

On Generating Chaotic Dynamics in Nonlinear Vibrating Systems

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The paper is aimed at demonstrating the mechanism triggering chaotic phenomena in dissipative nonlinear vibrating systems. The common dynamical element underlying the build-up of chaotic responses, i.e. the formation of nonattracting invariant sets (chaotic saddles), is highlighted. Characteristic examples of the practical consequences, such as chaotic transient motions, fractal basin boundaries and an unpredictability of the final outcome, are shown and discussed for two representative models of oscillators driven externally by periodic force. The results are presented and interpreted with the use of concepts and numerical techniques of nonlinear dynamics and chaos. It is shown that the presence of a chaotic saddle triggers chaotic transient motions apart from either single or multiple attractors coexist, as well as that transient chaos may appear at the level of control parameters much lower than a steady-state chaos (chaotic attractor). The study of formation of chaotic saddles related to the sequence of global bifurcations allows to establish critical thresholds of forcing parameters that define the domains of the safe (regular) and unsafe (unpredictable) system motion.

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