Chaos Control Applied to Pendula Systems

Aline Souza de Paula*
Department of Mechanical Engineering
University of Brasília
Brasília, Brazil

Abstract

Nonlinearities are responsible for a great variety of possibilities in natural systems. Chaos is one of these possibilities being related to an intrinsic richness due to the existence of an infinity number of unstable periodic orbits (UPOs). Chaos control may be understood as the use of tiny perturbations for the stabilization of these UPOs. Chaos control methods may be classified as discrete or continuous techniques. The first chaos control method was proposed by [1], nowadays known as the OGY method. This is a discrete technique that considers small perturbations promoted in the neighborhood of the desired orbit when the trajectory crosses a specific surface. On the other hand, continuous methods are exemplified by the so called delayed feedback control, proposed by Pyragas [2], which states that chaotic systems can be stabilized by a feedback perturbation proportional to the difference between the present and a delayed state of the system. In this work, two pendula systems are considered. In the first dynamical system, discrete and continuous chaos control techniques are numerically applied to a pendulum system, whose parameters have been experimentally identified, in order to stabilize different UPOs [3]. In the second system, continuous chaos control methods are employed in order to maintain the rotating solution of a pendulum-shaker system [4]. In this case, the main goal is to avoid bifurcations that destabilize the rotating motion, being useful for energy harvesting purposes. The control is carried out numerically and experimentally.

References

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*e-mail: `alinedepaula@unb.br`

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