Conference

Order-tuned vibration absorbers for rotating mechanical systems—how a symmetric bifurcation may affect the fuel economy of your next car

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Abstract

In this presentation I will summarize ongoing research of a class of mechanical vibration absorbers that are used to attenuate torsional vibrations in rotating machinery. These absorbers are essentially variable-length pendulums attached to a spinning rotor, designed so that their motion counteracts fluctuating torques acting on the rotor. By proper selection of absorbers parameters, most importantly the kinematic path along which they move, torsional vibrations of the rotor can be significantly attenuated. Under appropriate scaling, the absorber equations of motion can be reduced to a system of oscillators with all-to-all coupling and resonant excitation. It is shown that limitations in absorber effectiveness arise from two types of instabilities of the desired synchronous response: a saddle-node bifurcation (a classical jump in the response) and a symmetry-breaking bifurcation. System performance is evaluated for a two-parameter family of absorber paths that includes circles, cycloids, and epicycloids. The presentation will describe modeling, asymptotic analysis, path design, systematic experimentation, and applications to new fuel-efficient automotive engines.