On the Numerical Simulations of Amplitude Adaptive Impact-Dampers

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Technical systems generally contain undesired oscillations, which can interfere with the system behaviour or destroy the system completely. Dealing with such oscillations is an ongoing topic in research. Different possibilities including dynamic vibration absorbers [1] and friction elements [2] are considered in literature. Impact-dampers are also extensively investigated, see e.g. [3,4]. These impact-dampers do not allow a selective energy dissipation.

A new kind of adaptive impact damper using preloaded springs and inelastic collisions to reduce vibration amplitudes for forced vibrations is discussed. The system consists of a main mass, two collision masses and an absorber mass, see Figure 1. In resting position, the preloaded springs keep the collision masses in contact with the main mass. A numerical analysis is performed to determine the influence of system parameters on vibration amplitudes. Amplitude response is derived with a force excitation in the form of a sine sweep.

The system behaves as a standard dynamic vibration absorber until the preload is overcome, which happens in the vicinity of resonance frequencies. Then collisions take place and limit vibration amplitudes. The system is capable of both reducing vibration amplitudes and cancelling it completely for a single excitation frequency, see Figure 2. Analytic predictions for the transition points between different system behaviours are obtained. A lower bound for preload is found to make cancelling possible, which determines minimal amplitudes for collision to take place. Critical values are derived for other parameters, which should be avoided, in order to avoid large vibration amplitudes. This work has been supported by the DFG German Research Foundation Grant FI 1761/2-1 within the Priority Program SPP 1897 “Calm, Smooth and Smart - Novel Approaches for Influencing Vibrations by Means of Deliberately Introduced Dissipation”.

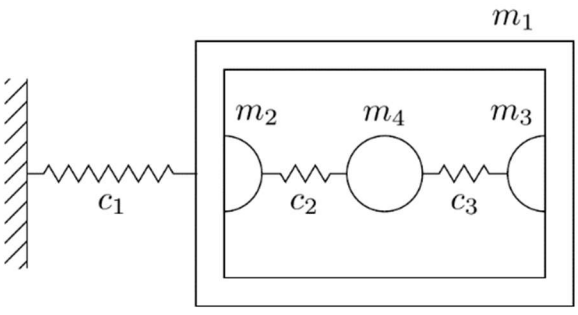

Figure 1: Proposed system

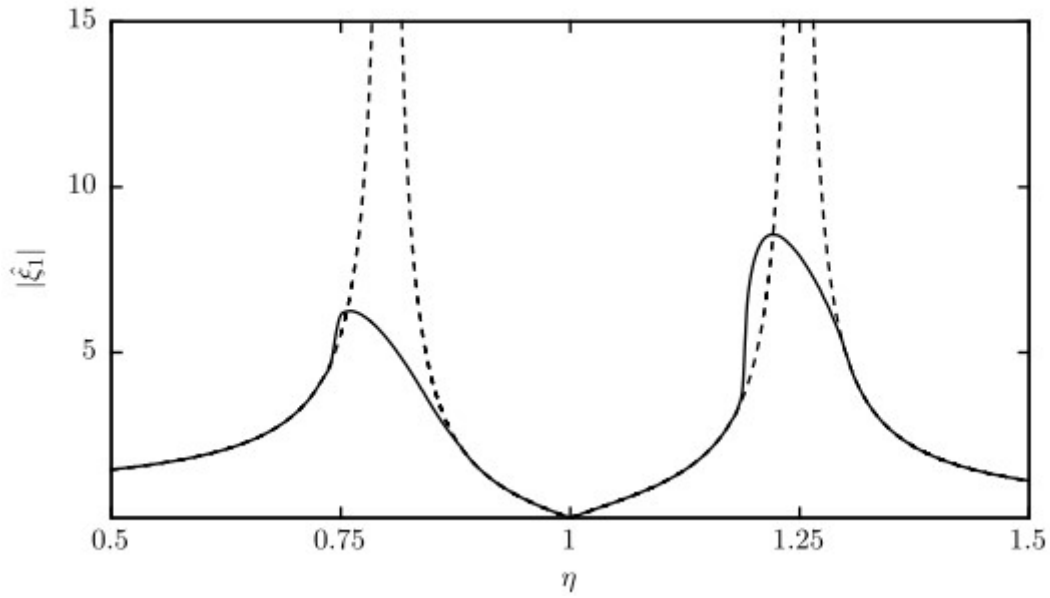

Figure 2: An exemplary result; amplitude responses of a standard dynamic vibration absorber (dashed) and of the proposed system (full)

References

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