Uncertainty analysis of a smart periodic truss

Leandro Rodrigues Cunha[a], Morvan Ouisse, Domigos Alves Rade
DMA FEMTO-ST, ITA

a. leandro.rodrigues@femto-st.fr

Résumé : *Periodic structures have been intensively studied and many researchers are directing their works to this area due to their interesting properties like mechanical filter behavior for vibration and wave propagation. As uncertainties are intrinsic in every kind of mechanical system, one must be aware of possible vulnerabilities in these structures in order to assure minimal risk of failure and unsatisfactory attenuation performance. In this paper, one considers the finite element model of a tridimensional truss, some bars of which contain piezoelectric stack actuators connected to resonant (resistor-inductor) shunt circuits. The structure is composed of ten 3D cells and the inductance of the shunt circuit associated to each cell is considered as uncertain. Assuming these inductances as random variables with gamma probability distribution, determined by using the Principle of Maximum Entropy, some performance curves are inspected using Monte Carlo Simulation combined with Latin Hypercube Sampling. The goal is to evaluate the influence of uncertainties affecting this key property of the shunt circuits on the prediction of the band gaps. Finite structure methods are used to model this structure and the obtained results are evaluated and compared. For this consideration, the decay rate and borders of the band gap are analyzed based on frequency response curves. Also, the consequences of increasing the uncertainty level on the robustness of the periodic structure are evaluated.*

Mots-clés : Periodic structures, wave propagation, vibration control, smart structures, uncertainty analysis, reliability.