6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

COMPUTATIONAL MULTISCALE DESIGN OF ENGINEERING METAMATERIALS. APPLICATION TO ACOUSTIC INSULATION PANELS

D. Roca[2], D. Yago[2], J.C. Cante[1,2], Oriol Lloberas-Valls[2], and J. Oliver[1,2]

[1] Technical University of Catalonia (Barcelona/Tech)
[2] International Center for Numerical Methods in Engineering (CIMNE)
oliver@cimne.upc.edu, http://oliver.rmee.upc.edu/xo

Key Words: *Multiscale analysis, Computational design, Topology optimization, Acoustic metamaterials.*

In recent years, there has been a growing interest among the scientific and technological communities in the concept of acoustic metamaterials. In particular, the so called Locally Resonant Acoustic Metamaterials (LRAM), are capable of stopping acoustic waves from propagating in frequency regions in the vicinity of their internal natural frequencies. This enables the design of a new kind of lightweight acoustic insulation panels with the ability to attenuate noises in the low frequency range (below 5000 Hz) without the need of large pieces of very dense materials. In this regard, a design procedure based on the computational multiscale homogenization framework proposed in [1] in conjunction with currently available topology optimization techniques has been proposed. This procedure starts by selecting a set of frequencies for which an optimized topology is obtained, the relevant natural frequencies of which fit with the targeted ones. Then, through the incorporation of viscoelastic effects in the model proposed in [1], which manages to merge the attenuation bands associated to the multiple resonating frequencies into an extended larger range, we are able to evaluate the performance of an acoustic panel with the proposed LRAM design in terms of transmission loss. Several examples have been computed not only by employing topology optimized designs, which may impose an additional challenge for the practical industrialization of such devices, but also with simplified sandwich-type configurations that are easier to implement with current manufacture technologies.

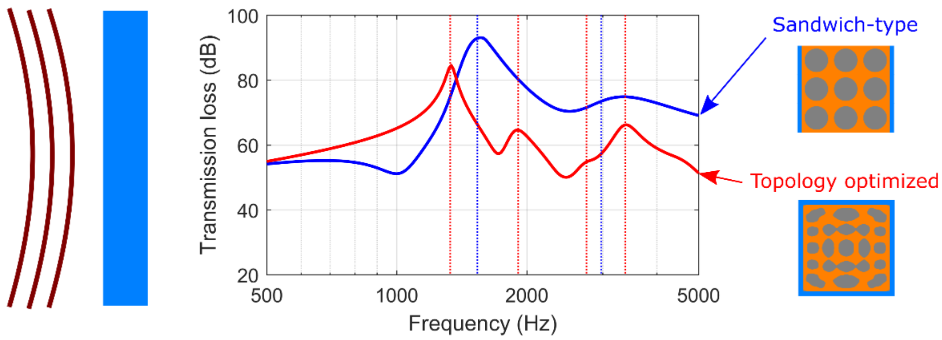

Figure 1. Proposed designs for a LRAM panel for acoustic insulation.

REFERENCES

[1] D. Roca, O. Lloberas-Valls, J. Cante, J. Oliver. A computational multiscale homogenization framework accounting for inertial effects: application to acoustic metamaterials modelling. *Comput. Methods Appl. Mech. Engrg.* (2017)