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Methods of localization of Lamb wave sources on thin plates

Semih Turkaya (1), Renaud Toussaint (1), Fredrik Kvalheim Eriksen (1,2), Guillaume Daniel (3), Eirik Grude Flekkøy (2), and Knut Jørgen Måløy (2)

(1) Institut de Physique du Globe de Strasbourg, CNRS, UMR 7516, Université de Strasbourg, 5 rue Descartes, 67084 Strasbourg Cedex, France (turkaya@unistra.fr), (2) Department of Physics, University of Oslo, P. 0. Box 1048, 0316 Oslo, Norway, (3) Magnitude, Route de Marseille 04220 Sainte Tulle, France

Signal localization techniques are ubiquitous in both industry and academic communities. We propose a new localization method on plates which is based on energy amplitude attenuation and inverted source amplitude comparison. This inversion is tested on synthetic data using Lamb wave propagation direct model and on experimental dataset (recorded with 4 Brüel & Kjær Type 4374 miniature piezoelectric shock accelerometers (1-26 kHz frequency range)). We compare the performance of the technique to the classical source localization algorithms, arrival time localization, time reversal localization, localization based on energy amplitude.

Furthermore, we measure and compare the accuracy of these techniques as function of sampling rate, dynamic range, geometry, Signal to Noise Ratio, and we show that this very versatile technique works better than classical ones over the sampling rates 100kHz - 1MHz. Experimental phase consists of a glass plate having dimensions of 80cmx40cm with a thickness of 1cm. Generated signals due to a wooden hammer hit or a steel ball hit are captured by sensors placed on the plate on different locations with the mentioned sensors.

Numerical simulations are done using dispersive far field approximation of plate waves. Signals are generated using a hertzian loading over the plate. Using imaginary sources outside the plate boundaries the effect of reflections is also included.

This proposed method, can be modified to be implemented on 3d environments, monitor industrial activities (e.g boreholes drilling/production activities) or natural brittle systems (e.g earthquakes, volcanoes, avalanches).