Dynamics and circuit emulation of a system of two linear oscillations coupled to a damped third order nonlinear oscillator

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A system of two linear oscillators coupled to a damped third order nonlinear oscillator with a mass much smaller than the linear oscillators is studied through numerical tools as bifurcation diagrams, poincare sections, Lyapunov exponents etc.

The importances of such systems are that they are connected to the Targeted Energy Transfer phenomenon, have various technical applications and play an important role in many physical phenomena [1].

In this work we study a slightly converted system that has multiple stability and hidden chaotic attractors. The unperturbed Hamiltonian part contains, apart from the quadratic harmonic oscillations, the nonlinear fourth order term an extra linear part with respect to the first two oscillators. This results to having only one stable equilibrium point. Thus the chaotic attractors and the limit cycles of the full system are hidden i.e. their basin of attraction does not have any unstable equilibrium point.

This new system has rich dynamics: it has periodic, semi periodic and chaotic orbits.

Finaly, this new system is experimentally emulated by an electronic circuit and its dynamical behavior is studied in order to confirm the feasibility of the theoretical model.

References


