Accepted Manuscript

Nonlinear magnetic vibration absorber for passive control of a multi–storey structure

S. Lo Feudo, C. Touzé, J. Boisson, G. Cumunel

PII: S0022-460X(18)30586-8

DOI: 10.1016/j.jsv.2018.09.007

Reference: YJSVI 14357

To appear in: *Journal of Sound and Vibration*

Received Date: 13 April 2018

Revised Date: 25 July 2018

Accepted Date: 3 September 2018

Available online at www.sciencedirect.com
ScienceDirect
Journal of Sound and Vibration 00 (2018) 1–25
Journal of Sound and Vibration

Nonlinear magnetic vibration absorber for passive control of a multi–storey structure

S. Lo Feudo[a,b,*], C. Touzé[b], J. Boisson[b], G. Cumunel[c]

[a] *QUARTZ (EA7393), VAST, Supméca – ISMEP, Saint-Ouen, France*
[b] *IMSIA, ENSTA ParisTech-CNRS-EDF-CEA, Université Paris-Saclay, Palaiseau, France*
[c] *Université Paris-Est, Laboratoire Navier (UMR 8205), CNRS, ENPC, IFSTTAR, F-77455 Marne-la-Vallée, France*

Abstract

A nonlinear magnetic vibration absorber is presented and used to control vibration of a three–storey structure. A distinctive feature of the absorber concerns its versatility for tuning the linear and nonlinear stiffness coefficients, depending on simple geometric design parameters such as the distance between fixed magnets and the moving one. In particular, the absorber can be set either as a nonlinear tuned vibration absorber, a nonlinear energy sink, or a bistable tuned vibration absorber, according to whether the linear stiffness term is positive, vanishing, or negative. The response of the primary structure and the vibration mitigation are investigated in the cases of impulsive shock, free vibration with imposed initial displacement, and single frequency excitation. Significant reductions of the primary structure vibrations are obtained for the three cases investigated, showing the ability of using a vibration absorber only relying on magnetic forces for passive control. The detailed comparisons of the absorbers performance show that, in this case study, no general guidelines can be easily deduced for selecting one of the three tunings for a nonlinear absorber. Depending on the excitation, the vibratory levels, and the frequency content of the excitation, the three configurations show advantages and drawbacks that are discussed.

Keywords: Passive control, Nonlinear absorber, NES, Magnetic Vibration Absorber, vibration experiments

1. Introduction

In the civil engineering field, vibration control devices are ever more required to face dynamic excitation such as wind load and ground motion acceleration. Several studies and applications concern the Tuned Mass Damper (TMD), which consists in a linear device added to a primary structure and tuned to one resonant mode. Early studies were conducted in [1–3], and the main parameter optimisation criteria are based on the minimization either of the transfer function maximum or of the energy [4, 5], as well as on the pole location [6, 7]. The effectiveness of one or multiple TMD added on single or multi degree of freedom systems subjected to harmonic, random, and seismic excitations has been studied in [8–12]. Among the experimental devices, recent studies deal with TMD based on the eddy currents damping effect, [13–17].

The performance of the TMD is very effective in the case of linear systems and has been proven to be a very reliable passive mitigation device in a large number of contexts. However it is known to bear some

*Corresponding author
Email addresses: stefania.lofeudo@supmeca.fr (S. Lo Feudo), cyril.touze@ensta-paristech.fr (C. Touzé), jean.boisson@ensta-paristech.fr (J. Boisson), gwendal.cumunel@enpc.fr (G. Cumunel)