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Investigation of the limp model validity for porous materials

Olivier Doutres, Nicolas Dauchez, Jean Michel Genevaux and Olivier Dazel
Laboratoire d'Acoustique de l'Université du Maine, Avenue Olivier Messiaen, 72085 Le Mans, France

A new criterion to test the validity of using the limp model for porous materials is proposed. The limp model is derived from the poroelastic Biot model assuming that the frame has no bulk stiffness. Being an equivalent fluid model accounting for the motion of the frame, it has fewer limitations than the usual equivalent fluid model assuming a rigid frame. A criterion is derived to identify the porous materials for which the limp model can be used. This criterion relies on a new parameter, the Frame Stiffness Influence (FSI) based on porous material properties. The critical values of FSI under which the limp model can be used, are determined using a 1D analytical modeling for three boundary sets: absorption of a porous layer backed by a rigid wall , radiation of a vibrating plate covered by a porous layer and transmission loss of a double leaf panel filled in by a porous layer. Compared with other criteria, the criterion associated with FSI provides information in a wider frequency range and can be used for configurations which include vibrating plates.