Surface wave velocity and attenuation in 3D media

(Proposer: Prof. Giorgio Cassiani)

Surface waves have been used for the near-surface site characterization since decades in engineering and environmental applications. However, in large-scale seismic exploration they are still mainly considered as coherent noise to be removed: their potential for the near-surface site characterization is not fully exploited yet.

An important paradigm shift is occurring, as the acquisition and processing technology allows acquiring and analysing in a complete and effective fashion the surface wave in large-scale, 3D seismic data.

The surface waves can be therefore analysed to extract their propagation properties, including velocity and absorption. These properties can be used for a model based noise attenuation approach, which can tackle aliased and scattered surface waves. But they can also be inverted for an integrated near-surface characterization.

Objective of this research project is developing an analysis and inversion approach for three-dimensional data, able to estimate the phase velocity and phase damping ratio of multimodal surface waves, in a 3D laterally varying medium.

The project involves staring from the development of a robust estimation of the local propagation properties: the initial point can be the super-resolution and beamforming techniques for the estimation of the real and of the complex wavenumber, to move to a tomographic inversion of the complex wavenumber, but also of the source and receiver term of the surface wave modal equation.
The first application is the near-surface characterization for the estimation of the perturbation corrections. The computation of shear-wave receiver statics in multicomponent data, but also the computation of the long-wavelength component of the P-wave statics in conventional single-component data. The use of the estimated near-surface quality factor Q for a constrained, model-based wavelet calibration is the secondary envisaged application.

Data are available from several two- and three-dimensional seismic surveys on land, and on sea bottom (Scholte waves).

The research requires developing algorithms and tools based on signal and image processing, wave physics.

The ideal candidate has a strong mathematical and physical background and an interest in signal and image processing, and in data processing. Seismic data processing and imaging knowledge is a plus.

Fundings:
2016-2019: WASA: WAter Saving in Agriculture: technological developments for the sustainable management of limited water resources in the Mediterranean area. EU FP7 ERANET-MED. P.I.: Giorgio Cassiani.
2013-2018: EU Framework Programme 7 Collaborative Project GLOBAQUA “Managing the effects of multiple stressors on aquatic ecosystems under water scarcity”. P.I.: Prof. Damià Barceló, Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC), Spain.