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Performance and Robustness of the Nonlinear Tuned Vibration Absorber

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Although nonlinear vibration absorbers recently studied in the literature can absorb disturbances in relatively wide ranges of frequencies due to their increased bandwidth, their performance critically depends on motion amplitude [1, 2]. The objective of this study is to introduce a new nonlinear vibration absorber that is effective in wide ranges of motion amplitudes. This absorber is termed the nonlinear tuned vibration absorber (NLTVA), because its functional form is tailored to the frequency-energy dependence of the host structure [3].

In addition, we will show that the harmonic balance (HB) method is an efficient and appropriate numerical tool for the tuning procedure of the NLTVA. In this study, the HB method is also employed for tracking the bifurcations of periodic solutions of the system in absorber parameter space, which, in turn, provides a clear indication of absorber robustness. In view of the richness and complexity of nonlinear dynamic phenomena, global analysis using a variant of the cell mapping method is then utilized for detecting the different attractors of the dynamics together with their domains of attraction.

The design methodology is validated using a numerical example, which consists in the mitigation of the primary resonance of a one-degree-of-freedom host system with cubic nonlinearity.

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