CFA/VISHNO 2016

Characterization of a porous plate saturated by water

M. Niskanen[a], A. Duclos[a], T. Lähivaara[b], O. Dazel[a], J.-P. Groby[a] et T. Huttunen[b]

[a]Laboratoire d'Acoustique de l'Université du Maine, Avenue Olivier Messiaen, Cedex9, 72085 Le Mans, France

[b]University of Eastern Finland, Department of Applied Physics, Postal Box 1627, 70211 Kuopio, Finlande

matti.niskanen@univ-lemans.fr

CFA2016/290
Characterization of a porous plate saturated by water

M. Niskanen[a], A. Duclos[a], T. Lähivaara[b], O. Dazel[a], J.-P. Groby[a] et T. Huttunen[b]
[a]Laboratoire d'Acoustique de l'Université du Maine, Avenue Olivier Messiaen, Cedex9, 72085 Le Mans, France
[b]University of Eastern Finland, Department of Applied Physics, Postal Box 1627, 70211 Kuopio, Finlande
matti.niskanen@univ-lemans.fr

In this work the aim is to estimate the properties of a porous plate saturated by water. This is done by measuring the plate's reflection and transmission coefficients $z = [R\ T]^{\mathrm{T}}$ and solving the inverse problem $z = h(\theta,v)$, where θ contains the parameters of interest and v is noise. The forward problem of solving z given θ, the acoustic and elastic properties of the plate, is modelled using the alternative 1962 formulation of the Biot's theory. The wave equations derived from the formulation are solved numerically using the state vector formalism.
The measurements are done with the plate submerged in a water tank so that it is completely saturated with the fluid. For now, to excite just the slow and longitudinal fast waves, only normal incidence is considered. Transmission coefficient is measured by recording first a reference signal with two transducers opposite to each other, and then doing another measurement with the plate in between them. The measurement with the plate is divided by the reference measurement in Fourier domain. Reflection coefficient is measured similarly by dividing the reflected field by the reference signal. For these measurements, only one transducer operating in a pulse-echo mode is needed. The reference signal is measured from a water-air -interface.
In this work, the inverse problem is solved in the Bayesian framework which is well-suited to handling measurement and model uncertainties. All the unknown quantities are modeled as random variables. Furthermore, the prior models can be formulated so that they carry information of the target. Preliminary results will be shown to investigate the feasibility of the Bayesian framework for the characterization of porous materials.