# Editorial

## Nonlinear Dynamics and Synchronization

Nonlinear dynamics is a concern of high importance as the behavior of most real-world systems and their motions are nonlinear and evolve in time and/or space. This is true for various types of systems: engineered systems, natural systems, social life events and phenomena. Nonlinear dynamical systems may display a series of behaviors: regular or irregular, stable or unstable, periodic or multi-periodic, torus or chaotic behaviors, etc. The modeling, simulation and also the control of nonlinear dynamic systems are very important issues. The related challenge lies in finding appropriate mathematical, physical or logical representations describing the real dynamical behavior by providing insights in the respective functioning principles. This is generally achieved through analytical modeling, simulations and/or experiments.

Synchronization in complex systems can be understood as the result of the adjustment of a given property of the motion exhibited by coupled systems or subsystems (either identical or non-identical). This adjustment is generally achieved under some suitable values of the control parameters, e.g. the couplings or the external excitation(s). To date, various types of synchronization have been identified: complete synchronization or identical synchronization, phase synchronization, lag synchronization, generalized synchronization, and rhythm synchronization. The use of each of these types of synchronization depends upon a specific systems and fields of interest.

The present special issue sheds light on both theory and selected applications of nonlinear dynamics and synchronization. This issue consists of **seven** contributions which are ordered according to these two aspects. The four first papers address mainly theoretical issues and the last three ones do focus on concrete application cases of nonlinear dynamics and synchronization concepts. In the following a brief summary of each of the papers is presented.

The first paper, "***Cumulant Analysis of Rössler Attractor and its Applications***", by Kontorovich et al., addresses a statistical analysis method of the chaos generated by the Rössler attractor by involving the so-called "Degenerated Cumulant Equations" method. Further, an approximate method for the variance calculation at the output of the Rössler strange attractor is presented. Finally, an illustrative application of the findings for modeling radio frequency interferences provided by the PCI serial bus is introduced.

The second paper, "***Localized Approaches for Nonlinear Analysis of Chaotic Systems in Multidimensional Phase Space***", by Dailyudenko, develops algorithms for calculating fractal measures and characteristic exponents for modeling chaotic systems evolution. The essential reduction of required computer resources is obtained through the use of temporal localizations along phase trajectories of a chaotic attractor. The reliability of the approach is confirmed by numerical simulations.

The third paper, "***Modeling and Design Concepts for Electronic Oscillators and its Synchronization***", by Mathis and Bremer, considers a selection of very interesting concepts of both deterministic and stochastic dynamical systems besides discussing their respective application to electronic oscillator design. The paper convincingly demonstrates that that a systematic design concept involving both nonlinearities and noise in an intrinsic manner can be developed.

The fourth paper, "***Design Couplings for Synchronization***", by Grosu, present a didactic method for designing both master-slave and mutual synchronization of two identical oscillators. For illustration, the synchronization design of two Sprott's chaotic electrical circuits is discussed.

The fifth paper, "***Adaptive Frequency Oscillators and Applications***", by Righetti *et al.*, suggest a generic mechanism for transforming an oscillator into an adaptive frequency oscillator. This last can dynamically adapt its parameters to learn the frequency of any periodic driving signal. To finish, several practical applications of this scheme are presented.

The sixth paper, "***Nonlinear Adaptive Control of a Two-Vehicle Convoy***", by Petrov, describes the modeling of a two-vehicle convoy and the design of the related vehicle following controller for tracking the trajectory of the vehicle ahead with prescribed inter-vehicle distance. The current inter-vehicle relative position and orientations is used feedback control whereby the control velocities of the following vehicle are computed using the leader velocity estimates.

The seventh paper, "***Application of Asynchronous Channels Method to the W-CDMA Sytems***", by Nameda *et al*., evaluates a novel interfering suppression method that utilizes the effect of asynchronous accesses in wireless telecommunication. The method called asynchronous channels (ACL) can be applied to one of the present third generation standards, wideband code division multiple access (WCDMA) systems. According to simulations, in band unlimited situations, ACL demonstrates highly interfering suppression effects as expected, a decreasing of the bit error rate (BER) and an increase of the system capacity. However, in band limited situations, the effect of ACL is highly affected by the pulse shapes.

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