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Minimization of the beam response using inerter-based passive vibration control configurations

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Abstract

Two inerter-based passive vibration control configurations, *i.e.*, a mass connected to a parallel combination of a spring and a damper in series with a spring and an inerter (Case I), and a traditional dynamic vibration absorber in series with an inerter (Case II), are proposed and are successfully applied to achieve the vibration suppression of beam-type structure. The frequency response functions of system displacement and acceleration are analytically derived through the classical vibration theory. The optimization problem of minimizing the maximum value of the frequency response function in the whole range or a certain range of frequency is expressed as a min-max problem and then the optimal parameters are derived numerically. Especially, for Case II the optimal system parameters can be analytically expressed by using the fixed-point theory. Numerical results show that the inerter-based passive vibration control configurations are more efficient than the traditional dynamic vibration absorber, especially for case with a small mass ratio. The inerter-based Case I is more efficient than the inerter-based Case II for a smaller mass ratio while contrary is true for a larger mass ratio. Also, the influences of the mass ratio and the inertance-to-mass ratio on the optimal system parameters are briefly discussed.

Keywords: Passive vibration control, Inerter, Beam-type structure, Frequency response function, Optimization