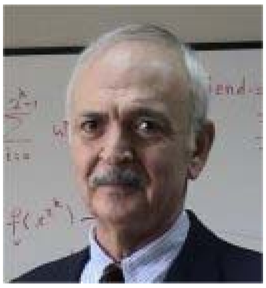
Keynote Lecture 1

Eigen-space Relations amongst the Universal Matrices in Fluctuation Free Approximation Theory



Professor Metin Demiralp
Informatics Institute
Istanbul Technical University
Istanbul, Turkey

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Abstract: Fluctuation free approximations are used everywhere matrix representation is directly or indirectly involved. The idea is simple: The matrix representation of a function operator, whose action on its operand is the multiplication by a function, is equivalent to the image of the matrix representations of the independent variables appearing in the argument of the function, under that function when all fluctuation terms are ignored. The fluctuation terms are matrix representations of certain operators involving a universal operator which is called the "fluctuation operator". This operator, in fact, projects its operand, which should be taken from an appropriately defined Hilbert space of functions, to the complement of an appropriately chosen subspace of this Hilbert space. The basis functions spanning the subspace are the members of a subset of the full basis function set which spans the mother Hilbert space. The matrix representations of the independent variables are defined with respect to these functions and therefore their number of rows or columns is equivalent to the dimension of the subspace under consideration. The basis functions span a space of multivariate functions. Therefore there should be more than one independent variable operators each of which multiplies its operand by a different independent variable. The matrix representations of these operators are called "universal matrices" since they do not depend on the function mentioned in the fluctuation free approximation. The independent variable operators naturally commute by definition. However this may not imply the commutativity amongst their matrix representations. The commutativity serves us to find a unique eigenfunction set to spectrally decompose the matrix representation of each independent variable such that the decompositions' projection matrices are constructed from this unique eigenfunction set while the linear combination coefficients vary from matrix representation to matrix representation. The case where the commutativity does not appear, one can conjecture that the norms of the commutators should decrease as the dimension of the subspace where the matrix representations are considered grows up to infinity. The fluctuation operator appears once or more than once in the structure of the commutators and tends to go to zero as the subspace dimension increases. This is the reason why the commutators should diminish as the dimension of the considered Hilbert subspace grows unboundedly. All these urge us to investigate the eigenspaces of the universal matrices. Each of these spaces is one dimensional if the corresponding eigenvalue has no multiplicity. Even the case of multiple eigenvalues does not prevent to orthogonally decompose the corresponding eigenspaces to one dimensional ones because of the symmetry in the universal matrices. Each of one dimensional spaces related to eigenspaces characterizes one axis in the considered subspace. The axes systems should be peculiar to the related universal matrix unless all of them commute. That is, they do not coincide to form a unique coordinate system. However, the angles between the coordinate axes corresponding to different universal matrices should diminish as the dimension of the considered Hilbert subspace grows unboundedly. This speech focuses on the issues roughly mentioned above in details as much as possible and tries to make comments and remarks on the possible pitfalls and misunderstandings. The talk sufficiently addresses to the related works emphasizing on the findings of the author's and his group on this topics.

Brief Biography of the Speaker: Metin Demiralp was born in Turkey on 4 May 1948. His education from elementary school to university was entirely in Turkey. He got his BS, MS, 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 months long postdoctoral visit to the same group in 1979–1980.

Metin Demiralp has more than 70 papers in well known and prestigious scientific journals, and, more than 110 contributions to the proceedings of various international conferences. He has given many invited talks in various prestigious scientific meetings and academic institutions. He has a good scientific reputation in his country and he is the full member of Turkish Academy of Sciences since 1994. He is also a member of European Mathematical Society and the chief–editor of WSEAS Transactions on Mathematics currently. He has also two important awards of Turkish scientific establishments.
The important recent focii in research areas of Metin Demiralp can be roughly listed as follows: Fluctuation Free Matrix Representations, High Dimensional Model Representations, Space Extension Methods, Data Processing via Multivariate Analytical Tools, Multivariate Numerical Integration via New Efficient Approaches, Matrix Decompositions, Quantum Optimal Control.

Plenary Lecture 1

EHDMR Based Bound Analysis Methods in Multivariate Interpolation Problems

Assistant Professor M. Alper Tunga
Bahcesehir University
Software Engineering Department
Istanbul, Turkey

Email: alper.tunga@bahcesehir.edu.tr

Abstract: If a multivariate data set is given to specify a multivariate function and it is asked to determine an analytical structure for the sought multivariate function, instead of using standard interpolation methods, given multivariate data can be partitioned into low–variate data and then an analytical structure is determined with the aid of these partitioned data.

However, the given data is collected or produced by some devices or means which may cause unavoidable errors. This results in an uncertainty interval for each datum. The errors in data may come from their construction because of the incapabilities or limited capabilities of the devices, tools, and/or algorithms used to construct data. This implies that each component of data is reliable only within an interval which contains the data value. If the length of the interval is assumed to be sufficiently small to enable us to approximate the differentiation operator with corresponding order difference operator then we may proceed to make an error analysis which reveals how the errors propagate.

The main purpose here is to determine the analytical structure of a multivariate function when a data set including measurement or construction errors is given. In this case, not a unique structure but a band structure with a presumably small thickness will be obtained for the multivariate function in accordance with the given data set and the given error ratios for this data set.

In this lecture, Interval GHDMR, Interval FHDMR and Interval HHDMR methods are given to explain one way of obtaining these abovementioned band structures for the given multivariate interpolation problems in which the errors in data occur.

Brief Biography of the Speaker: M. Alper TUNGA was born in Istanbul, Turkey on 11th June 1975. He received a B.Sc. degree in Mathematics Engineering from? Istanbul Technical University (I.T.U.) in 1997. He got his M.Sc. degree in Systems Analysis from Istanbul Technical University in 1999. He got a PhD from Istanbul Technical University in 2006 with a thesis entitled “Data Partitioning and Multivariate Interpolation via Various High Dimensional Model Representations”. In 1998, he worked as a research assistant in Computational Science and Engineering Department of I.T.U. Between the years 1999-2006 he worked as a research assistant in the Computer Engineering Department of Isk University of Turkey. Since 2007, he is Assistant Professor in Bahcesehir University. He is also a member of Group for Science and Methods of Computing in Informatics Institute of Istanbul Technical University. He is working on methodology for computational sciences. His interests are HDMR, Multivariate Data Modelling and Data Mining. M. Alper Tunga has 7 papers about these subjects in various scientific journals

Plenary Lecture 2

Utilization of Fluctuationlessness Theorem in the Remainder Term of Taylor Polynomials

Professor N. A. Baykara
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Istanbul, Turkey

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Abstract: The Fluctuationlessness approximation is based on a theorem which was conjectured and proven by M. Demiralp. This theorem states that the matrix representation of an algebraic operator which multiplies its argument by a scalar univariate function, is identical to the image of the independent variable's matrix representation over the same space via the same basis set, under that univariate function, when the uctuation terms are ignored. The same principle applies to multivariable functions too. In the first part of these lecture basic concepts of the Fluctuationlessness theorem are given and based on this theorem approximations to functions of a single variable as well as to multivariable functions are made by using the Taylor expansion with the remainder term expressed in integral form. Results are compared with those obtained from the corresponding Taylor series expansion without the error term. In the second part of the lecture, after using the Fluctuationlessness concept for approximations to univariate and multivariate functions by using the Taylor expansion with the explicit remainder term this approximate expression is integrated and a new quadrature-like numerical integration method is obtained. The results of numerical experiments are compared with the results obtained from the corresponding Taylor series expansion without the remainder term and errors are analyzed.

Brief Biography of the Speaker: N. A. BAYKARA was born in Istanbul,Turkey on 29th July 1948. He received a B.Sc. degree in Chemistry from Bosphorous University in 1972. He obtained his PhD from Salford University, Greater Manchester, Lancashire,U.K. in 1977 with a thesis entitled "Studies in Self Consistent Field Molecular Orbital Theory". Between the years 1977-1981 and 1985-1990 he worked as a research scientist in the Applied Maths Department of The Scientific Research Council of Turkey. During the years 1981-1985 he did postdoctoral research in the Chemistry Department of Montreal University, Quebec, Canada. Since 1990 he is employed as a Staff member of Marmara University. He is now an Associate Professor of Applied Mathematics mainly teaching Numerical Analysis courses and is involved in HDMR research and is a member of Group for Science and Methods of Computing in Informatics Institute of Istanbul Technical University. Other research interests for him are "Density Functional Theory" and "Fluctuationlessness Theorem and its Applications" which he is actually involved in.

Plenary Lecture 3

Multi-time Dynamic Programming for Multiple Integral Actions

Professor Constantin Udriste
Department of Mathematics
University Politehnica of Bucharest
Romania

E-mail: anet.udri@yahoo.com

Abstract: This paper introduces a new type of dynamic programming PDE for optimal control problems with performance criteria involving multiple integrals. The main novel feature of the multitime dynamic programming PDE, relative to the standard Hamilton-Jacobi-Bellman PDE, is that it is connected to the multitime maximum principle. In other words, we present an interesting and useful connection between the multitime maximum principle and the multitime dynamic programming, characterizing the optimal control by means of a multitime Hamilton-Jacobi-Bellman PDE system that may be viewed as a feedback law. In the case of performance criteria involving multiple integrals with quadratic integrands, the new equations lead to multitime variant of the Riccati equation.
Section 1 introduces the multitime Hamilton-Jacobi PDE from geometrical point of view. Section 2 shows how a multitime control dynamics determines the multitime Hamilton-Jacobi-Bellman PDE via the value functions. Section 3 describes the connection between multitime dynamic programming and the multitime maximum principle.

Brief Biography of the Speaker: Important Career Positions: Dean, Director, Chair, Full Professor 1990-, University Politehnica of Bucharest, Department of Mathematics.
Number of PhD Students: 25 in due time and 13 Doctors in Mathematics.
Membership of Associations: AMS, 1987; Tensor Society, 1985; Balkan Society of Geometers, President, 1994;
Publications: over 40 books; 200 papers; 200 communications.
Honors: D. Hurmuzescu Prize, Romanian Academy, 1985; Award MEI, 1988; Correspondent Member, Academia Peloritana, Messina, 1997; Titular Member, Academy of Romanian Scientists, 2007; Honorary Member, World Scientific and Engineering Academy and Society, 2008-;
Organizer: The International Conference of Differential Geometry and Dynamical Systems, University Politehnica of Bucharest, October 5-7, 2007; 7th WSEAS International Conference on Systems Theory and Scientific Computation (ISTASC'07), Vouliagmeni Beach, Athens, Greece, August 24-26 (2007); European Computing Conference, Vouliagmeni Beach, Athens, Greece, September 24-26, 2007; 12th WSEAS International Conference on Applied Mathematics, Cairo, Egypt, Dec. 29-31, 2007; 7th WSEAS International Conference on Circuits, Systems, Electronics, Control and Signal Processing, Cairo, Egypt, Dec. 29-31, 2007; Chair-Committee: American Conference on Applied Mathematics (Math'08) and Management, Marketing and Finances (MMF'08), Cambridge, Massachusetts, USA, March 24-26, 2008; International Program Committee: The Applied Computing Conference (ACC-08), Istanbul, Turkey, May 27-30, 2008.
Fields of Interest: Differential Geometry, Optimizations on Riemannian Manifolds, Magnetic Dynamical Systems, Geometric Dynamics.

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