NOLTA 2009

2009 International Symposium on Nonlinear Theory and its Applications
Chateraise Gateaux Kingdom Sapporo Hotel & Spa Resort, Sapporo, Japan,
October 18-21, 2009.

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Plenary Talks

Prof. Toshiyuki NAKAGAKI

Professor Nakagaki was awarded the 2008 Ig Nobel Prize for discovering that slime molds can solve puzzles. (Winners of the Ig Nobel Prize)

[Affiliation]
Research Institute for Electronic Science, Hokkaido University, Sapporo, Japan

[Title]
Smart behaviors of a living cell based on nonlinear dynamics

[Abstract]
We will present that ability of information processing in an amoeboid organism is higher than we had thought. The model organism is the plasmodium of Physarum polycephalum (true slime mold), which is a large aggregate of protoplasm with a large number of nuclei. The organism found the optimal path when it obtained the multiple locations of food. A simple mathematical model for the path finding was proposed in terms of differential equations. As well as the path-finding ability, the organism was able to anticipate the next timing of periodic climate change after experienced some periodic changes of climate. We indicated that a simple dynamics was enough to reproduce the observed anticipatory behavior. We may learn a new method for information processing from the studies of amoeba.

Dr. Ferdinand PEPER

[Affiliation]
Kobe Advanced ICT Research Center, National Institute of Information and Communications Technology (NiCT), Japan

[Title]
Exploiting Noise in Computation

[Abstract]
Noise and Fluctuations are usually considered obstacles in the operation of electronic and mechanical devices, and most strategies to deal with them are focussed on supression. This presentation gives a focussed overview of systems that employ different strategies, *i.e.*, strategies that can exploit the properties of noise to improve the efficiency of operations. These strategies may be an important ingredient in the designs of computers with devices of nanometer-scale feature sizes.

Dr. Andrzej CICHOCKI

[Affiliation]
Laboratory for Advanced Brain Signal Processing, BSI, RIKEN, Japan

[Title]
Tensor Factorizations and Decompositions for Modern Massive Data Sets and their Potential Applications

[Abstract]
Nonnegative and sparse multi-way array (tensor) factorizations and decompositions have emerged as new tools with a wide range of important potential applications, including bioinformatics, neuroinformatics, brain computer interface (BCI), text mining, image understanding, air pollution research, chemometrics, and spectral data analysis. Tensor factorizations and decompositions have many other applications, such as multi-way clustering, image classification, neural learning process, sound recognition, remote sensing, and object characterization. For example, we applied tensor decompositions for early diagnosis (detection) of Alzheimer Disease before any clinical symptom and also for Brain Computer Interface. We believe that a potential impact of the tensor decompositions on scientific advancements in biomedical signal processing and machine learning might be greater than Independent Component Analysis (ICA), or even the Singular Value Decomposition (SVD). In contrast to ICA or SVD/PCA approaches, sparse and nonnegative tensor decomposition techniques if successively implemented, may improve dramatically physical interpretation and 3D visualization of large-scale noisy data while maintaining the physical feasibility more closely. Multi-modality and high-dimensionality massive datasets are rapidly becoming more commonplace in many applications because they provide useful information that cannot be obtained from 2D data sets. Our goal is to explore novel techniques for modeling and analyzing massive, high-dimensional, and nonlinearly-structured scientific data sets. Analysis of such multidimensional data using traditional 2D processing is insufficient because of the interleaving and superimposed structures that often occlude the target regions of interest. Visual representation and understanding of such data is also an emerging area of research interest.
In this talk main emphasize will be given to multi-linear models, nonlinear iterative algorithms for large-scale tensor factorizations and decompositions and their various applications.

References:
[1] A. Cichocki, R. Zdunek, A.-H. Phan, and S. Amari: Nonnegative Matrix and Tensor Factorizations: Applications to Exploratory Multi-way Data Analysis, John Wiley, ISBN: 978-0-470-74666-0, (552 pages), September 2009.
[2] A. Cichocki and A-H. Phan: "Fast local algorithms for large scale Nonnegative Matrix and Tensor Factorizations", IEICE Transaction on Fundamentals, E92-A(3), 708-721 (invited paper) (March 2009).
[3] A-H. Phan and A. Cichocki: "Block Decomposition for Very Large-Scale PARAFAC and Nonnegative Tensor Factorization", ICONIP 2009 (submitted).
[4] C. Caiafa and A. Cichocki: "Methods for Factorization and Approximation of Tensors by Partial Fiber Sampling", CAMSAP-2009 (invited paper).

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