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EXPLORING MULTI-FUNCTIONALITY IN PORO-ELASTIC MATERIALS WITH CONSIDERATION GIVEN TO SOME ASPECTS RELATED TO THE INFLUENCE OF SCALE, SHAPE AND SPACE.

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The parameters available for design of multi-functional, poro-elastic materials (or combinations thereof in a multilayer arrangement), opens up for tailoring and tuning to provide acoustic and vibrational damping performance at, as an example, low weight. To balance a set of functional requirements, the attributions of global performance to the underlying physical phenomena need to be established. These may conveniently be defined in terms of multi-physics models incorporating:

- elastic properties (i.e. stiffness controlled by solid material, topology, geometry, interfaces),
- viscoelastic properties (i.e. dissipation controlled by solid material, geometry),
- acoustic properties (given by the fluid medium) and
- viscoacoustic properties (i.e. dissipation controlled through geometry, topology, interfaces).

Each contribute to the dynamic behaviour observed on a macro-scopic scale, linking the transport of energy through the sound pressure waves propagating through the fluid in the pores to the elastic stress waves carried through the solid frame of the material. For a given situation, the balance between energy dissipated through vibration of the solid frame, changes in the acoustic pressure and the coupling between the waves varies with the topological arrangement, choice of material properties, interfacial conditions, etc. An example of a multi-functional panel obtained through topology, sizing and property optimization against structural and acoustical constraints is shown in Figure 1.

This contribution will discuss some aspects of multi-functionality illustrated through

numerical experiments involving Finite Element (FE) simulations and material modelling, where the influences of scale (e.g. micro-structural dimensions), shape (e.g. cell geometry) and space (e.g. topology) are illustrated in terms of efficiency and importance.

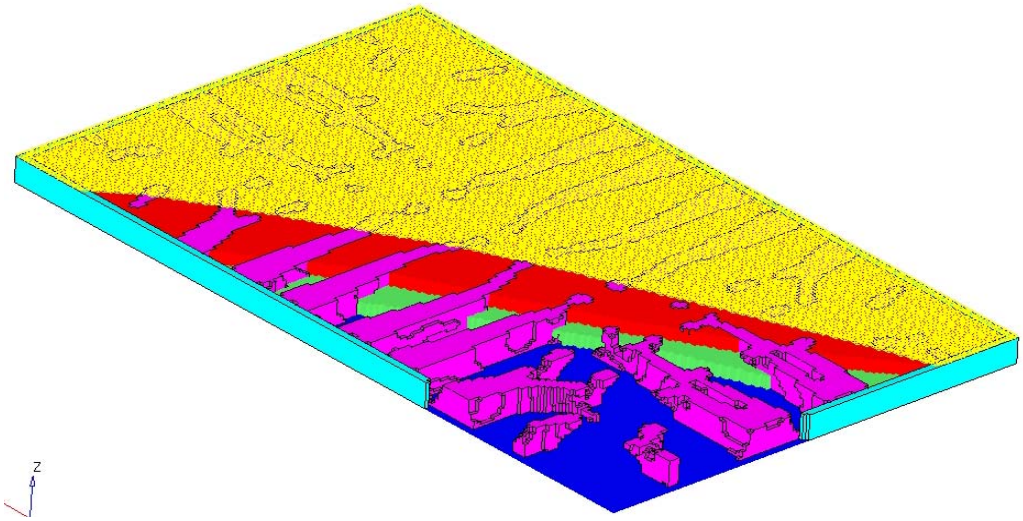

Figure 1. Multi-functional panel meeting structural and acoustical constraints, [1, 2].

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