Metaporo-elastic structures for subwavelength sound and elastic energy absorption/isolation

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Metaporous structures, as previously developed [1,2,3], consist in combining viscothermal losses inherent to porous materials with resonant phenomena arising from the periodic arrangement of resonant inclusions as well as from the structure of the rigid backing. These structures were optimized considering rigid frame porous materials, i.e., the skeleton of the porous material was considered motionless, giving rise to almost perfect absorption over a wide frequency band and for wavelength larger than 20 times the thickness of the materials. In a recent work [4], the possible motion of the skeleton was accounted for, therefore enabling the use of elastic resonant inclusions [5] and extending the application field of these materials to elastic energy damping. The goal of the present PhD is to answer the following questions:

(i) How to optimally excite the Lamb modes in this type of structures?
(ii) How to optimally combine acoustic and elastic resonators embedded in a poroelastic matrix for sound and elastic energy absorption/insolation?
(iii) How to optimally excite the skeleton and therefore the elastic resonators?
(iv) How to optimize the elastic energy dissipation mechanisms?

Samples with enhanced acoustic and elastic properties will be designed by answering these questions, manufactured and experimentally validated. In particular, the critical coupling condition [6] will be extended to periodic structures.
The candidate should possess strong background in physics (more specifically physical acoustics) and should be motivated by both experiments and theory. He/she will have the possibility to benefit from research exchanges with a number of international laboratories, in particular european partners of the DENORMS Action (CA-15125).

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[2] J.-P. Groby, B. Nennig, C. Lagarrigue, B. Brouard, O. Dazel, et V. Tournat, *Enhancing the absorption properties of acoustic porous plates by periodically embedding Helmholtz resonators*, J. Acoust. Soc. Am., **137**: 273-280, 2015

[3] C. Lagarrigue, J.-P. Groby, V. Tournat, et O. Dazel, *Design of metaporous supercells by genetic algorithm for absorption optimization on a wide frequency band*, Appl. Acoust., **102**: 49-54, 2016

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[5] V. Romero-García, A. Krynkin, L. M. García Raffi, O. Umnova, and J. V. Sánchez Pérez. *Multi-resonant scatterers in sonic crystals: Locally multi-resonant acoustic metamaterial*, J. Sound Vib., **332**: 184 – 198, 2013.

[6] V. Romero-García, G. Theocharis, O. Richoux and V. Pagneux, *Use of complex frequency plane to design broadband and sub-wavelength absorbers*, J. Acoust. Soc. Am., 139, 3395, 2016.