

Time Reversal methods in Acousto-Elastodynamics

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ABSTRACT

In this talk, we will present a method to solve an inverse problem in order to determine the presence and some properties of an elastic “inclusion” (an unknown object, characterized by elastic properties discriminant from the surrounding medium) from partial observations of acoustic waves, scattered by the inclusion. The method will require developing techniques based on Time Reversal methods.

Time Reversal (TR), introduced by M.Fink [1] is a subject of very active research. The principle is to take advantage of the reversibility of wave propagation phenomena, for example in acoustics, elastic or electromagnetism in an unknown medium, to back-propagate signals to the sources that emitted them.

In a previous paper [2], we introduced a time-reversed method for acoustic equation. In this talk, a finite element numerical method based on acousto-elastodynamics equations will be derived and used to solve the inverse problem. Our approach will be applied to configurations modelling breast cancer detection, using simulated ultrasound waves.

We will present the original method we have developed and introduce it with some numerical results that illustrate the feasibility of the algorithm in a heterogeneous fluid-solid medium (breast tissue with skin), using only partial information, that is pressure recorded data in the fluid part. An illustration of such a result is given in Figure 1.



Figure 1: RTM of Y component in case of a medium that mimics breast tissue with a skin part and 2 tumors, one benign and one malignant

REFERENCES

- [1] Fink, M., Wu, F., Cassereau, D. and Mallart, R. Imaging through inhomogeneous media using time reversal mirrors. *Ultrasonic Imaging* (1991), **13-2**: 179–199.
- [2] Assous, F., Kray, M. and Nataf, F. Time-reversed absorbing conditions in the partial aperture case. *Wave Motion* (2012), **49**: 617–631.