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# Topology Optimization of Multilayered Acoustic-Poroelastic-Elastic Structures for Sound Attenuation

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Multilayered structures for sound attenuation have been explored in many scenarios, ranging from civil construction to automotive and aerospace industries. However, the proper multiphysics interactions comprised by acoustic-poroelastic-elastic structures are still challenging, especially when topology optimization techniques are involved. This work entails a new topology optimization methodology based on the Bi-directional Evolutionary Structural Optimization (BESO) approach to design bidimensional multilayered structures for sound absorption enhancements. The full modeling of poroelastic bodies is done by the mixed **u**/p technique, while the elastic and acoustic (air) materials are obtained by the degeneration of the latter, leading to the well-known elasto-dynamic and Helmholtz formulations, respectively. Such procedure is done in a systematic manner by the combination of the Finite Element Method (FEM) with the Unified Multi-Phase (UMP) modeling method, which in turn contributes to the development of material interpolation schemes suited for the application. In this scenario, the topology optimization problem is established as the maximization of the sound absorption coefficient, as composed by the summation of the time-averaged power dissipated through structural damping together with its corresponding viscous and thermal dissipative components. The numerical examples show the effectiveness of the proposed methodology, since it provides well-defined topologies with generally enhanced sound attenuation performances.