Acoustic characterization of a viscoelastic medium

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Although widely used for example in medical imaging, there are only few quantitative measurement methods exist for shear waves. The necessary addi- tion of a highly viscous fluid coupling material to transmit shear waves from a source in a solid medium makes difficult to perform absolute measurements. This requires on one hand to perform a coupling in a reproducible manner, and on the other hand to characterize the rheological properties of the coupling material. For this purpose, we set up an experiment to measure reflection and trans- mission coefficients of a coupling material layer. Reversible transducer devices associated with two delay lines enables the echoes of an incident pulse to be separated and analyzed in order to measure these coefficients. The thickness of the layer is controlled by multiple slip gauges in a reproducible manner. The analysis of the signals and the reflection coefficient as a function of the frequency provides a very sensitive characterization of the properties of the medium. In particular, a large thickness gives rise to interference phenomena whose frequency signature reveals the attenuation of the medium. The com- mercial shear wave couplant (SWC-2) by Olympus has been characterized using this method. Zener's viscoelastic model allows to fit the experimental data and provides a measure of relaxation time for this fluid. We performed measure- ments with shear waves as well as longitudinal waves for a full characterization of the viscoelastic properties of the couplant.