CHAOS 2010

Book of Abstracts

3rd Chaotic Modeling and Simulation International Conference

Editor

Christos H. Skiadas

June 1 - 4, 2010

Chania Crete Greece

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Introduction

Chaotic Modeling and Simulation International Conference

Chania, Crete (Greece) June 1 - 4, 2010

It is our pleasure to welcome the guests, participants and contributors to the 3nd International Conference (CHAOS2010) on Chaotic Modeling, Simulation and Applications. The study of nonlinear systems and dynamics has emerged as a major area of interdisciplinary research and found very interesting applications. This conference is intended to provide a widely selected forum among Scientists and Engineers to exchange ideas, methods, and techniques in the field of Nonlinear Dynamics, Chaos, Fractals and their applications in General Science and in Engineering Sciences.

The principal aim of CHAOS2010 International Conference is to expand the development of the theories of the applied nonlinear field, the methods and the empirical data and computer techniques, and the best theoretical achievements of chaotic theory as well. CHAOS2010 Conference provides a forum for bringing the various groups working in the area of Nonlinear Systems and Dynamics, Chaotic theory and Application for exchanging views and reporting research findings.

We thank all the contributors to the success of this conference and especially the authors of this *Book of Abstracts* of CHAOS 2010.

Chania, May 2010

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Keynote Talks

Gennady Leonov
Member (corresponding) of Russian Academy of Science
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Attractors, limit cycles and homoclinic orbits of low dimensional quadratic systems

Sergey V. Prants
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De Broglie-wave chaos

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Scattering by many small inhomogeneities

Valentin V. Sokolov
Budker Institute of Nuclear Physics and
Novosibirsk Technical University
Novosibirsk, Russia
Classical Versus Quantum Dynamical Chaos: Sensitivity to External Perturbations, Stability and Reversibility

Contents

Mutual Information and Dynamics

Massimo Materassi[1], Giuseppe Consolini[2] and Nathan Smith[3]

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In studying the dynamics resulting from the interaction of two or more systems with stochastic elements, the use of information theory quantities, as the mutual information or the transfer entropy, has been growing in importance in the last decade. Those quantities are naturally de.ned for discrete-time systems, while must be generalized to continuous evolutions with some care. The goal of using the Mutual Information Analysis (MIA) and the Transfer Entropy Analysis (TEA) in physics of complex interactions is to de.ne the best mathematical form of a dynamical system mimicking the evolution of two unknown physical processes X and Y, of which one only knows that they do interact, and measures as proxies the time series $x(t)$ and $y(t)$ respectively.
Here we propose a discussion of MIA and TEA, in which the role of non-linearity and memory properties of the dynamics is stressed: after a brief review of their de.nition, and of the problems arising in applying them to continuous processes (e.g. the binning problem), the more fundamental matter of unbiasing MIA and TEA from the potentially different degree of stochasticity in the processes X and Y is faced. In order to do this, some new quantities are introduced, which are the central result of this paper. Their application to some controversial natural and numerical cases is then showed.

Reliability of bioelectric activity (EEG, ECG and HRV) researches of the deterministic chaos by the nonlinear analysis methods

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There has been proposed a new approach to the process of investigation of bioelectric activity in the human and animal brain, basing on the use of multidimensional spectral analysis methods to detect cerebral hemisphere and subcortical structure regions involved temporarily in a certain functional system (according to P.K. Anokhin) for the purpose of realization of behavior acts, and the subsequent analysis and modeling of their nonlinear-dynamic parameters from the position of the deterministic chaos theory.

The possible reasons of errors occurrence are analyzed at research deterministic chaos in bioelectric activity of man and animals organism (EEG, ECG, HRV, etc.) by methods of the nonlinear analysis. The complex approach is offered, allowing to increase accuracy and reliability of received results at a correct choice of stationary sites of a signal, a delay and scale of consideration, use of adequate parameters during attractor reconstruction (an estimation of dimension of reconstruction and embedding dimension), for estimating entropy process and maximal Lyapunov exponent. Corresponding software NeuroResearcher® is created and examples of «chaos parameters» calculations of typical EEG and ECG signals illustrated.

Keywords: bioelectric activity of organism, EEG, ECG, HRV analysis, multidimensional spectral analysis, deterministic chaos, attractor reconstruction, attractor dimensions, delay, entropy, maximal Lyapunov exponent.