Experimental Study of Probe-Sample Contact Influence on Dispersion Curve Measurement with Phased Arrays in Plates

Aurélien Baelde, François Bruno, Jérome Laurent, Claire Prada, Institut Langevin, Ondes et Images, ESPCI, Université Paris 7, CNRS UMR 7587, 1, rue Jussieu, 75231 Paris Cedex 05, France

Dispersion curves of guided modes in plate-like structure are used to investigate elastic properties. Laser based ultrasound are conventional contactless techniques to acquire dispersion curves. Measurements are broadband and quite sensitive but time consuming. Linear transducer arrays in contact with the sample can also be used to generate and measure guided modes in plate. Measurements are limited by the probe’s bandwidth to few MHz but are really fast. An array response matrix is used to improve the signal processing with a singular value decomposition (SVD) filtering and plane wave subspace projection [1]. A contact gel is used to allow the ultrasound transmission from the transducers to the sample, which may lead to some issues. Indeed, the contact modifies the stress boundary conditions on the sample. Simulations are performed to observe the dispersion curves variations induced by the contact. Modifications are showed to occur mainly around points where group velocity vanishes. Experiments are conducted in aluminum-epoxy-aluminum tri-layer structures. Some new features on SVD techniques are performed on phased array measurements to provide the dispersion curves. Comparison with laser based ultrasound measurements shows good agreement between the two techniques into the shared bandwidth. These results show that linear transducer array provides reliable and precise dispersion curves in a very fast manner.

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References