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Mathematical Applications in Modern Science

Proceedings of the 19th International Conference on Applied Mathematics (AMATH '14)

Istanbul, Turkey, December 15-17, 2014

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Mathematics and Computers in Science and Engineering Series | 38

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ISSN: 2227-4588
ISBN: 978-1-61804-258-3

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Published by WSEAS Press
www.wseas.org

All papers of the present volume were peer reviewed by no less that two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.

ISSN: 2227-4588
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Preface

This year the 19th International Conference on Applied Mathematics (AMATH '14) was held in Istanbul, Turkey, December 15-17, 2014. The conference provided a platform to discuss linear algebra and applications, numerical analysis and applications, differential equations and applications, probabilities, statistics, operational research, optimization and applications, algorithms, discrete mathematics, systems, communications, control 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 sent to international indexes. They will be also available in the E-Library of the WSEAS. Extended versions of the best papers will be promoted to many Journals for further evaluation.

Conferences 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

Interpolative Aspects of Function Representations in Ascending Derivative Values

Professor Metin Demiralp
Istanbul Technical University
Informatics Institute
TURKEY
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Abstract: Taylor series can be shown as a very well known example to function representations in ascending derivative values. Even though the most widely used ones are on univariate functions there exist very well designed formulae also on multivariate functions. The construction of Taylor series are based on the identity which dictates us that the integral of the derivative of a univariate function over an interval is equal to the difference between the function values evaluated on the greater and smaller interval endpoints respectively. This identity requires the continuity and the differentiability of the function at the focus, and, it seems to be sufficient to get the continuity and first order differentiability. However, this is not the case since this integral of derivative identity is not only required to be used for the target function but repetitiously for its all derivatives. This means that the basic requirement is not only continuity and differentiability but analyticity.

Taylor series are in fact the limiting form of the Taylor polynomials at infinite degree. These polynomials and a remainder integral defines the Taylor decomposition of a univariate function. In the case of multivariance a similar decomposition can be constructed between two points in a multidimensional Euclidean space. The convergence of the Taylor series is provided us when the integral remainder of the Taylor decomposition formula decreases towards zero as the polynomial degree grows unboundedly.

When exists a Taylor series is an infinite linear combination over an appropriate power basis set and the linear combination coefficients are the relevant function's derivatives, evaluated at a common expansion point, divided by the factorial of the derivative order.

Quite recently, the presenter of this speech has used identity on the integral of the derivative of a function repetitiously but not on the same interval. Instead, the intervals whose one endpoints are at different nodal points while the other endpoints are located at the independent variable. This apparently changes everything. Each derivative value becomes evaluated at a different independent variable value while the basis set deviates from the power basis set to a polynomial basis set whose structure is completely determined by the nodal values. This approach has been called Separate Node Ascending Derivatives Expansion or as an acronym SNADE by Demiralp group. SNADE is now under an intense study in Demiralp's so-called Group for Science and Methods of Computing. SNADE will be at one of the main foci of this presentation.

On the other hand, in a very recent attempt Demiralp has been able to show that Integral of Derivative Identity can be more generalized to cover more than one intervals by using interpolatory concepts. By having this more complicated identity it has been possible to use each derivative values at different set of nodes. This baby age approach has been called Separate Multinode Ascending Derivatives Expansion or in acronym format SMADE. A separate invited paper will also be presented in this conference to better explain SMADE.

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

ISBN: 978-1-61804-258-3

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

Non Linear Electrodynamics and a Minimum Time Step Allowed in Early Universe Cosmology

Professor Andrew Walcott Beckwith
Department of Physics
Chongqing University
P. R. China
E-mail: Rwill9955b@gmail.com

Abstract: This article poses the question of a minimum time length at the start of cosmological space-time evolution. Using the methodology of Zeldovich (1972) as to a problem with electron-positron pair production we propose an upper bound to the problem of minimum time length which may be accessible to experimental inquiry. The previously done work by the author as to graviton production invoking non linear electrodynamics in cosmology is re introduced for the purpose as to density functions which are used to create an upper bound to the largest initial time step, in cosmological evolution. The results,are independent of massive graviton arguments , and the author will present a case that the minimum time step is part of a pre quantum gravity formulation, whereas the massive graviton is an artifact of quantum gravity occurring as a consequence of physics set up right after the formation of the minimum time step.

Brief Biography of the Speaker: Born December 15, 1954: PhD December 2001, Texas Center for Superconductivity, TcSAM.
Affiliation as research professor, Chongqing University, November 2010-Present
Interested in ideas which bridge, and which cross reference often too narrow research specialties. I.e. due to what I have known about laser physics through seeing / participating in experimental laser applications lead to a deeper appreciation of domain wall physics, with consequences as to cosmology questions which have been presented in conference talks. Finding commonality in often seemingly disparate specialties is something I look forward to doing, and an expertise which I would like to share with others to mutual benefit and profit.
In addition, engineering details can and should enable idea formation in general physics. Having device physics separated from theory is old, out of date, and belongs to the era where theoreticians were more important than experimentalists.
Specialties: GW physics, cosmology, condensed matter physics simulations of structure formation, and their applications to both Astro physics, and generalized domain wall physics. Applications of laser physics problems in both condensed matter/bio physics and space physics exploration.

ISBN: 978-1-61804-258-3

Plenary Lecture 2

On Some Selected Issue in Stability of Functional Equations

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Abstract:

There arises a natural question what errors we commit when we replace functions that satisfy some equations only approximately by the exact solutions to those equations. Some tools to evaluate them are provided within the theory of stability of functional equations (nowadays often called Ulam's type stability), which has been developed in connection with a question posed by S.M. Ulam in 1940 (see [3, 7, 14, 15, 16]). The talk contains some basic definitions and (early and recent) results concerning that stability of functional equations; in particular, the notions of superstability and hyperstability are discussed. The following three definitions describe partially the main ideas of them (see [7]).

Definition 1. *Let A be a nonempty set, (X, d) be a metric space, $\mathcal{E} \subset \mathcal{C} \subset \mathbb{R}_+{}^{A^n}$ be nonempty, $\mathcal{T}$ be an operator mapping $\mathcal{C}$ into $\mathbb{R}_+{}^A$ and $\mathcal{F}_1, \mathcal{F}_2$ be operators mapping a nonempty set $\mathcal{D} \subset X^A$ into X^{A^n}. We say that the equation*

$$\mathcal{F}_1\varphi(x_1, \ldots, x_n) = \mathcal{F}_2\varphi(x_1, \ldots, x_n) \tag{1}$$

is $(\mathcal{E}, \mathcal{T})$ – stable provided for any $\varepsilon \in \mathcal{E}$ and $\varphi_0 \in \mathcal{D}$ with

$$d(\mathcal{F}_1\varphi_0(x_1, \ldots, x_n), \mathcal{F}_2\varphi_0(x_1, \ldots, x_n)) \leq \varepsilon(x_1, \ldots, x_n), \qquad x_1, \ldots, x_n \in A, \tag{2}$$

there exists a solution $\varphi \in \mathcal{D}$ of equation (1) such that

$$d(\varphi(x), \varphi_0(x)) \leq \mathcal{T}\varepsilon(x), \qquad x \in A. \tag{3}$$

Roughly speaking, $(\mathcal{E}, \mathcal{T})$ – stability of equation (1) means that every approximate (in the sense of (2)) solution of (1) is always close (in the sense of (3)) to an exact solution of (1).

Definition 2. *Let A be a nonempty set, (X, d) be a metric space, $\varepsilon \in \mathbb{R}_+{}^{A^n}$ and $\mathcal{F}_1, \mathcal{F}_2$ be operators mapping a nonempty set $\mathcal{D} \subset X^A$ into X^{A^n}. We say that equation (1) is ε – hyperstable provided every $\varphi_0 \in \mathcal{D}$, satisfying (2), fulfils equation (1).*

Definition 3. *Let A be a nonempty set, (X, d) be a metric space and $\mathcal{F}_1, \mathcal{F}_2$ be operators mapping a nonempty set $\mathcal{D} \subset X^A$ into X^{A^n}. We say that operator equation (1) is superstable if every $\varphi \in \mathcal{D}$, that is unbounded (i.e., $\sup_{x,y\in A} d(\varphi(x), \varphi(y)) = \infty$) and satisfies*

$$\sup_{x_1,\ldots,x_n\in A} d(\mathcal{F}_1\varphi(x_1, \ldots, x_n), \mathcal{F}_2\varphi(x_1, \ldots, x_n)) < \infty,$$

is a solution of equation (1).

The lecture focuses, in particular, on stability of the difference equation of the form

$$x_{n+1} = F(x_n),$$

its generalizations and related functional equations. Also, stability of some conditional equations of the forms

$$g(x + y) = g(x) + g(y), \qquad x \perp y,$$
$$g(x + y) = g(x)g(y), \qquad x \perp y,$$

are considered (cf. [4, 5, 6]) with some relations $\perp$ patterned on some classical orthogonality notions.

Some examples of stability outcomes for differential and integral equations (cf. [1, 2]) are provided, as well.

ISBN: 978-1-61804-258-3

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Brief Biography of the Speaker: Present permanent employment: Department of Mathematics, Pedagogical University, Kraków, Poland;
position of professor
1983 – Master of Science in Mathematics, Jagiellonian University, Kraków, Poland
1991 – PhD in Mathematics
2000 – Habilitation in Mathematics
Major research interests: functional equations and inequalities with their applications, Ulam's type stability (e.g., of difference, differential, functional, integral and operator equations), real and functional analysis, fixed point theory.
Author of over 100 papers that are already printed or accepted for publication.
Chairman of the Scientific Committee of the series of conferences: International Conference on Functional Equations and Inequalities (ICFEI) (http://uatacz.up.krakow.pl/icfei/15ICFEI/)
Chairman of the Organizing Committees of 10th (2005), 11th (2006), 12th (2008), 13th (2009), 14th (2011), 15th (2013), and 16th (2015) ICFEIs (http://uatacz.up.krakow.pl/icfei/15ICFEI/prev.php)
Chairman of the Scientific and Organizing Committees of the conference: Conference on Ulam's Type Stability, Ustron (Poland), June 2-6, 2014 (http://cuts.up.krakow.pl/)
Member of the Programm or Scientific Committees of several other international conferences
Editor (jointly with Th.M. Rassias) of the monograph Functional Equations in Mathematical Analysis (nearly 750 pages; collection of 47 papers of 67 authors), volume 52 (2013) of Springer Optimization and Its Applications series, dedicated to the 100th anniversary of S.M. Ulam
Lead Editor of Banach Center Publications volume 99 (2013) titled: Recent Developments in Functional Equations and Inequalities. Selected Topics
Lead Guest Editor of Abstract and Applied Analysis annual special issues: Ulam's Type Stability (http://www.hindawi.com/journals/aaa/type.stability/) in the years 2012, 2013
Lead Guest Editor of Journal of Function Spaces (formerly: Journal of Function Spaces and Applications) special issue: Ulam's Type Stability and Fixed Points Methods (http://www.hindawi.com/journals/jfs/si/329604/cfp/)
Lead Guest Editor of Discrete Dynamics in Nature and Society special issue: Approximate and Iterative Methods (http://www.hindawi.com/journals/ddns/si/473241/)
Supervisor of four promoted PhD students.
Editor of several international journals.

Authors Index

ISBN: 978-1-61804-258-3