# A benchmark study on the configuration of metaporoelastic interfaces for acoustic isolation enhancement.

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**Abstract**

Porous materials such as foams are commonly used to improve acoustic isolation due to their high viscothermal loss properties. However, they suffer from a lack of absorption at low frequencies compared to their efficiency at higher ones. While multi-layering approaches allow reducing the impedance mismatch at the air-material interface, they rapidly have to face size issues as their performance relies on the allowable thickness. Hence, metaporous surfaces/interfaces have been proposed by incorporating periodic resonant elements inside the porous layer to trap the sound energy inside the system at lower frequencies and to modify its attenuation properties [1]. In particular, split rings and Helmholtz resonators have proved to achieve perfect and/or wide band absorption under specific conditions [2]. More recent works have focused on the inertial regime of the porous material by accounting for the relative motion of its skeleton and embedding purely elastic inclusions [3], whose resonances may occur at lower frequencies than acoustic ones.

This paper proposes a benchmark study to investigate the acoustic isolation properties of a poroelastic layer, possibly coated by thin elastic plates, in both reflection and transmission problems. Different types of inclusions are considered, namely: rigid or full poroelastic ones, elastic thin shells filled with air, poroelastic/steel spring-mass resonators. A parametric study is performed to derive the influence of the associated design parameters on the acoustic isolation properties and to provide general design trends. Furthermore, these different configurations are used as test cases to compare a dedicated semi-analytical approach to an in-house code based on finite elements [4], thus cross-validating both methods and underlining some benefits and limitations.

J.-P. Groby, O. Dazel, A. Duclos, L. Boeckx, and L. Kelders, "Enhancing the absorption

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coefficient of a backed rigid frame porous layer by embedding circular periodic inclusions", J. Acoust. Soc. Am., 130, 3771–3780 (2011).

J.-P. Groby, C. Lagarrigue, B. Brouard, O. Dazel, V. Tournat, and B. Nennig, "Enhancing the absorption properties of acoustic porous plates by periodically embedding Helmholtz resonators", J. Acoust. Soc. Am., 137(1), 273–280 (2015).

T. Weisser, J.-P. Groby, O. Dazel, F. Gaultier, E. Deckers, S. Futatsugi and L. Monteiro, "Acoustic behavior of a rigidly backed poroelastic layer with periodic resonant inclusions by a multiple scattering approach", J. Acoust. Soc. Am. 139(2), 617–629 (2016).

M. Gaborit, L. Schwan, O. Dazel, J.-P. Groby, T. Weisser and P. Göransson, "Coupling FEM, Bloch waves and TMM in meta poroelastic plates", Acta Acust *united* Ac., 104, 220-227 (2018).