Sound absorption by perforated walls along boundaries

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Asymptotic analysis of multiscale models with periodically heterogeneous coefficients became possible with the development of the method of homogenization in the 1970s. If the periodicity length is small compared to the size of the sample of the medium it turns out that the original equation is approximated well by an effective model with constant coefficients.

In this talk our interest lies in the mathematical analysis of a sound absorbing perforated plate, e.g. along the wall or ceiling of a room. To this end we analyze the Helmholtz equation in a complex domain where a sound absorbing structure at a part of the boundary is modelled by a periodic geometry with periodicity $\varepsilon > 0$. A resonator volume of thickness ε is connected with thin channels (opening ε^3) with the main part of the macroscopic domain. We analyze solutions in the limit $\varepsilon \to 0$ to find that while the lowest order approximation is trivial the effective system at order ε indeed describes sound absorption.