CONTRIBUTIONS TO CONTINUOUS AND DISCRETE DYNAMICAL SYSTEMS

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Abstract

The results described in the habilitation thesis are grouped in four sections.

1) The first section describes the results we obtained on periodic, homoclinic and heteroclinic orbits in several three-dimensional differential systems, namely in Chen, Lu, T and Shimizu-Morioka systems. For the first three systems we used a method based on Lyapunov-like functions and showed that the systems under some constraints of their parameters have neither homoclinic nor closed orbits but they have heteroclinic orbits. We showed that the Chen system has two symmetrical homoclinic orbits. For the T system we studied also periodic orbits arising from Bautin bifurcation. For the Shimizu-Morioka system used a different method, namely a method based on detecting the traces left by the separatrices of a saddle point on certain surfaces. With this method we could prove the existence of homoclinic orbits in the Shimizu-Morioka system.

2) In the second section we give details about the results we obtained on nonsmooth dynamical systems. We have studied a two-dimensional discrete non-smooth system (map), which is continuous but non-differentiable with respect to one of the variables. The map generalizes in some sense the so-called Nordmark map, which is related to one-dimensional impact oscillators near grazing points. Examples of impact oscillators range from simple to complex phenomena such as, a ball bouncing on a vibrating table and a charged particle moving in strong magnetic fields in tokamaks.

3) The third section presents the results we obtained on perturbed Hamiltonian systems. We studied firstly a one-and-a-half degrees of freedom perturbed Hamiltonian system with a quartic unperturbed part and broad perturbation spectrum. An approximate interpolating Hamiltonian system was firstly studied. We pointed out results on the behavior of the Poincare-Birkhoor dimerised chains in their routes to reconnection when the perturbation parameter varies. A discrete system associated to the full Hamiltonian system was constructed and studied.

4) In the fourth section we present details on the results we obtained on degenerate fold-Hopf bifurcations. We studied degenerate with respect to parameters fold-Hopf bifurcations in three-dimensional differential systems. Such degeneracies arise when the transformations between parameters leading to a normal form are not regular at some points in the parametric space. The fold-Hopf bifurcation (or zero-Hopf) occurs in smooth differential systems of minimum dimension three and having minimum two independent parameters. The hallmark of the bifurcation is that at certain values of the parameters the linearized system has an eigenvalue equals to zero and two purely complex eigenvalues. We obtained new generic results for the dynamics of the systems in such a degenerate framework.

The full abstract at:
http://iosud.utcluj.ro/teze-de-abilitare.html

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