

Development of a new method for the in-situ measurement of sound absorption



E.R. Kuipers, Y.H. Wijnant and A. de Boer

Institute of Mechanics, Processing and Control
Chair of Structural Dynamics and Acoustics, University of Twente
P.O. Box 217, 7500 AE Enschede, The Netherlands
tel: +31 53 489 56 18, e-mail: e.r.kuipers@utwente.nl

UNIVERSITY OF TWENTE.



Introduction

Material samples are required when applying standard techniques to determine the sound absorption characteristics. Alternatively, in-situ methods can be applied. However, many methods do not yield satisfactory results in arbitrary environments. In this research project we are developing an in-situ method that is based on the direct measurement of the active sound intensity and the incident sound intensity.

Theory

A new quantity called the total intensity can be derived from the acoustic energy density, assuming local plane wave behavior. Knowing the active sound intensity as well, the incident and reflected intensities can be determined. By dividing the active intensity by the incident intensity, the absorption coefficient is obtained.

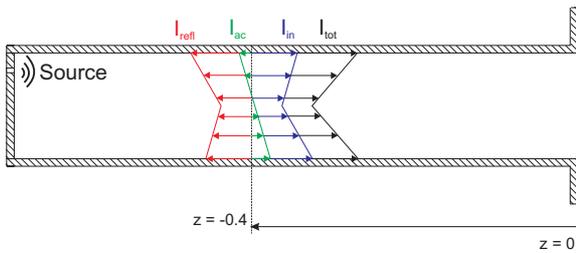


Figure 1 : Duct with cross-section intensity distributions

For the duct shown in figure 1, the spatially averaged incident- and active intensities are obtained by scanning the duct at different cross-section levels.

Experimental results

The new method has been validated by measuring the absorption coefficient of the open end of a large duct. The left end of the tube is terminated by a rigid plate that contains a small hole to enable acoustic excitation, see figure 2. The figure illustrates the first non-axial acoustic mode at 1000 Hz.

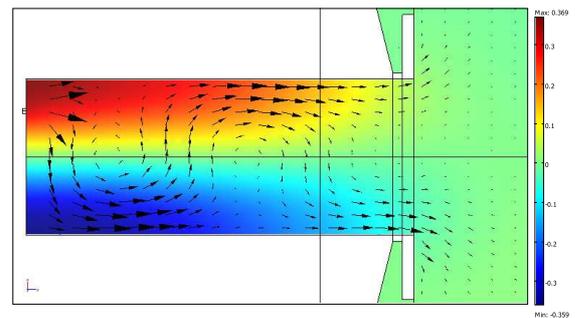


Figure 2 : Duct sound field at 1000 Hz;
Arrows: active intensity, color: sound pressure

The absorption curves obtained by simulation and experiment, shown in figure 3, clearly show a dip at 1000 Hz, as predicted by the theory. Furthermore, the experimental results are in close agreement with those obtained by simulation.

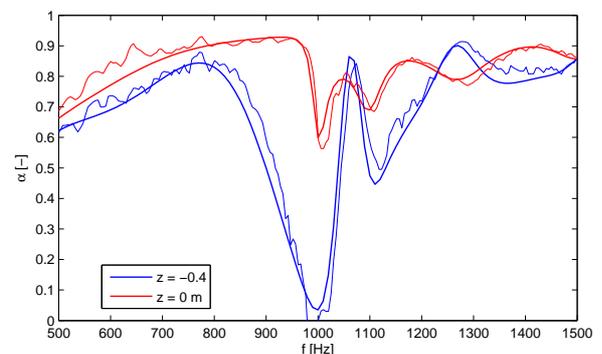


Figure 3 : Sound absorption coefficient
Thick curves: simulation, thin curves: measurement

Conclusions and future work

The newly developed absorption measurement method was validated by a simulation model and an experiment. It is concluded that this method offers potential for application with respect to sound absorption. In the near future, application of this method in rooms will be investigated.