Workshop APPLIED MATHEMATICS: METHODS AND MODELING
Craiova, May 7 - 8, 2017

Multistability, self-excited and hidden attractors in some 3D dynamical systems

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Abstract: The coexistence of many attractors (multistability) and the identification of hidden attractors is analyzed in some 3D dynamical systems of interest in physics. The deep analysis of multistable systems is very important in applications, because it is interesting to precise the conditions for a system to remain on the most desirable attractor and to reduce the risk of a sudden jump to undesired behavior.
We focus on Lorenz-like systems (with applications in the study of convective fluid motion), Chua system (with application in the study of electrical circuits) and a low dimensional system describing the variation of plasma parameters in fusion plasma physics. For these systems self-excited attractors (attractors whose basin of attraction intersects any neighborhood of an unstable equilibrium) are localized numerically by standard computational procedures and hidden attractors (whose basin of attraction is located far away from equilibrium points) are pointed out from numerical simulations. In each case some specific analytical-numerical procedures are developed in order to localize them and to describe their basin of attraction. The obtained results are interpreted in terms of physical phenomena described by the dynamical systems, which gives a better understand of our mathematical considerations.