ÉCOLE DOCTORALE SCIENCES DE LA TERRE

Subject offered for a contract starting in October 2013

SUBJECT TITTLE: ***3D anisotropic joint inversion of refracted and reflected traveltime data based on an adjoint-state method:***

Advisor: **Mark NOBLE**
Second Advisor/ Supervisor:
Host lab/ Team : **GPX team**

Financing: GPX/IPGP/Industry

For more information go to http://ed109.ipgp.fr, section: Offres de these (PhD offer), You must apply on the Doctoral School website

First arrival traveltime tomography aims at inferring a seismic wave propagation velocity model from first arrival traveltimes picked on seismograms. The velocity model inferred can be used directly to perform a structural interpretation of the subsurface or as an initial model for another seismic imaging method such as prestack depth migration or full waveform inversion. This technique can be applied at different scales from geotechnical studies to seismology through oil exploration. The geophysicist know-how plays an important role in the difficult resolution of the nonlinear and ill-posed tomographic problem. Numerous studies have tried to ease and improve this resolution considering a physical or mathematical approach. We recently developed a pragmatic approach based on a novel adjoint state algorithm (Taillandier et al., 2009; Noble et al., 2010), i.e. we consider that the tomographic problem should be solved using an interactive algorithm whose tuning parameters are clearly identified. The interactive aspect of the algorithm facilitates the acquisition of the tomographic know-how because it allows performing, within a reasonable time, many simulations for different kinds of parameterization. This algorithm has been successfully applied on 2-D and 3-D large real, marine and land data sets.

1. In order to improve resolution and increase depth penetration, we propose to improve our current algorithm based on the adjoint state by performing a joint inversion of refracted and reflected waves. After tomography the resulting velocity model will be much more reliable at greater depths, resolution will be higher and it will be also a reliable starting model for full waveform inversion.
2. With denser acquisitions (several hundred thousands of receivers per shot point) in terms of number of receivers and azimuthal converage, more and more often we are encountering the problem of azimuthal anisotropy. We propose to also include in the inversion algorithm a 3D anisotropic eikonal solver that can simulate realistic azimuthal anisotropy.

The interested candidate must have a research master degree in physics, geophysics or applied mathematics, and be interested in seismic signal processing and seismic imaging. The candidate should also have experience in programming. Good knowledge of English is essential.

References:

Noble, M., P. Thierry, C. Taillandier, and H. Calandra, 2010, High performance 3D first arrival traveltime tomography, The Leading Edge (Tulsa, OK), 29 (1), 86-93.

Taillandier, C., M. Noble, H. Chauris, and H. Calandra, 2009, First arrival travel time tomography based on the adjoint state methods, Geophysics, 74, (6), WCB57-WCB66.