

Multiscale modeling of acoustic shielding materials

Citation for published version (APA):

Gao, K., Dommelen, van, J. A. W., & Geers, M. G. D. (2013). *Multiscale modeling of acoustic shielding materials*. Poster session presented at Mate Poster Award 2013 : 18th Annual Poster Contest, .

Document status and date:

Published: 01/01/2013

Document Version:

Accepted manuscript including changes made at the peer-review stage

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

Multiscale modeling of acoustic shielding materials

K. Gao, J.A.W. van Dommelen, M.G.D. Geers



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.

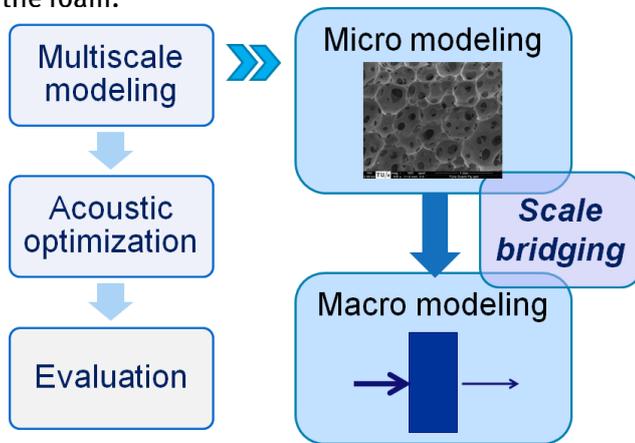


Figure 1: The plan of this project and the current work focusing on the scale bridging technique.

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.

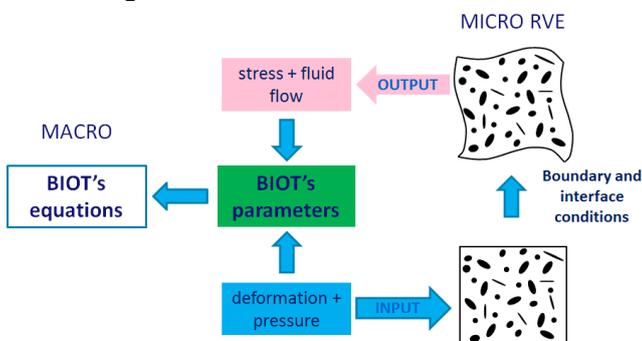


Figure 2: Homogenization approach to determine Biot's parameters.

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.

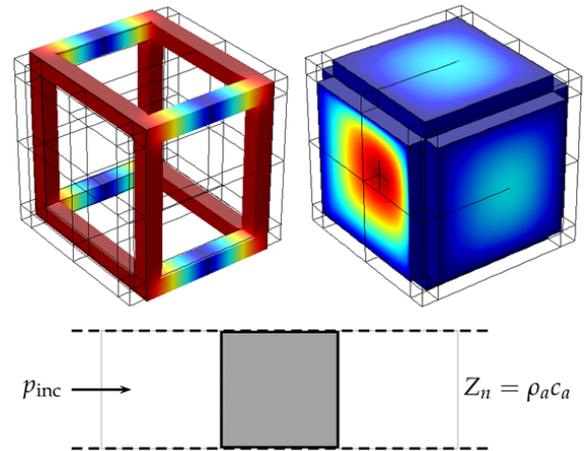


Figure 3: 3D cubic RVE with the deformable solid skeleton (the left graph) and the air (the right graph). The bottom graph illustrates the macroscopic transmission loss simulation.

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.

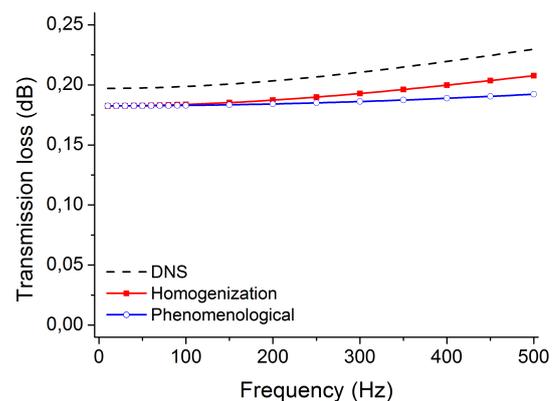


Figure 4: Comparison of transmission losses in different models.

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.