ON THE ENGINEERING IMPLICATIONS OF SEISMIC METAMATERIALS: TECHNICAL REQUIREMENTS AND PRACTICAL CHALLENGES

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Abstract

This presentation will initiate with an overview of the state-of-the-art in seismic metamaterials, incorporating direct references on the identified challenges towards their engineering. The latter set includes the filtering effects of superimposed waves, space requirements, minimum intervention and ecological footprint, the integration of seismic metamaterials into the earthquake risk assessment process, as well as the conservatism of the market and the compliance to standards. We then present a feasibility study on earthquake attenuation in the [0.5 5] Hz band, relying on adoption of a preliminary unit cell design investigated under numerical simulations of both 1D and 2D wave propagation [1]. In achieving a feasible and efficient design, we attempt to optimize seismic rainbow traps, ensuring a wider stop-band which aligns with the targeted response spectrum range. Finally, the design problem is reexamined in the form of an uncertainty and reliability investigation, and a robust-to-uncertainties optimization of seismic metastructures is carried out.

[1] Dertimanis, V.K., Antoniadis, I.A., Chatzi, E.N. (2016). “Feasibility analysis on the attenuation of strong ground motions using finite periodic lattices of mass-in-mass barriers”, Journal of Engineering Mechanics, 142(9), 10.1061/(ASCE)EM.1943-7889.0001120, 04016060.

[2] Wagner, P.R., Dertimanis, V., Chatzi, E., Antoniadis, I., “Design of metamaterials for seismic isolation”, IMAC-XXXIV, 25-28 January 2016, Orlando, United States.