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Prof. Valeri Mladenov, Technical University of Sofia, Bulgaria
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Recent Researches in Circuits, Systems, Control and Signals

Proceedings of the 2nd International Conference on Circuits, Systems, Control, Signals (CSCS '11)

Prague, Czech Republic, September 26-28, 2011

ISBN: 978-1-61804-035-0

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Published by WSEAS Press
www.wseas.org

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www.wseas.org

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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: 978-1-61804-035-0

Institute for Environment, Engineering, Economics and Applied Mathematics

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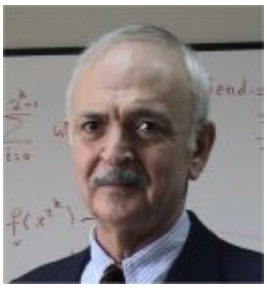
Keynote Lecture 1

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



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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)

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.

ISBN: 978-1-61804-035-0

Plenary Lecture 1

On a State Space Energy Based Generalization of the Nose - Hoover Non - Hamiltonian Dynamics

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Abstract: Experimental investigations of molecular dynamics at constant temperature for many-particle systems have been strongly influenced by introduction of the Nose-Hoover thermostat dynamic's in 1980's. At low energy levels the dynamic behavior is known to be regular. At higher energy levels the regular motion is destroyed by perturbations, as follows from Kolmogorov-Arnold-Moser theory. The resulting chaotic behavior has traditionally been analyzed by means of the Lyapunov exponents. It will be demonstrated in the proposed contribution that such a behavior is typical for a broad class of interconnected oscillators with at least one non-linear element. A new concept of abstract state space energy for a broad class of dissipative system representations, including such as the recently introduced non-Hamiltonian Nose-Hoover thermostat system will be presented as a limiting case too. The questions of system instability, dissipativity, conservativity, asymptotic stability, state and parameter minimality, and many other related structural properties, are traditionally described in physical terms and are known to be closely related to the total system energy evolution. In contrary, the presented paper deals exclusively with an abstract state space energy measure for a broad class of finite dimensional strictly causal systems described in state-space representation form. The resulting energy metric function is induced by the observed output signal power of an abstract dissipative system representation in such a way that a form of abstract conservation law holds. The concept of the state space energy is defined by power integration. Using abstract form of the energy conservation principle a specific structure of the corresponding class of physically correct system representations is derived. The same technique is applied for continuous-time as well as for discrete-time systems. Some typical examples of linear and nonlinear causal systems are investigated from the proposed state space energy point of view, too. The system simulation results will also be presented in the lecture. The obtained results of a number of simulation experiments are compared with classical dynamics based techniques as well as with recently published Nose-Hoover dynamics related results.

Brief Biography of the Speaker:
Milan Stork received the M.Sc. degree in electrical engineering from the Technical University of Plzen, Czech Republic at the department of Applied electronics in 1974. He specialized in electronics systems and control in research institute in Prague. Since 1977 he worked as
lecturer on University of West Bohemia in Plzen. He received Ph.D. degree in automatic control systems at the Czech Technical University in Prague in 1985. In 1997, he became as Associate Professor and in 2007 full professor at the Department of Applied Electronics and Telecommunication, faculty of electrical engineering on University of West Bohemia in Plzen, Czech Republic. He has numerous journal and conference publications. He is member of editorial board magazine "Physician and Technology". His research interest includes analog/digital linear, nonlinear and chaotic systems, control systems, signal processing and biomedical engineering, especially cardiopulmonary stress exercise systems.

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ISBN: 978-1-61804-035-0