S-19

"Application of Chaos Concepts in Mechanical and Biomechanical Engineering"

Jan AWREJCEWICZ

A talk is focused on the nature of chaos from an engineering point of view. First, an introduction including definitions of chaos and diagnosis tools of chaotic orbits are briefly reviewed. Then examples of chaotic motions found in coupled oscillators are discussed and illustrated.

The first example includes analysis of nonlinear dynamics of a self-excited stick-slip oscillator, which often occurs in many machine applications. All possible geometry configurations of the system which correspond to different types of equilibria are analytically analyzed. Two general types of transition scenarios, one due to period doubling bifurcation and the other due to intermittency, are demonstrated. Transitional as well as asymptotic chaos with the observed stick-slip phenomena is shown.

In the second example the human vocal cords oscillations are considered. The mechanical model of the vocal cords is presented, and periodic, quasiperiodic and chaotic motion is demonstrated. The analysis is supported by analytical and numerical computations and results in many conclusions related to the applications.

In the third example (two degrees of freedom nonautonomous system) some special nonlinear phenomena, including the occurrence of the strange nonchaotic attractor, are briefly discussed.

Based on presented examples analytical and numerical methods for investigation in a systematic way of nonlinear dynamical systems are outlined. The bifurcation points, new bifurcated solutions and the parameter sets for which chaos appears are calculated using shooting and Newton-Raphson methods. Chaotic orbits are traced based on solving an initial value problem.