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Analytical microstructural model for acoustical porous materials with single or double porosity

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An analytical model of sound propagation for porous materials with single or double scale of porosity is described. For each scale, pores and interconnections between them are modelled by a serie of two cylinders; a cylindrical periodical cell is thus considered. Scales are supposed to be separated, the porous medium is supposed to be periodic and to have a motionless skeleton. The geometrical parameters needed to quantify visco-thermal effects are directly related to the microstructure of the material. These parameters: lengths and radii of pores and interconnections can be extracted from image analysis for example. From additional conditions on cell morphology, independent parameters per porosity scale can be reduced to a number of three. Good comparisons between theoretical calculations of the sound absorption coefficient at normal incidence and impedance tube measurements are obtained for single and double porosity (meso-perforated) materials.