# Multiscale modeling of acoustic shielding materials

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# Multiscale modeling of acoustic shielding materials

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Enabling new technology

## Background

High-tech systems must be protected from acoustic excitations while operating in a noisy environment. Acoustic foams can improve the performance depending on the interaction of the acoustic wave and the microstructure of the foam.

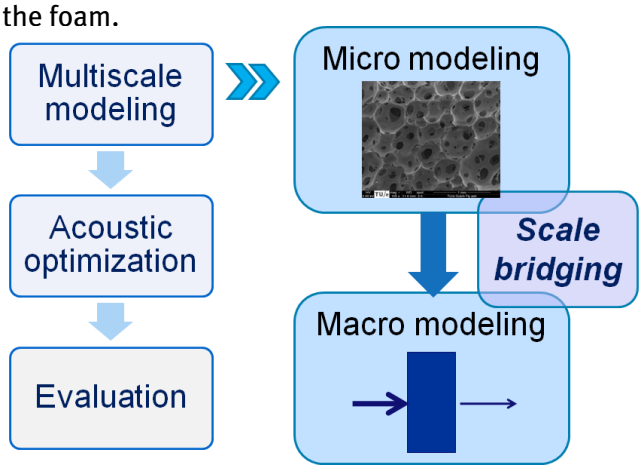


*Figure 1: The plan of this project and the current work focusing on the scale bridging technique.*

## Approach

Macroscopic sound propagation in a porous medium can be described by Biot's isotropic poroelastic equations involving microstructure-dependent parameters. Starting from the microscopic governing equations of a representative volume element (RVE), these Biot's parameters can be obtained based on the homogenization approach as shown in Figure 2.

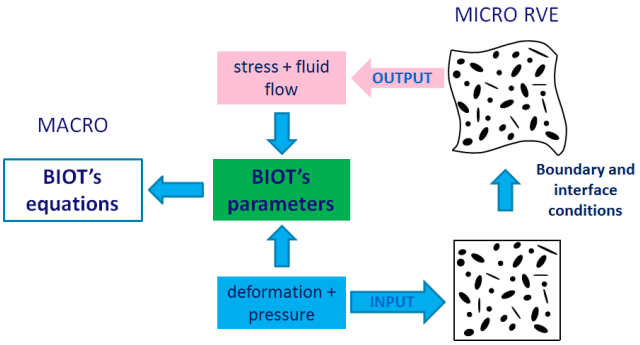


*Figure 2: Homogenization approach to determine Biot's parameters.*

## Simulation

A 3D cubic is simulated with given macroscopic solid deformation and fluid pressure gradient. The output Biot's parameters are used in a macroscopic transmission loss simulation as shown in Figure 3.

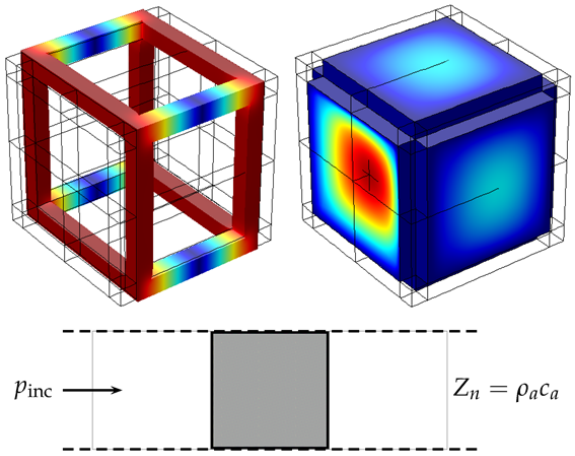


*Figure 3: 3D cubic RVE with the deformable solid skeleton (the left graph) and the air (the right graph). The bottom graph illustrates the macroscopic transmission loss simulation.*

The homogenization result is compared with a semi-phenomenological model. Besides, a direct numerical simulation (DNS) is used for reference. It shows that the performance of the homogenization approach is better.

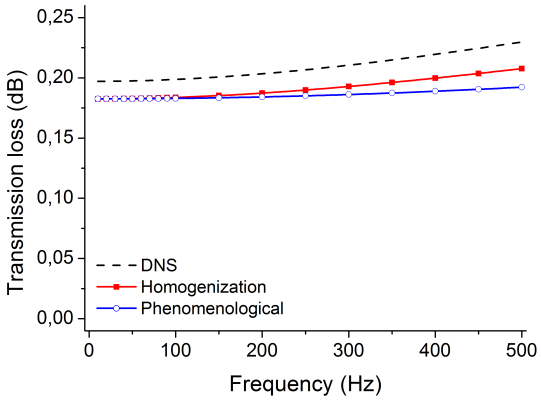


*Figure 4: Comparison of transmission losses in different models.*

## Conclusions & future work

The homogenization approach gives a better performance for Biot's equations. Further work is to include microscopic thermal effects and consider realistic microstructures.