



SPECTRAL ELEMENT MODELING OF 3D WAVE PROPAGATION IN THE EARTH: THE GRAVER PART OF THE SPECTRUM

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The Spectral Element Method (SEM) has been recently established as a new reference to compute synthetic

seismograms in 3D models of the Earth.

So far, all the studies involving the SEM have been performed within the Cowling approximation, i. e. neglecting the variations of the gravity field during wave propagation.

For low-frequency studies (typically less than 5 mHz) the previous assumption fails and the complete treatment of self-gravitation has to be considered.

This requires the introduction of the mass redistribution potential (MRP) which has to satisfy

Poisson's equation everywhere in space.

Unlike spherical harmonics approaches, the use of a grid based method does not provide

a natural framework for the resolution of the exterior problem.

However, we show that a Dirichlet-to-Neumann operator at the surface of the Earth provides a simple and efficient solution to this problem.

A special attention is needed for the fluid parts to avoid spurious oscillations.

To this end, we introduce a general two-potentials formulation which allows to take

any density stratification into account.

Contrary to other studies that considered the velocity potential, our decomposition is applied to the displacement field in order to obtain natural solid-fluid boundary conditions for the MRP.

At each time step, the MRP is computed from the displacement field through a preconditioned conjugate gradient algorithm. This procedure has to be accurate enough in order to ensure a stable calculation on long time series.

Some examples of synthetic seismograms computed in spherical Earth models illustrate the accuracy of our approach.