Abstract

Passive dynamic vibration absorbers have been extensively used for harmful vibration attenuation in many practical engineering systems. The applicability of these passive vibration absorption devices is limited to a specific narrow operation frequency bandwidth. In this article, a novel active vibration absorption scheme is proposed to extend the vibration suppression capability of a passive mass-spring-damper absorber for any excitation frequency, including interest resonant harmonic perturbation forces. The central foundations of a passive absorber are exploited in the design stage of the presented absorption scheme. Thus, the active absorption device applies forces on the protected mechanical system that counteract the unknown perturbation forces, conserving the vibration attenuation property of the passive absorber. The perturbation force is estimated on-line using an extended state observer proposed in this work. Simulation results are included to show the efficiency of the active vibration absorption scheme to reject completely unknown resonant and chaotic forced vibrations affecting the primary mechanical system, and to prove the effectiveness of the estimation of exogenous perturbation forces.

Keywords

Mechanical vibrations, dynamic vibration absorbers, active vibration absorption, force estimation.