Editors:

Prof. Nikos Mastorakis, Technical University of Sofia, Bulgaria

Prof. Metin Demiralp, Istanbul Technical University, Turkey

Prof. N. A. Baykara, Marmara University, Turkey

Recent Researches in Applied Informatics

Proceedings of the 2nd International Conference on Applied Informatics and Computing Theory (AICT '11)

Prague, Czech Republic, September 26-28, 2011

ISBN: 978-1-61804-034-3

RECENT RESEARCHES in APPLIED INFORMATICS

Proceedings of the 2nd International conference on Applied Informatics and Computing Theory (AICT '11)

Prague, Czech Republic
September 26-28, 2011

Published by WSEAS Press
www.wseas.org

ISBN: 978-1-61804-034-3

RECENT RESEARCHES in APPLIED INFORMATICS

Proceedings of the 2nd International conference on Applied Informatics and Computing Theory (AICT '11)

Prague, Czech Republic
September 26-28, 2011

Published by WSEAS Press
www.wseas.org

All papers of the present volume were peer reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.
See also: http://www.worldses.org/review/index.html

ISBN: 978-1-61804-034-3

Institute for Environment, Engineering, Economics and Applied Mathematics

RECENT RESEARCHES in APPLIED INFORMATICS

Proceedings of the 2nd International conference on Applied Informatics and Computing Theory (AICT '11)

Prague, Czech Republic
September 26-28, 2011

Editors:
Prof. Nikos Mastorakis, Technical University of Sofia, Bulgaria
Prof. Metin Demiralp, Istanbul Technical University, Turkey
Prof. N. A. Baykara, Marmara University, Turkey

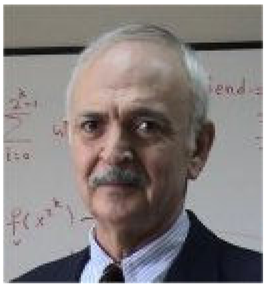
Table of Contents

ISBN: 978-1-61804-034-3

ISBN: 978-1-61804-034-3

Keynote Lecture 1

Dominating the Constancy in Enhanced Multivariance Product Representation (EMPR) Via Support Function Selection



Professor Metin Demiralp
Informatics Institute
Istanbul Technical University
TURKEY
E-mail: metin.demiralp@be.itu.edu.tr

Abstract: Enhanced Multivariance Product Representation (EMPR) has been recently proposed by the “Group for Science and Methods of Computing” which is under leadership of Metin Demiralp. EMPR involves High Dimensional Model Representation (HDMR) which was proposed by I.M. Sobol and has been developed basically by H. Rabitz, M. Demiralp and their groups in last two decades. HDMR decomposes a multivariate function to components ordered in ascending multivariance starting from constancy. EMPR introduces “Support Functions” to multiply HDMR components such that the resulting representation becomes composed of terms which have same multivariance as the original function’s. Support functions are particularly chosen univariate functions each of which depends on a separate independent variable. The constant component is multiplied by all support function factors while the univariate components are multiplied by all support functions except the one depending on the same independent variable as the relevant univariate component’s. As we proceed to higher multivariate components the number of the support function factors decreases because of the discarded factors of same independent variables as the relevant component’s. Regarding to this definition HDMR corresponds to the EMPR case where all the support functions are unit constant functions. EMPR, like HDMR, is composed of 2N terms for a multivariate function of N variables. The words “term” and “component” have different meanings in contrast to HDMR. Component implies the function showing a specific multivariance whereas term means the product of the component under consideration by the relevant support functions. The first term of EMPR is the product of the constant component by the all support functions. The next N terms are composed of univariate components multiplied by the corresponding (N ?1) number of support function. The following N(N ?1)/2 terms are composed of the products of the bivariate components with the relevant support functions and so on. The kth group of terms are composed of the product of the kth component by the relevant support functions. Thus, EMPR is also a finite term involving decomposition like HDMR. Despite this finiteness, the number of the terms may grow undesiredly when N tends to grow unboundedly. Hence, not the whole decomposition but its truncations at some multivariate components like preferably constant, more meaningfully univariate, or at most, bivariate ones are desired to be used in practical applications. EMPR components, as in HDMR, are mutually orthogonal, under an appropriately given weight and over a specified orthogonal geometrical hypervolume, and, this permits us to define some functionals we call “Additivity Measurers” or “Quality Measurers”, to estimate how constant, univariate or bivariate EMPR is. They reflect the contributions of some level truncations to the target function in norm square. Of course the most lovely case is the constant function although it is somehow trivial. If the constancy can not be achieved exactly then constancy dominancy is sought. Quality measurers form a well ordered sequence between 0 and 1 inclusive, and, the closer constancy measurer to 1 the better numerical efficiency in the truncation at the constant component. Even though there is almost nothing to do for having constant term dominancy in HDMR except the weight function selection, EMPR has more flexibilities, the support functions to this end. By appropriately choosing them it is possible to maximize the contribution of the constant component to the target function in norm square. As proven by us, the constancy of HDMR approaches to 1 when its geometry suppressed to 0 in size, so does the EMPR’s. This brings the idea of choosing support functions in such a way that the considered function’s weighed integral, giving EMPR’s constant component, becomes having asymptotically flat kernel, that is, some number of first derivatives of the kernel vanish at a specified point in the domain of EMPR. Presentation will focus on these issues by also emphasizing on certain practicality aspects.

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)

ISBN: 978-1-61804-034-3

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 90 papers in well known and prestigious scientific journals, and, more than 170 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 is one of the principal members of Turkish Academy of Sciences since 1994. He is also a member of European Mathematical Society and the chief–editor of WSEAS Transactions on Computers currently. 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: 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, Multiway Array Decompositions, Enhanced Multivariate Product Representations, Quantum Optimal Control.

Plenary Lecture 1

On Computational Techniques based on Nonlinear and Fuzzy Systems Theory for NMR Spectroscopy Data Mining

Professor Dimitris Karras
Chalkis Institute of Technology
Dept. Automation
Evoia, Greece
E-mail: dakarras@hotmail.com

Abstract: Magnetic resonance spectroscopic imaging (MRSI) integrates spectroscopic MRS and imaging methods to acquire spatially localized MRS spectra associated with a specific patient. MRSI is a relatively new imaging entity for clinical applications while MRS is a more widely used signal processing modality in clinical practice. Both are related to NMR spectroscopy and scanners. The goal of this plenary talk will be to present the computational techniques for processing such complex spectra towards efficient NMR data mining regarding potential applications in clinical practice. These techniques will be based on Nonlinear Signal Processing methodologies including Dynamical Systems Analysis and Global Optimization methods as well as on Fuzzy Systems Theory involving development of suitable Fuzzy Descriptors. A series of experiments illustrate the feasibility and potential of the proposed approaches using synthetic images and model MRS signals derived from benchmark MRS spectra, towards successful data mining in clinical applications.

Brief Biography of the Speaker:
Dimitrios A. Karras received his Diploma and M.Sc. Degree in Electrical and Electronic Engineering from the National Technical University of Athens, Greece in 1985 and the Ph. Degree in Electrical Engineering, from the National Technical University of Athens, Greece in 1995, with honours. From 1990 and up to 2004 he has collaborated as visiting professor and researcher with several universities and research institutes in Greece. Since 2004, after his election, he has been with the Chalkis Institute of Technology, Automation Dept., Greece as associate professor in Digital Systems and Signal Processing as well as with the Hellenic Open University, Dept. Informatics as a visiting professor in Communication Systems (since 2002). He has published more than 50 research refereed journal papers in various areas of pattern recognition, image/signal processing and neural networks as well as in bioinformatics and more than 150 research papers in International refereed scientific Conferences. His research interests span the fields of pattern recognition and neural networks, image and signal processing, image and signal systems, biomedical systems, communications, networking and security. He has served as program committee member in many international conferences, as well as program chair and general chair in several international workshops and conferences in the fields of signal, image and automation systems. He is, also, editor in chief of the International Journal in Signal and Imaging Systems Engineering (IJSISE), topics editor in chief of the International Journal of Digital Content Technology and its Applications (JDCTA) as well as associate editor in various scientific journals. He has been cited in more than 350 research papers, his h-index is 8 and his Erdos number is 5.

ISBN: 978-1-61804-034-3

Plenary Lecture 2

Rayleigh Quotient Flattening Methods for the Eigenvalue Problems of Linear Operators Between Separable Hilbert Spaces

Professor N. A. Baykara
Marmara University, Mathematics Department
Istanbul, TURKEY
Email: nabaykara@gmail.com

Abstract: An algebraic Rayleigh quotient is a ratio of two quadratic forms whose kernel matrices can be considered as symmetric or Hermitian without any loss of generality. The vectors in these types of entities are taken from a Cartesian space whose dimensionality is equivalent to the number of the elements of those vectors. Cartesian spaces are structures very close to the real life spaces which can be perceived by our sensual organs. Analogues to real spaces, the distance between the points, the norm of the vectors each of which is considered to represent a point in the space, and the angle between the vectors are all defined in Cartesian spaces. Hence, in the sense of linear vector spaces theory they belong to the class of Hilbert spaces. The only restriction in Cartesian spaces is the members of the space. They are specific structures, algebraic vectors while the members of a given Hilbert space can be any kind of mathematical object as long as it fulfills the requirements to form a linear vector space. The dimensionality of a Cartesian space is generally finite as long as infinite algebraic vectors are not under consideration. Whereas the dimensionality of Hilbert spaces are generally infinite in the most widely encountered practical cases. For example, functions, univariate or multivariate, form a Hilbert space where the inner product is the integral over the product of two functions appearing as the argument of the relevant functional. These spaces which can be called function spaces are infinite dimensional since any function belonging to such a space can be uniquely expressed as a linear combination of certain linearly independent universal functions which are denumerable. The denumerability brings the concept of separability. We focus on only separable Hilbert spaces. The linear operators on the other hand, mapping from an Hilbert space to itself very frequently comes to the scene in many applications of mathematical and engineering modellings. A quadratic form for such an operator is defined as the inner product of an arbitrary function's image under the considered operator with the same arbitrary function. If a quadratic form of this typeis accompanied by a condition, like normalization, on the arbitrary function then it is better to use Rayleigh quotient which is a ratio between the quadratic form and a divisor quadratic form like the one having unit operator as the argument, instead of introducing Lagrange multipliers. The kernel of the divisor quadratic form does not need to be a unit operator and some other, but preferably positive definite, operators can be used to this end. Then the Rayleigh quotient can be called \Weighted Rayleigh Quotient". It is very well known that the extrema of a Rayleigh (or Weighted Rayleigh) quotient are the eigenvalues of the eigenvalue (or weighted eigenvalue) problem of the linear operator under consideration and these values are achieved when the arbitrary function of the Rayleigh (or Weighted) quotient becomes equal to the eigenvector(s) corresponding to the relevant eigenvalue. This implies that making a Rayleigh quotient sufficiently at around an eigenvalue of the related eigenvalue problem facilitates the solution of the spectral problem related to the considered Rayleigh quotient. The solution of the eigenvalue problem related to the extremization of a Rayleigh quotient may not be easy depending on the structure of the linear operator under consideration, the weight operator (if any) and certain accompanying conditions like boundary conditions. So certain approximation methods ay be required. Their construction can be based on certain facilitating features of the Hilbert space under consideration. However, beyond those, it is possible to consider some closure properties. For example the subspace composed of multiples of an eigenfunction must be closed under the action of the considered linear operator. Similarly if there are some conditions to define the subspace (these conditions must be linear and homogeneous for producing subspace) the image of a function from that subspace under the relevant operator should be inside the same subspace. The so-called Wronskian approaches and Space Pruning techniques are amongst the approaches are based on these types of ideas. The talk will focus on these issues within the given time limitations.

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

ISBN: 978-1-61804-034-3

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 ofMontreal 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. Most recent of his concerns is focused at efficient remainder calculations of Taylor expansion via Fluctuation–Free ?Integration, and Fluctuation–Free Expectation Value Dynamics.

Authors Index

ISBN: 978-1-61804-034-3