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Time and space multi-resolution extensions of the Spectral Element method : applications for earthquake rupture dynamics

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Earthquake rupture dynamics and short wave radiation require to resolve different time and space scales involved in the nucleation, the rupture front propagation and the stopping phases. From a numerical point of view, this implies a high frequency resolution in the vicinity of the fault while wave propagation, away from from the fault to the receivers, may be solved at lower frequency, in part due to our limited knowledge of the geological structure.

Although the size of the elements can be larger away from the fault than in its neighbourhood, the time step is imposed by the smallest distance between the grid nodes, increasing unnecessarily the computational time.

A multi-resolution stategy is proposed to match domains with different space and time steps, combining the classical Mortar method in space with a condition based on the energy conservation in time. Numerical examples illustrate the main features of the methodology and assess the accuracy of such a strategy. On going applications to rupture dynamics will be outlined.