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Latest Trends in Applied Computational Science

Proceedings of the 12th International Conference on Applied Computer and Applied Computational Science (ACACOS '13)

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Kuala Lumpur, Malaysia, April 2-4, 2013

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Recent Advances in Computer Engineering Series | 11

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Preface

This year the 12th International Conference on Applied Computer and Applied Computational Science (ACACOS '13) was held in Kuala Lumpur, Malaysia, April 2-4, 2013. The conference provided a platform to discuss programming languages, software engineering, educational software, project management, security, web engineering, supercomputing, mobile networks, network applications, operating systems, network modelling 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.

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

Fluctuation Expansion in the Expected Value Evolution for Quantum Dynamics: Basic Issues and the Fluctuation Free Equations

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Abstract: In recent years, we have focused on the construction of ordinary differential equations (ODEs) for certain basic operators' expectation values whose totality suffice for describing the system's dynamics. This has been done for Quantum Dynamical Systems and the systems whose motion is governed by Liouville Equation. However, the starting point has been the construction of a linear set of ODEs for any given explicit ODE set even they are nonlinear in the description (right hand side) functions. The key idea was to use a complete basis set of unknown functions, each of which is functionally related at most to the unknown solution set of original ODEs. After some intermediate steps we could have been able to construct an infinite, first order, linear, homegeneous ODE set with a constant infinite square matrix coefficient. This infinite set of ODEs can be, in principal, analytically solved and the solution is unique as long as the initial conditions are given. The infinity could be handled by using appropriate truncation approximants in practical applications.
These equations define an evolution starting from a system state characterized by the initial vector which is a power vector whose block elements are the Kronecker powers of the system vector (which is composed of unknowns or the operators like momenta and positions in quantum mechanics) initial values. If the initial vector is not a power vector then there is a probabilistic nature in the initial vector because any vector can be expressed by the expectation values of the system vector's Kronecker powers with respect to a unique weight function (see the moment problem). In these cases the probability distribution also evolves. Hence we have called the solution method to determine the motion defined by these equations "Probabilistic Evolution Approach (PEA)". Since the classical systems obey the causality, the probabilistic weight function in the initial vector and therefore in the solution for any time instance has to be exteremely sharp, zero-width-infinite-lenght, that is Dirac delta function.
This approach for ODEs has been quite appropriate to solve the equations of motion for classical dynamical systems. The quantum dynamical equivalent for the equations of motion for a given classical system is exactly same as the classical PEA in the infinite coefficient matrix if the mathmetical fluctuations are ignored. The only difference in the initial value vector. It is not a power vector. It is the expectation values of the Kronecker powers of the system vector under the probability density (the complex modulus square of the wave function). This brings the fluctuations (the differences between the expectation value of the system vector Kronecker power and the same power of the expectation value of the system vector) on the stage. Beyond that the fluctuations are not only on independent variables or their functions but operators bringing the noncommutative operator algeba to the method. These are just for initial values and the fluctuations for the infinite coefficient may change the face of the issue since quantum mechanics is governed by fluctuations as the considered system particle dimensions tends to diminish.
In this talk we use the one dimensional quantum systems for rather easy explanations even though the multidimensionality does not bring any noticeable complication except the increase in the number of routine manipulations. A rather general one dimensional quantum system can be defined via the following Hamilton operator.

$$\widehat{H} \equiv \frac{1}{2\mu}\widehat{p}^2 + V(\widehat{q}) \quad (1)$$

where μ stands for the mass parameter while the definitions of the momentum $(\widehat{p})$ and the position operator $(\widehat{q})$ are given below

$$\widehat{p}f(x) \equiv -\hbar f'(x), \qquad \widehat{q}f(x) \equiv xf(x) \quad (2)$$

where *h* stands for the reduced Planck constant and *x* is called "position variable" which can take values from the real number set or its certain subdomain. The function *f(x)* is assumed to be lying in the space where the wave function resides. It should be at least four times differentiable even though its analyticity preferable since otherwise the

convergence issues may arise. The potential function is also preferably analytic even though second order differentiability suffices.
The starting formula to construct the fluctuation free approximation can be given as follows by skipping the derivation details in this extended abstract

$$\left\{\widehat{H},\left\{\widehat{H},f\left(\widehat{q}\right)\right\}\right\}=-\frac{1}{\mu}V'\left(\widehat{q}\right)f'\left(\widehat{q}\right)-\frac{2}{\mu}V\left(\widehat{q}\right)f''\left(\widehat{q}\right)+\frac{\hbar^2}{4\mu^2}f^{(4)}\left(\widehat{q}\right)+\frac{1}{\mu}\left[\widehat{H}f''\left(\widehat{q}\right)+f''\left(\widehat{q}\right)\widehat{H}\right] \tag{3}$$

where the left hand side is autonomous as long as the Hamilton operator and the function *f* have no explicit time dependence. For this case we can write (3) as follows

$$\frac{d^2\left\langle f\left(\widehat{q}\right)\right\rangle(t)}{dt^2}=-\frac{1}{\mu}\left\langle V'\left(\widehat{q}\right)f'\left(\widehat{q}\right)\right\rangle(t)-\frac{2}{\mu}\left\langle V\left(\widehat{q}\right)f''\left(\widehat{q}\right)\right\rangle(t)+\frac{\hbar^2}{4\mu^2}\left\langle f^{(4)}\left(\widehat{q}\right)\right\rangle(t)\\ \frac{2}{\mu}H_{exp}\left\langle f''\left(\widehat{q}\right)\right\rangle(t)+\frac{1}{\mu}\left\langle\left[\widehat{H}_f f''\left(\widehat{q}\right)+f''\left(\widehat{q}\right)\widehat{H}_f\right]\right\rangle(t) \tag{4}$$

where $\widehat{H}_f\equiv\widehat{H}-H_{exp}\widehat{I}$ (where $\widehat{I}$ symbolizes the unit operator) defines the fluctuation in the Hamiltonian whose autonomous expectation value is denoted by the constant H_{exp}.
We call the cases where fluctuation containing terms are ignored, “Fluctuation free equation”. By taking one of the elements of a basis set it is possible to construct sufficient number of equations to investigate the expectation value evolutions for the quantum system under consideration. The talk will focus on certain details of this issues.

Brief Biography of the Speaker: Metin Demiralp was born in Turkiye (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 90 papers in well known and prestigious scientific journals, and, more than 200 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 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.

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Plenary Lecture 1

On Robust Expectation & Maximization Clustering Algorithm

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Abstract: Data analysis is a science for analyzing data in real world, and clustering is a useful tool for data analysis. In general, clustering is a method for finding structure in a data set characterized by the greatest similarity within the same cluster and the greatest dissimilarity between different clusters. It is a branch in multivariate statistical analysis and an unsupervised learning in pattern recognition. From the statistical point of view, clustering methods could be divided into nonparametric and probability model-based approaches. For a nonparametric approach, clustering methods may be based on an objective function of similarity or dissimilarity measures, such as hierarchical clustering and k-means, fuzzy c-means, possibilistic c-means and mean shift, etc. On the other hand, the probability model-based approach assumes that the data set follows a mixture model of probability distributions so that the mixture likelihood approach to clustering is a popular clustering method, in which the expectation & maximization (EM) algorithm is the most used method. However, the EM algorithm for Gaussian mixture models is quite sensitive to initial values and the number of its components needs to be given a priori. To resolve these drawbacks of the EM, we develop a robust-type EM clustering algorithm for Gaussian mixture models. We first create a new way to solve these initialization problems so that it will be robust to initials and different cluster volumes. We then construct a schema to automatically obtain an optimal number of clusters. Therefore, the proposed EM algorithm will be robust to initialization and also different cluster volumes with automatically obtaining an optimal number of clusters. Some experimental examples with artificial datasets and real datasets are used to compare our robust EM algorithm with existing clustering methods. The results demonstrate the superiority and usefulness of our proposed method.

Brief Biography of the Speaker: Prof. Miin-Shen Yang received the BS degree in mathematics from the Chung Yuan Christian University, Chung-Li, Taiwan, in 1977, the MS degree in applied mathematics from the National Chiao-Tung University, Hsinchu, Taiwan, in 1980, and the PhD degree in statistics from the University of South Carolina, Columbia, USA, in 1989.
In 1989, he joined the faculty of the Department of Mathematics in the Chung Yuan Christian University as an Associate Professor, where, since 1994, he has been a Professor. From 1997 to 1998, he was a Visiting Professor with the Department of Industrial Engineering, University of Washington, Seattle. During 2001-2005, he was the Chairman of the Department of Applied Mathematics in the Chung Yuan Christian University. His research interests include applications of statistics, fuzzy clustering, neural fuzzy systems, pattern recognition and machine learning.
Dr. Yang was an Associate Editor of the IEEE Transactions on Fuzzy Systems (2005-2011), and is an Associate Editor of the Applied Computational Intelligence & Soft Computing and Editor-in-Chief of Advances in Computational Research. He was awarded with 2008 Outstanding Associate Editor of IEEE Transactions on Fuzzy Systems, IEEE; 2009 Outstanding Research Professor of Chung Yuan Christian University; 2010 Top Cited Article Award 2005-2010, Pattern Recognition Letters; 2012 Distinguished Appointment Professorship of Chung Yuan Christian University.

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Plenary Lecture 2

Computational Trust Management and Its Applications

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Abstract: Trust management is now being researched in the computing society for almost fifteen years and important advances have been made. This presentation will therefore give an overview of some most important computational trust management methodologies by focusing on Qualitative Assessment Dynamics, QAD. Based on this, applications of computational trust management methodologies to computational economics will be given.

Brief Biography of the Speaker: Prof. Dr. Denis Trcek is with Faculty of Computer and Information Sciences, University of Ljubljana, where he heads Laboratory of e-media. He has been involved in the field of IT security, privacy and trust for almost twenty years. He has taken part in various EU and national projects in government, banking and insurance sectors (projects under his supervision totaled to approx. one million EURs). His bibliography includes over one hundred titles, including monograph published by renowned publisher Springer. D. Trcek has served (or still serves) as a member of various international bodies and boards like MB of the European Network and Information Security Agency, and others.

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Plenary Lecture 3

Holistic Business Intelligence Management

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Abstract: Holistic business intelligence management requires organizational culture, business processes, and technologies being designed and implemented with the goal of improving the strategic, operational, and tactical decision-making capabilities of a wide range of internal and external stakeholders. It is important to emphasize that BI encompasses not only technology capabilities but also information access, analysis, and decision-making processes. Nevertheless, in today's economy, the technology is a key enabling factor that allows organizations of all sizes to support these processes.
There are, in essence, two layers in this view of the BI management. The first layer includes the data warehousing platform, which consists of data warehouse generation or data integration and data warehouse management tools. This layer of technology enables organizations to track, collect, integrate, and manage data. The second layer is composed of query, reporting, analysis, and statistical tools and various business process and industry-specific analytic applications.
Although this view may seem imposing, organizations have many choices regarding how to acquire and deploy this technology. Some BI solutions prepackage all the necessary components, including data integration, data warehousing, and end user-facing tools or applications. Other solutions provide modularity whereby organizations can pick and choose components that make the most sense for their current needs. However, every solution must support a complete BI portfolio regarding types (customer intelligence, competitive intelligence, supply chain intelligence, business process intelligence, and management intelligence), styles (reporting, dimension analysis, ad hoc queries, data mining, scorecards, business dashboards) as well as methods of BI delivery (e.g., mobile or location-based intelligence). Unlike ERP projects, most BI projects are incremental because end-user needs change periodically. Thus a holistic and flexible BI system architecture that enables rapid prototyping and modular deployment of functionality is a key to the long-term success of any BI program management.

Brief Biography of the Speaker: Zeljko Panian is full professor of business informatics at The Faculty of Economics and Business, University of Zagreb, Croatia. He received his master degree in 1978 and Ph. D. in 1981 at the University of Zagreb. His scientific interests are primarily focused on Enterprise Information Systems, e-Business and Business Intelligence. He wrote 35 books and more than 190 scientific and professional papers, and lectured as a visiting professor at the People's University of China at Beijing, Florida State University in Tellahassee (USA), University of Maribor (Slovenia) and University of Sarajevo and Mostar (Bosnia and Herzegovina), as well as nearly all universities in Croatia.
For several times, he delivered invited, keynote and plenary speeches at WSEAS and other international conferences and symposiums.

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Plenary Lecture 4

Interacting with the Internet through Intelligent Agent & Natural Language: An Enabler for Global Development

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Abstract: In this Information Age, information is money" like "time is money". The largest source of information is the Internet. Hence, it is important that everyone can access the Internet easily and economically. It is needless to mention the importance of the Internet for education, employment, economic, social, cultural and other developments, and more. Internet is becoming an important and essential part of everybody's life. In fact, Internet has already become a key driver for almost everything, including the basic necessities – food, water, shelter, health and the like. For example, Internet information can be used by farmers to improve and increase food production, to sell food directly to the buyers bypassing middlemen; thus significantly improving overall return to the farmers, which in turn provides great incentive to farmers to produce more food. Similarly, Internet based research & collaboration using large biological database is helping to develop variety of genetically engineered food at low cost. Obviously, it is not just food, the same logic applies for many things in our life. Thus, everyone (including people at the Base of the Pyramid [BOP], & with aging & disabilities) should have the right to access & interact with the Internet so that information can be for everyone. Unfortunately, only a small fraction of population can access the Internet today resulting a large Digital Divide. Existing approaches to bridge the Digital Divide are important & good but not sufficient to completely bridge the Digital Divide. A good solution to completely bridge the Digital & Language Divides is to allow the access & interaction with the Internet using Natural Language and an Intelligent Agent. In fact, this is becoming a must for a very large population, especially at BOP. Moreover, it is an enabler for Global Development (including Economic, Social, Cultural & other developments with increased Global Peace). This lecture will describe the details of an Intelligent Agent, associated Internet Content & Form rendering, User Interface issues and Natural Language based User Interface (UI). It will show that a Natural Language Understanding (NLU) based Intelligent Agent (IA) overcomes the existing problems by automating the key tasks while allowing a natural user interface using user's voice (or typing). Our solution not only makes it much easier to effectively use mobile devices & computers by non-technical, semiliterate and illiterate people, but also by technical people as the key tasks in a high end mobile device or computer now handled by manual scrolling (or navigating) and rendering by user's eyes & brain are automated via the use of IA. While current approaches to Natural Language Understanding (NLU) produce good results in some specific domains, NLU, in general, remains a complex open problem. NLU complexity is mainly related to semantics: abstraction, representation, real meaning, and computational complexity. We argue that while existing approaches are great in solving some specific problems, they do not seem to address key Natural Language problems in a practical and natural way. We propose a Semantic Engine using Brain-Like approach (SEBLA) that uses Brain-Like algorithms to solve the key NLU problem (i.e. the semantic problem) as well as its sub-problems. The main theme of our approach for Semantic Engine is to use each word as object with all important features, most importantly the semantic. In our human natural language based communication, we understand the meaning of every word even when it is standalone without any context. Sometimes a word may have multiple meanings which get resolved with the context in a sentence. The next main theme is to use the semantics of each word to develop the meaning of a sentence as we do in our natural language understanding as human. Defining semantics this way help "biological reasoning" and minimize "mechanical reasoning" used in existing formal logic.

Brief Biography of the Speaker: Dr. Emdad Khan is the Founder of InternetSpeech. He founded the company in 1998 with the vision to develop innovative technology for accessing information on the Internet anytime, anywhere, using just an ordinary telephone and the human voice. As a pioneer in the Internet voice space, Khan is a frequent speaker at voice-recognition, Internet applications, bridging the Digital and Language Divides and other industry trade shows and conferences. He holds 23 patents and has published more than 40 papers on the advent of voice technology on the Internet, content rendering, Natural Language Processing, neural nets, fuzzy logic, intelligent

systems, VLSI and optics. Khan's acute technical knowledge and keen understanding of emerging markets has played an important role in the development of InternetSpeech's first product/service netECHO, the only product available today that delivers complete voice Internet access. During his career, Khan invented, defined, developed and deployed worldwide new intelligent software products for micro-controller-based home appliances. He has also created and deployed speech recognition Internet applications. He has 20 years of experience with large semi-conductor companies, including Intel and National. Khan is doing active research. His current major interest is to use brain-like and brain-inspired algorithms to solve some open problems, especially, NLU (Natural Language Understanding) which is very well aligned for InternetSpeech's next generation products & services to allow users (especially bottom of the pyramid people) to interact with the Internet using their natural language. He holds a doctorate in computer science, master of science degrees in electrical engineering and engineering management and a bachelor of science degree in electrical engineering. Khan is currently on leave from InternetSpeech and a faculty at the Computer Science department of Imam University, Riyadh, Saudi Arabia. Khan is also a visiting Research Professor at the Southern University in Baton Rouge, Louisiana, USA.

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Plenary Lecture 5

Computer Application in Heart Imaging and Monitoring

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Abstract: Cardiovascular disease is the first common cause of death in human worldwide. Unhealthy life style is believed as the main cause of this disease. In order to prevent and cure this disease, some approaches based on computer have been applied. These include heart problem early detection based on electrocardiography signal and echocardiography image, computer based clinical decision support system for cardiovascular diseases, computerized clinical pathways for patient management, heart surgery monitoring, cardiac patient monitoring and telecardiology. Besides, computer plays also important role in the cardiac visualization for education purpose and cardiac assistive device design and simulation. In this paper, state of the art of computer applications in heart imaging and monitoring is discussed. The technology effectiveness is also evaluated in order to give important information for clinicians or cardiologists for technology selection. The advanced techniques in signal and image processing are explored. As a main technique to support clinical decision, the most suitable artificial intelligence techniques are introduced. Computerized clinical pathway as an effective tool to manage cardiovascular patient during treatment is detailed in this paper. Without computer, it is almost impossible to monitor the heart surgery during this era. This includes the using of imaging modalities such as ultrasound, computed tomography X-Ray and magnetic resonance imaging, as well as computer controlled biosensors. Since telemedicine become more and more advanced, it is also possible to use this system for home patient monitoring. This technological review is very important tool not only for clinicians but also for engineer or computer scientist for the future development and application of computer in the heart imaging and monitoring.

Brief Biography of the Speaker: Professor Dr.-Ing. Eko Supriyanto is the Director of IJN-UTM Cardiovascular Engineering Centre, Universiti Teknologi Malaysia. He obtained his PhD in electronics engineering from University of Federal Armed Forces Germany, Hamburg. He worked as an academic staff at this university and a product development manager in a private company in Duesseldorf, Germany, before moved to Malaysia. He is a visiting professor at Ilmenau University of Technology, Germany and guest professor at Department of Radiology, Padjajaran University, Indonesia. His involvement in the computer application in medicine has been started since 1996 for the dialysis machine safety monitoring system. He has 15 patents in the area of biomedical and computer based products. He also obtained more than 24 awards for his achievement from international institutions. He has more than 120 publications in international journals and proceeding and author of few international books. He has been also active in WSEAS conferences since 2009 as an invited speaker, speaker for more than 36 papers and session chairman.

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