S53B-03 - A probabilistic method for earthquake source parameter estimation

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Abstract

We develop a probabilistic method, grounded on the conjunction of states of information between data and model spaces, to retrieve the a-posteriori probability density function (PDF) of earthquake source parameters and anelastic attenuation factor from the inversion of displacement amplitude spectra. Exploitation of the joint PDF allows then to take into account between-parameter correlations in the final estimates and related uncertainties.

The method is divided in two steps. First, we search for the maximum of the PDF through an optimization technique that couples a global exploration built on a Markov chain with a local, deterministic maximization. Then, we compute statistical indicators - mean, variance and correlation coefficients - on source parameters and anelastic attenuation by integration of the PDF around the maximum likelihood solution. Quality checks based on the signal-to-noise ratio and the similarity of the marginal PDFs with a Gaussian function enable us to the define the frequency domain for the inversion and to get rid of unconstrained solutions.

We estimate site effects analyzing single station residuals between observed and predicted spectra, for all the events in the data-set. Finally, we correct observed spectra for site contribution, providing final estimates with reduced epistemic uncertainty.

We perform synthetic tests to assess theoretical correlations as a function of the signal-to-noise ratio and to define the minimum bandwidth around the corner frequency for consistent parameter resolution.

We apply the described methodology to Central Italy 2016/2017 seismic sequence and large data-set of events recorded by Near-Fault-Observatories.

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A Fuzzy Inversion Approach to Earthquake Kinematic Finite-Fault Source Modelling

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