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EDITORIAL

Nonlinear dynamical systems often show complicated temporal, spatial and spatio-temporal behavior. Theory of nonlinear dynamics provides fundamental mathematical concepts, such as phase space, attractors, stability and bifurcation analysis to characterize these complex systems and networks. Nonlinear methods enable us to categorize and understand complex behavior of real world phenomena from many scientific disciplines, including physics, chemistry, biology, economics, and other social sciences.

The aim of the 13th "Nonlinear Dynamics of Electronic Systems" (NDES) conference, therefore, was to bring together leading specialists from physics and mathematics, neuroscience, theoretical biology and engineering in order to discuss and exchange methods and tools for the analysis of complex systems and networks. This conference took place from September 18th to 22nd 2005 in Potsdam, Germany (http://www.agnld.uni-potsdam.de/∼ndes2005). More than 150 participants from all over the world (from various countries in Europe as well as China, India, Japan, USA, Brazil) exchanged knowledge in the field of nonlinear dynamics not only of electronic systems. The 13th NDES conference had a special focus on networks of dynamical systems. Complex network structures have been observed in such diverse areas as physics, biology, economics, ecology, electronics and computer science. The conference presented cutting-edge research in this highly active field and explore new perspectives for nonlinear dynamics in interdisciplinary applications.

This special issue, which highlights the best contributions of the NDES 2005 conference, will focus on many of these advanced and innovative methods. It is divided into three tutorials on nonlinear time series analysis with application to cardiology and neuroscience and on power electronics as well as papers and letters in the categories of "Networks and Synchronization", "Circuits and Systems" or "Data Analysis and Applications". In the first tutorial Osterhage *et al.* excellently demonstrates that nonlinear EEG analysis allows to reliably identify the seizure generating structure in different areas of the brain. Nonlinear EEG analysis provides supplementary information about the epileptogenic process in humans, contributes to an improvement of the presurgical evaluation of epilepsy patients, and offers a basis for the development of new therapy concepts for seizure prevention. The second tutorial presents recently developed nonlinear methods of cardiovascular physics and their potential for clinical applicability in medicine. It is shown, that these data analyses and modeling methods lead to significant improvements in different medical fields. In the third tutorial, Saito *et al.* provide an overview of nonlinear dynamics of switching power converters. Simple test circuits are introduced and typical phenomena are confirmed experimentally. These results provide useful information for both practical and fundamental studies. Finally, some future problems are discussed: the detailed analysis of bifurcation phenomena, the efficient hardware implementation and the development of novel paralleled converters.

In the category "Networks and Synchronization", 17 contributions are included, ranging from synchronization phenomena in excitable media, via coupled organ pipes and neurons to genetic and electrical nonlinear oscillator networks. The "Circuits and Systems" category is the biggest one with 26 manuscripts covering the following topics: Fitz–Hugh Nagumo electronic system, coupled Chua oscillators, coupled Bonhöffer–van der Pol oscillators, Colpitts oscillators, forced Roberts dynamo, mobile robot, single-electron circuits as well as chaos-based ElGamal public-key encryption. Finally, in the "Data Analysis and Applications" category there are 13 contributions which present nonlinear methods (recurrence quantification analysis, permutation entropy among others) to minimize stochasticity in the North Atlantic Oscillation index, to analyze multivariate data from paleoclimate records, to suggest a wavelet transfer model for time-series forecasting, to quantify firing in nerve fibers, to analyze ECG data, to investigate inhomogeneities in reaction–diffusion media as well as to detect coupling directions in multivariate oscillatory systems.

Summarizing, this special issue gives recent trends and perspectives of nonlinear dynamical methods and applications in different scientific fields and can serve as a handbook for the analysis of complex systems and networks.

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