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3D Spectral Element Method simulations of the seismic response in complex media

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3D numerical simulation is a challenging issue for assessing the seismic response of complex media like basins. In such models, the 3D geometry and the local geological features can result in significant amplifications and trapping of specific frequencies. These 3D effects must be taken into account for strong motion prediction and seismic risk assessment. A particular attention must be paid on the geometrical discretization and the incorporation of the velocities heterogeneities.

Using spectral element methods (SEM), unstructured mesh generation is actually a difficult part of the modelling process. Even though unstructured hexahedral mesh generators, like CUBIT, offer new perspectives, assessing the quality of a mesh both in terms of geometrical and numerical accuracy is a challenging problem.

We analyze here the influence of unstructured discretization both for geometry (topography, interfaces, corners) and velocities discontinuities on the seismic response, depending on the source characteristics (wavelength, angle of incidence). A typical application is the basin response where site effects prevail. Surface waves created by diffraction at the corners of a basin play here an important role. Two strategies may be adopted. In the first one, an unstructured mesh respecting the main discontinuities and topological features can be defined at the expense of strongly deformed elements. In the second one, a smoother mesh strategy can be adopted at the expense of highly non homogeneous properties within the elements. We compare both strategies, with respect to the accuracy and efficiency of the SEM.

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