Integration of piezostacks as frequency dependent stiffness elements in load bearing structures

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ABSTRACT

In previous work [1] we have described the use of piezoelectric elements as means to obtain variable connectivity between the elements of a phononic crystal [2] by exploiting the frequency dependent stiffness of resonantly shunted piezoelectric elements. There, piezoelectric disks were intercalated between an aluminum plate and aluminum stubs and were used to effectively disconnect the stubs creating a phononic structure from the substrate. Given the function of the investigated object, no special structural requirements were set to the piezoelectric disks. Here, we present work related to the structural integration of piezoelectric elements in a load bearing structure. The goal of the integration is to exploit frequency dependent stiffness properties of resonantly shunted piezos to modify the stiffness matrix of a simple truss structure. In order to demonstrate the proposed approach, a ring-shaped piezo-stack is axially mounted into the diagonal strut of a square frame. In order to guarantee the function of the piezoelectric element under the expected load conditions, axial pre-compression needs to be applied. This contribution describes the design, implementation and initial investigation of the dynamic response of a variable connectivity truss structure.

REFERENCES

[1] Andrea Bergamini, Tommaso Delpero, Luca De Simoni, Luigi Di Lillo, Massimo Ruzzene, and Paolo Ermanni. Phononic crystal with adaptive connectivity. *Advanced Materials*, 26(9):1343–1347, 2014.

[2] Tsung-Tsong Wu, Zi-Gui Huang, Tzu-Chin Tsai, and Tzung-Chen Wu. Evidence of complete band gap and resonances in a plate with periodic stubbed surface. *Applied Physics Letters*, 93(11):111902, 2008.