Labex MEC "Mechanics And Complexity"

Post-Doctoral position offer

Duration: 1 year Period: 1 January 2018 - 31 December 2018

Location: Marseille, France. Laboratoire de Mécanique et d'Acoustique

Gross salary: from 2423 € to 2843 €/ month, depending on qualification and experience

Research project and job description

Title: *Inversion in nonlinear elastodynamics: application to the imaging of damaged media*

Summary:

The propagation of waves in damaged solids (concrete, rocks, etc.) involves nonlinear phenomena, even for very weak stresses [3]. These effects are manifested both by wave distortion, by the generation of harmonics, and by a variation in the propagation speed of waves at a long time scale. A thermodynamically admissible model has recently been proposed [2]. Numerical methods for simulating wave propagation in such media are being developed and are implemented in the PROSPERO propagation code (http://prospero-software.science). .

The proposed research project consists of studying the inverse problem of parameter identification: quantifying the nonlinear properties of the propagation medium from elastodynamic data measured at the boundary of the domain. To do this, Full Waveform Inversion is a widely used approach in the linear framework for seismic imaging and non-destructive testing [1,4] via the implementation of optimization methods. These approaches are based on the minimization of a cost function that quantifies the difference between real and simulated data. The extension of these algorithms to nonlinear behaviors raises questions about the computation of the gradient of the cost function, which is based classically on the construction of an adjoint state. This approach must be revisited in the case of nonlinear elastodynamics. The objective is to extend these methods to the propagation of nonlinear elastic waves, drawing on the work done in fluid mechanics, notably on the Navier-Stokes equation.

[1] C. Bellis, S. Imperiale, "Reciprocity identities for quasi-static piezoelectric transducer models: Application to cavity identification using iterated excitations and a topological sensitivity approach", Wave Motion 51-1 (2014), 125-145.
[2] H. Berjamin, N. Favrie, B. Lombard, G. Chiavassa, "Nonlinear waves in solids with slow dynamics: an internal variable model", Proceedings Royal Society London A 473 (2017) 20170024.
[3] R.A. Guyer, P.A. Johnson, "Nonlinear mesoscopic elasticity: Evidence for a new class of materials", Phys. Today 52 (1999), 30-36.
[4J. Tromp, C. Tape, Q. Liu, "Seismic tomography, adjoint methods, time reversal and banana-doughnut kernels, Geophys. J. Int. 160 (2005), 195-216.

Job description:

The work will address the theoretical and numerical aspects of the problem (implementation in PROSPERO). The work will take place at the Laboratory of Mechanics and Acoustics (LMA) and will be supervised by

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Requirements:

The fields of expertise of the candidate should include applied mathematics. The doctoral thesis must have been defended before the start of the contract.

Desired skills:

Skills in theoretical mechanics would be appreciated. Research interests of the candidate must be oriented towards the described applications (seismology, nondestructive evaluation)

Labex team Axe, action, volet : axe 2, actions 2-1, 2-2 et 2-3

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How to apply

Send an application including:

- A detailed CV with a list of publications
- A cover letter
- A list of scientific personalities able to comment on the application

to both these addresses:

Relevant group leader (lombard@lma.cnrs-mrs.fr)

Labex management (LabexConseilCoordination@irphe.univ-mrs.fr)