Combined Analytic-Numerical Investigation of Discrete-Physical Systems and Two-Dimensional Maps

J. Awrejcewicz
Technical University of Lódź
Division of Control and Biomechanics (I-10)
1/15 Stefanowskiego St., 90-924 Lódź, Poland
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The paper includes two main parts of analysis. First, one- and two-degree-of-freedom nonlinear physical systems serve as examples for illustration of various analytical as well as numerical investigations of regular and chaotic behaviour governed by ordinary differential equations. Analytical approaches consist of applications and extensions of averaging and Melnikov methods supported by symbolic computations using "Mathematica" package. The numerical techniques applied are focused on solving both the initial and boundary value problems. The stability of periodic orbits and prediction of their bifurcations are analysed using Floquet theory and its modification for the numerical purposes. Special attention is paid to the systems with friction and discontinuouties (impacts). Also control of the periodic orbits including their stability improvement by means of either analytical or numerical techniques will be discussed and illustrated.

The second part of the paper consists of investigation of chaotic dynamics exhibited by two-dimensional maps. The numerical analysis include numerical tracking of fixed points (equilibra and periodic orbits), their stability and bifurcations, basins of attractors and basin boundaries, basin of attraction of infinity and metamorphoses, stable and unstable manifolds, saddle-straddle trajectories, routes to chaos. Two dimensional maps are represented by the Hénon and Ikeda maps. Chaotic and hyperchaotic dynamics are explored and a particular order in organization of saddle orbits is discussed.

References

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