Adaptive structure based on phononic crystals with embedded magnetic harvesters

R. Mech,[1] A. Łaszcz,[1] and J. Kaleta[1]

[1] *Wrocław University of Science and Technology, Department of Mechanics, Materials and Biomedical Engineering, Smoluchowskiego 25, 50-372, Wrocław, Poland*

Phononic crystal, referring to structures consisting of periodic arrays of acoustic or elastic inclusion in matrix system. Phononic crystal structure has potential applications in the design of acoustic filters, waveguides, vibration isolators and noise suppressors [1]. In this work authors developed construction with periodically distributed matrix, which work as phononic crystal structure.

In this structure magnetic harvesters were embedded. Harvesters that were used based on magneto-mechanical phenomena. It is assumed that even in the case of low power and efficiency, they can be a valuable source of power supply [2]. Theses devices can also be efficiently used in wireless energy and information transfer using ultrasonic vibration.

The work presents a method of both power and information transmission through pair of rails with phononic crystal structure using novel system developed by authors. The solution allows to (electrically) feed sensors located in hardly accessible places of mechanical constructions with simultaneous half-duplex data transmission (e.g. measurement "question-response"), when conventional power supply (requiring e.g. electricity networks, storage batteries, batteries, etc.) is eliminated. The mechanism of power transmission consists in "sending" of mechanical energy through an actuator in a form of "pure" sinusoidal ultrasonic wave and next "receiving" it and transforming into useful electrical current by harvester with reverse magnetostriction induced by the mechanical resonance. To optimise transmission (the highest possible efficiency and acceptably low noise level), a properly designed phononic crystal matrix as well as software allowing to select the right type of an actuator, modulation and the recommended frequency band was developed. Additionally it is possible to determine resonance frequency for each construction which is to be used for information and power transfer.

References:

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