Semester Thesis - FS 2013

Determining the largest Lyapunov exponent of mechanical systems with impacts using chaos synchronization

Description:
The spectrum of Lyapunov exponents characterize the convergence or divergence of nearby trajectories in the phase space and therefore measure the sensitivity of initial conditions. It is a quantitative measure for the chaotic behaviour of dynamical systems. If the largest Lyapunov exponent is positive, then the limit set is chaotic.

Well established methods exist for the calculation of the spectrum of Lyapunov exponents for smooth dynamical systems. In the recent years, several methods have been proposed which can be applied to dynamical systems with impulsive motion. The basic idea of this project is to calculate the largest Lyapunov exponent using chaos synchronization.

Objective:
The main goal of this thesis is to investigate the relation between the synchronization property and the largest Lyapunov exponent of the system. Therefore, two impact oscillators (as depicted in Figure 1) are simulated in a master-slave or bidirectional coupling configuration with proportional state feedback. The largest Lyapunov exponent is calculated using an approved method and is compared to the synchronization property of the coupled system. Furthermore, the results are generalized to more general mechanical systems with unilateral constraints.

Prerequisites:
Nonlinear Dynamics, Technical Dynamics, MATLAB

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