7th ECCOMAS Thematic Conference on Smart Structures and Materials
SMART 2015
A.L. Araújo, C.A. Mota Soares, et al. (Editors)

Abstract ID-126

ADAPTIVE INDUCTOR FOR VIBRATION DAMPING IN PRESENCE OF UNCERTAINTY

[1]Bilal Mokrani, [2]Ioan Burda, [1]Zhui Tian,[1] Andre Preumont

[1]Active Structures Laboratory, Université Libre de Bruxelles, Belgium
bilal.mokrani@ulb.ac.be ; zhui.tian@ulb.ac.be ; andre.preumont@ulb.ac.be

[2]Babes Bolyai University, Romania
ioan_burda@yahoo.com

Keywords: Oiezoelectric Shunt Damping, Rl Shunt, Non-Linear Shunt, Broadband Damping,

Summary: This paper considers two problems related to the RL shunt damping of vibration with a piezoelectric transducer.

The first problem is that of the variability of the natural frequency of the structure. The inductive shunt damping is notorious for not being robust when the natural frequency of the electrical circuit does not match the natural frequency of the structure. In the proposed implementation, the shunted piezoelectric transducer is supplemented with a small additional one (with open electrodes) measuring the mechanical extension X of the structure at the location of the transducer. The adaption strategy uses the property that, at resonance, the current i in the shunted transducer (i.e. the voltage drop in the resistor R) is in phase with X (i.e. the voltage in the transducer with open electrodes). A Phase Lock Loop (PLL) circuit is used to evaluate the phase shift between these two signals and to adapt the (synthetic) inductor L via a programmable digital potentiometer. The proposed strategy is supported by simulations and experimental results.

The second part of the paper explores the capability of the RL shunt with a variable inductor for damping several (closely space) modes of vibration. The variable inductor is obtained by combining a synthetic inductor and a variable (programmable) resistor. The strategy consists of sweeping continuously the electrical frequency of the RL shunt in the frequency band of the targeted modes. This variation of the electrical circuit parameters results in a parametric excitation of the electrical system, which may be destabilized under certain conditions (as described by the Mathieu equation). Numerical and experimental results are reported.