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INDS'09

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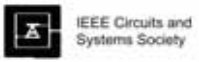

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Message from the Chair

On behalf of the organization committee we welcome you to the Second International Workshop on Nonlinear Dynamics and Synchronization (INDS'09) located at the Alpen-Adria University Klagenfurt in the beautiful small town Klagenfurt. INDS'09 brings together researchers, developers and practitioners from different horizons, with the main aim to establish a platform for discussing the latest advances in both theory and applications of nonlinear dynamics and synchronization. INDS is an interdisciplinary workshop and serve as a forum to present current and future works as well as to exchange research ideas pertaining to various aspects in this exciting and challenging field.

With great pleasure I can inform you that we have received a substantial number of high-quality contributions and we thank all authors for their overwhelming response. The best papers were selected through a thorough review process and we have an acceptance rate of below 40 percent. In addition to the key notes and paper presentations, INDS'09 also features poster and demo sessions. It is further worth a mentioning that the proceedings of INDS'09 will be published in IEEE Xplore.

Similarly to last year (i.e. INDS'08) Once again, we could win four international renowned experts to present exceptionally interesting insights and ideas in nonlinear dynamics and synchronization in keynotes and invited talks. We thank them for their availability and precious time: Leon O. Chua, Tamás Roska, Martin Hasler, and Kestutis Pyragas.

We also thank all our reviewers for their efforts to ensure the high standard of this workshop's contributions. Additionally, our thanks are directed to both the local organization committee (especially the staff of the Institute for Smart System Technologies) and to the program and organization chairs for their distinguished work and their efforts to make this second edition of INDS a great success. We do hope that all participants will enjoy two interesting and stimulating workshop days and the stay in our beautiful city Klagenfurt.

From this year we plan to organize this interdisciplinary workshop every two-years. Thus, this is also an invitation to join and actively participate in INDS'2011. We further advertise the possibility to submit either an extended paper version or a fully new paper to the post-conference publication, that is a Special Issue of the ISAST Transactions on Computers and Intelligent Systems; special issue Title: Selected Topics in Nonlinear Dynamics and Synchronization. The deadlines and guidelines will be posted on the workshop's website (http://inds09.uni-klu.ac.at) in due time. After undergoing a thorough further review process selected papers will be published in this special issue to appear end of 2009.

Kyandoghere Kyamakya
General Chair, INDS'09

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Keynotes

We could win international experts from various fields of non-linear dynamics and synchronization to fascinate us with their exciting keynote speeches and invited talks. The speaker's biographies and a short abstract of their planned talks are presented on the next pages.

Prof. Leon O. Chua, ***University of California, Berkeley, USA***

Leon O. Chua received the MSEE from Massachusetts Institute of Technology in 1961, and the Ph.D. from University of Illinois, Urban-Champaign in 1964. After that he was Assistant and Associate Professor at Purdue University until 1970. He became a Professor of Electrical Engineering and Computer Sciences at University of California at Berkeley since 1971.

Dr. Chua is known internationally as a pioneer in 3 major research areas, namely, neural networks, chaos and nonlinear circuits. His word in these areas has been recognized internationally through numerous major awards, including 11 honorary doctorates from major universities in Europe and Japan, and 7 USA patents. He was elected Fellow of IEEE in 1974, a foreign member of the European Academy of Sciences (Academia Europea) in 1997, and a foreign member of the Hungarian Academy of Sciences in 2007. He was honored with many major IEEE prizes, including the IEEE Browder J. Thompson Memorial Prize Award in 1972, the IEEE W. R. G. Baker Prize Award in 1978, the Frederick Emmons Award in 1974, twice winner of the IEEE M.E. Van Valkenburg Award (1995 and 1998). He is also a recipient of the top 15 most cited authors award in 2002 from all fields of engineering published during the 10-year period 1999 to 2001, from the Current Contents (ISI) database, the IEEE Neural Networks Pioneer Award in 2000, the IEEE Gustav Kirchhoff Award in 2005, and the IEEE Vitold Belevitch Award in 2007.

Dr. Chua has authored more than 500 papers and 8 books. He is widely recognized as the father of nonlinear circuit theory and cellular neural networks (CNN). Dr. Chua also invented a five-element electronic circuit for generating chaotic signals. Known internationally as the Chua Circuit, it is used by many researchers to design secure communication systems based on chaos and has become a standard paradigm for teaching chaos in textbooks on nonlinear dynamics.

Keynote: Memristors: 38 Years Later

On the May 1 2008 issue of Nature, scientists from the Hewlett-Packard Company unveiled a nano-scale device called the *memristor*, a hypothetical circuit element postulated in 1971. This Nature paper has generated unprecedented worldwide interests because, among many applications, memristors can be used as super-dense non-volatile memories for building instant turn-on computers. Even more exiting is the recent suggestion from many brain-research scientists that the memristor's continuous (analog) memory can be used to build ultra-small brain-like learning machines with nano-scale *memristive* synapses having a density of more than 50,000 synapses per neuron on a single chip. This lecture will provide an introduction to memristors and its potential applications, along with some historical and philosophical perspectives.

The circuit-theoretic foundation of the *memristor*, and its generalizations to a lossless *memory capacitor*, and a lossless *memory inductor*, will be presented along with the devices' constitutive relations. Their identifying fingerprints consist of a *pinched hysteresis loop* when plotted in the voltage-vs.-current plane, flux-vs.-integrated-charge plane, and charge-vs.-integrated-flux plane, respectively. All three devices are *nonlinear* and their underlying physical mechanisms are expected to dominate and manifest their *memory character* as the device size scales below 20 nanometers, when electrons and ions are coupled strongly under intense electric and/or magnetic fields. While all three devices are ideal candidates for *non-volatile nano memories*, the long-term significance lies in their enabling potentials for designing intelligent *nano machines*, with *learning* and *adaptive* capabilities. Even more fundamental is their *memristive* nonlinear dynamics, which underpins the biological basis of *life* itself, where *ion channels*, with their complex biochemical synaptic dynamics, are essentially *memristors*.

Prof. Támas Roska, ***Pázmány P. Catholic University, Hungary***

Tamás Roska received the Diploma in electrical engineering from the Technical University of Budapest in 1964 and the Ph.D. and D.Sc. degrees in Hungary in 1973 and 1982, respectively. He is the Fellow of the IEEE and elected member of four Academies of Sciences in Europe. Since 1964 he has held various research positions, since 1982 he has been with the Computer and Automation Research Institute of the Hungarian Academy of Sciences where he is presently head of the Analogic and Neural Computing Research Laboratory and the Chairman of the Scientific Council. He is also a Professor and had been a founder Dean of the Faculty of Information Technology at the Pázmány P. Catholic University, Budapest. Professor Roska has taught several courses, presently, he is teaching graduate courses on "Nonlinear Dynamics and Emergent Computations" and "Cellular Wave Computers and Visual Microprocessors". Since many years he is directing a Multidisciplinary Doctoral School. In 1974 and since 1989 in each year, he has been a Visiting Scholar at the University of California at Berkeley.

His research interests: cellular wave computing, info-bionics, cellular neural networks, nonlinear circuit and systems, neural electronic circuits, and analogic spatial-temporal supercomputing and computational complexity. He has published more than hundred research papers and four books (partly as a co-author). His seminal paper on the CNN Universal Machine, co-authored by L. O. Chua, has received close to 500 citations, and five of his papers published in 1992 and 1993 has been among the most cited papers of the IEEE Transactions I and II in the last 15 years. Altogether, he has more than 2000 citations.

Dr. Roska is a co-inventor of the CNN Universal Machine (with Leon O. Chua) and the analogic CNN Bionic Eye (with Frank S. Werblin and Leon O.Chua), US patents of UC Berkeley. During the last 15 years he has received two NSF grants, four ONR grants, two EU Grants and several Hungarian Grants. He has been a founding member of two spin/off companies, one in Berkeley and one in Budapest.

In 2002 and 2003 he had been serving as Editor-in-Chief of the IEEE Transactions on Circuits and Systems He is a member of the Editorial Board of the International Journal of Circuit Theory and Applications, the International Journal on Bifurcation and Chaos, the Journal of the Franklin Institute, and the Neural Processing Letters. He has been a founding Chair of the Technical Committee on Cellular Neural Networks and Array Computing in the IEEE Circuits and Systems Society. He received the IEEE Third Millenium Medal and the IEEE Circuits and Systems Society's Golden Jubilee Award. He has been awarded a "doctor honoris causa" from the University of Veszprém. For 4 years, in Hungary, he had been the advisory Chair of the National R&D Program on Information and Communication Technology, and since 2005 he is serving in the Advisory Committee of the EU Commissioner (M̃inister) in the Commission of Information Society and Media Technologies in Brussels.

Dr. Roska received in Hungary the Széchenyi Prize, the Szentgyörgyi Prize and the D. Gabor Prize, the Grand Prize of the "Pro Renovanda Cultura Hingariae", and the 2002 Bolyai Prize, given biannually to one Hungarian Scientist. Dr. Roska is a member of the Hungarian Academy of Sciences, the Academia Europaea, the European Academy of Arts and Sciences, the St. Steven Academy, and a Fellow of the IEEE.

Keynote: Implementing and use of spatio-temporal nonlinear dynamics on Cellular Wave Computers via kilo-processor chips

Cellular Wave Computers operate on spatially discrete 1-, 2-, or 3-dimensional image flows, or signal arrays, and the main instructions are defined via mainly locally connected dynamic cell arrays. The instructions are typically, not exclisively,, defined aslo as Partial Differential Difference Equations, implemented by the local interconnection patterns acting between the dynamic cells. These cells also contain local analog and logic memories as well as the communication and control units. Local logic operators, fully parallel are also part of the architecture.

Nowadays there are chips with 25, 000 cell processors with fully stored programmable instructions as well as many kilo-processor chips can implement the spatial-temporal algorithms, including FPGAs and GPUs.

After a brief review of the architecture and typical physical implementations, two new applications, the bio-relevance, the combined algorithmic and physical signal combinations and a 3D chaotic dynamics will be shown, applying Chua's circuits in the cell processors in the latter case.

The role of the dynamic input will be described as the major new direction in spatial-temporal nonlinear computing.

Prof. Martin Hasler, ***École Polytechnique Fédérale de Lausanne (EPFL), Switzerland***

Martin Hasler received the Diploma in 1969 and the PhD degree in 1973 from the Swiss Federal Institute of Technology, Zurich, both in physics. He continued research in mathematical physics at Bedford College, University of London, from 1973 to 1974. At the end of 1974 he joined the Circuits and Systems group of the Swiss Federal Institute of Technology Lausanne (EPFL), where he is at present full professor. In 2002, he was acting Dean of the newly created School of Computer and Communication Sciences of EPFL.

His current research interests are centered in nonlinear dynamics and information processing, both in engineering and in biological systems. In particular, he is interested in the engineering applications of complicated nonlinear dynamics, especially chaos. This also includes the modeling and identification of nonlinear circuits and systems. Recently, he is concentrating his research effort on the qualitative behavior and modeling of complex dynamical networks, be they of biological or technical nature. The study of synchronization phenomena is part of this effort.

He is a Fellow of the IEEE. He was Associate Editor and then Editor-in-Chief of the IEEE Transactions on Circuits and Systems. He was member of the Board of Governors and Vice-President for Technical Activities of the IEEE CAS Society. He was a member of the Scientific Council of the Swiss National Science Foundation.

Keynote: On blinking (stochastically switched) dynamical systems

It is expected that stochastically switched dynamical systems behave like the corresponding averaged systems if the switching is fast enough. We make this statement more precise and rigorous. If no more assumptions about the averaged and the blinking system are made, then the solutions of the blinking system follow the solutions of the averaged system only for a finite time interval. If the averaged system has a unique attractor, then the solutions of the blinking system get with high probability close to the attractor. If, in addition, the attractor is an invariant set of the blinking system, then almost all solutions of the blinking system converge to the attractor of the averaged system. In case of multiple attractors, corresponding results are also formulated and bounds on probabilities and speed of convergence are given.

Prof. Kestutis Pyragas, ***Semiconductor Physics Institute, Lithuania***

Kestutis Pyragas received the M.S. and PhD degrees in theoretical physics from Vilnius University in 1974 and 1979, respectively. He is currently the head of the laboratory of the Theory of Solid State Physics at the Insitute of Semiconductor Physics and Professor of theoretical physics at Vilnius University.

From 1992 to 1994, he was an Alexander von Humboldt Fellow first at the Institut fuer Theoretische Physik Technische Universitaet Berlin, then at the University of Tuebingen and later on at the University of Bayreuth. He was Professor of Physics at Vilnius Pedagogical University from 1997 to 2008. His research interests include nonlinear dynamics and chaos with application to biological systems as well as control and synchronization of chaotic systems. He is known as an inventor of the "delayed feedback control method" alternatively referred to as the "Pyragas method". He is authored and coauthored more than 100 scientific works. One of his papers devoted to the delayed feedback control method is cited in the literature over 1300 times.

Prof. Pyragas is a member of editorial boards of four scientific journals: "Chaos & Complexity Letters, International Journal of Dynamical Systems Research" , "International Review of Phyics (IREPHY)" , "Nonlinear Phenomena in Complex Systems, An Interdisciplinary Journal" and "Nonlinear Analysis Modeling and Control". He is the board member of the International Physics and Control Society (IPACS). In 1999 he received Lithuanian republic award for Theoretical and experimental investigations in the field of dynamical chaos and in 2006 awarded via Saint Christopher statuette for scientific achievments the award is annually delivered to most merit citizens of Vilnius.

Keynote:Control and synchronization of dynamical systems via a time-delay feedback

Some methods in the field of chaos control and synchronization involve a time-delay feedback in order to stabilize certain unstable manifolds embedded in chaotic attractors. Here we discuss two problems with the time-delay feedback, namely, the delayed feedback control algorithm that aims to stabilize unstable periodic orbits of chaotic systems and the anticipating synchronization algorithm, which enables a real-time forecasting of chaotic states.

Content

Day One

Poster Session 1 - Applications of Nonlinear Dynamics and Synchronization (NDS)

Conditions for the formation of clusters depending on the conductance and the coefficient of clustering 12
A. Caneco, C. Grácio, S. Fernandes, J.L. Rocha, C. Ramos
ANN Based Adaptive Controller Tuned by RTRL Algorithm for Non-linear Systems 17
K.C. Sindhu Thampatty, M.P. Nandakumar, Elizabeth P. Cheriyan
A Novel Method for Computing the Minimum Spanning Tree and Solution Based on Cellular Neural Networks Implemented on Digital Platforms 23
Do Trong Tuan, J. C. Chedjou, A. Fasih, K. Kyamakya
Stability and Bifurcation Analysis in Transformer Coupled Oscillators 30
J. Kengne, J.C. Chedjou, K. Kyamakya, I. Moussa
An Extended Nonlinear Hicks Model of the Cycle for a Semi-Open Economy: Application to the USA (1960-2008) 40
Panayotis Michaelides, Athena Belegri-Roboli, Gerasimos Arapis
Nonlinear Feature Extraction Approaches with Application to Face Recognition over Large Databases 44
Hima Deepthi Vankayalapati, Kyandoghere Kyamakya
New Computational Modeling for Solving Higher Order ODE based on FPGA 49
Alireza Fasih, Tuan Do Trong, J.C. Chedjou, K. Kyamakya
A Digital Chaos Generator for Use Within Chaos Encrypted Communication Systems 54
S. Amini
Different Types of Chaotic Behavior for Different Space and Time Scales in Complex Systems 60
Alexander Makarenko
Chaotic Security Based On Non-stationary Dynamics and Random Manifolds 65
Thang Manh Hoang
Correlation between the chaotic emissions of two coupled erbium-doped fibre ring lasers 71
J.C. Martín, J. Used, J.A. Sánchez-Martin
Synchronizing Shaking Sequences for Generating Symmetric Keys 75
Daniel Bichler, Guido Stromberg, Mario Huemer

Session 1 - Applications of Nonlinear Dynamics and Synchronization in Technical Systems

Frog Call-Inspired Self-Organizing Anti-Phase Synchronization for Wireless Sensor Networks 81
Akira Mutazono, Masashi Sugano, Masayuki Murata
Analysis of Jump Behavior in Nonlinear Electronic Circuits Using Computational Geometric Methods 89
Wolfgang Mathis, Philipp Blanke, Martin Gutschke, Franz-Erich Wolter
Grid Generation in Decentralized Systems 95
Daniel Berg, Panchalee Sukjit, Herwig Unger
Modelling of Nonlinear Seismic Response of Structures with Active Control 100
Svetla Radeva
Application of hypergraphs in microcode length reduction of microprogrammed controllers 106
Monika Wiśniewska, Remigiusz Wiśniewski, Marian Adamski, Wolfgang A. Halang
Distributed Estimation and Synchronization in Wireless Networks: Coupled Dynamical Systems Approach 110
Nikolai Nefedov

Day Two

Poster Session 2 - Theory of NDS

Analytical Treatment of the Signal Propagation in an EM Transistor/Memristor (EMTM) 116
Rostyslav Sklyar
Multi-Agent-Architecture for Simulating Traffic Management - A Case Study on Highway Networks 121
Ante Vilencia, Wolfgang Renz, Jan Sudeikat
A Test-bed Framework for Self-organizing Approaches over Distributed Systems 128
Ichiro Satoh
A Decision Theory based Multimodal Biometric Authentication System using Iris Recognition and Speech Identification 135
Ashwini Kumar, Monisha Saggi, Anwesha Bhattacharjee, Akash Tayal, Ramya Balasubramaniam
Short Term Load Forecasting Using A Novel Wilcoxon Neural Network 143
Sanjib Mishra, Sarat Kumar Patra
Jitter Analysis of Mixed PLL-DLL Architecture in DRAM Environment 150
Md Sayfullah, Barth Roland, Arpad L. Scholtz
On the Synchronization and Amplification of Chaos for Chua's Systems with Cubic Nonlinearity 155
Ioan Grosu, Servilia Oancea
An Image Segmentation Method for Detecting Objects in Images with Textural Background 158
Kaveh Samiee
Application of Hopfield Neural Networks in Target Recognition Through Mathematical Morphology 164
Fereidoun A. Mianji, Ye Zhang, Asad Babakhani, Homayun K. Sulehria
Superresolution of Hyperspectral Images Using Backpropagation Neural Networks 168
Fereidoun A. Mianji, Ye Zhang, Asad Babakhani
Pinpoint Planetary Landers: Vision Based Hazard Detection and Obstacle Avoidance 175
Syed Musaddiq Ali Shah, Waqas Mahmood
Feature Selection for Facial Expression Recognition Based on Optimization Algorithm 182
Seyed Mehdi Lajevardi, Zahir M. Hussain
Resolution Enhancement of Hyperspectral Imagery Through Spatial-Spectral Data Fusion 186
Fereidoun A. Mianji, Ye Zhang, Asad Babakhani

Session 2 - Nonlinear Dynamics and Theory of Synchronization

Noise Induced Temporal Patterns in Populations of Globally Coupled Oscillators 194
M.-O. Hongler, R. Filliger, Ph. Blanchard, J. Rodriguez
A CAD-Tool for the Design of n-Scrolls Chaotic Systems from Behavioral Modeling 198
J.M. Muñoz-Pacheco, E. Tlelo-Cuautle, V.H. Carvajal Gómez
A Novel Adaptive Intrusion Detection Approach Based on Comparison of Neural Networks and Idiotypic Networks 203
Linhui Zhao, Xin Fang, Yaping Dai
Design of Associative Memories by Using Machine Learning 209
Wieslaw Citko, Wieslaw Sienko
Solving Stiff Ordinary Differential Equations and Partial Differential Equations Using Analog Computing Based on Cellular Neural Networks 213
J.C. Chedjou, K. Kyamakya, M.A. Latif, U.A. Khan, I. Moussa, Do Trong Tuan
Nonlinear Filtering Algorithms for Chaotic Signals: A Comparative Study 221
V. Kontorovitch, Z. Lovtchikova