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PHONONIC BAND-GAP MATERIALS DESIGN BY MEANS OF TOPOLOGY OPTIMIZATION

Rolando Yera[a], Carlos G. Méndez[a] and Alfredo E. Huespe[a,b]

[a]*CIMEC-UNL-CONICET, Predio Conicet "Dr Alberto Cassano", CP 3000 Santa Fe, Argentina*

[b]*E.T.S d'Enginyers de Camins, Canals i Ports, Technical University of Catalonia (Barcelona Tech) Nord UPC, Mòdul C-1, c/ Jordi Girona 1-3, 08034, Barcelona, Spain*

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Abstract. Phononic materials can exhibit phononic band gaps that prevent the propagation of elastic waves within certain frequency range, for this reason they may be used to create frequency filters, as vibration or sound protection devices, as waveguides, or as beam spliters. In the present work, we show a topology optimization tool for the design of biphasic periodic materials exhibiting phononic band gaps. We optimize two dimensional infinitely periodic band-gap materials by maximizing the relative width between two adjacent frequency bands making the range of prohibited frequencies wider. The finite element analysis is implemented using the Floquet-Bloch wave theory for solving the dynamic behavior of two-dimensional unit cells. The topology optimization problem is solved using a density approach, the SIMP (Simplified Isotropic Material with Penalization) interpolation (M.P. Bendsoe, Struct Optim 1:193-202 (1989)) which establishes the relation between the density design variable and the material property as a power law. The nested and Simultaneus Analysis and Design (SAND) formulations for the optimization problem are discussed.