Simulation of Geophysical Wave Propagation Using Domain Decomposition Techniques

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Wave problems are often encountered in several fields of physics. Acoustic, electromagnetic, seismology and mechanical waves in solids or fluids, inter alia. These problems can be solved using their harmonic solutions that correspond to solutions subjected to harmonic excitations. Using a finite element method, a fairly fine mesh needs to be used to properly represent the wave behavior. In a three-dimensional problem, this can lead to a significant number of complex unknowns, especially at high frequencies. Thus, using direct sparse solvers is not suitable for these kinds of problems, while iterative solvers converge slowly or worse, diverge. Domain decomposition methods such are used to overcome this problem.

This work analyses the Schwarz domain decomposition method, presents a partitioning tool used to automatically create partitioned meshes, and applies the method to geophysical waves. Figure 1 illustrates an example of a two-dimensional geophysical wave simulation. Some transmission operators that make the link between subdomains are presented, and their efficiency is compared in the case of a regular manual partitioning and an irregular automatic partitioning that is created with the partitioning tool. The work shows that some transmission operators that allows fast convergence with regular partitioning are not efficient for irregular partitioning.

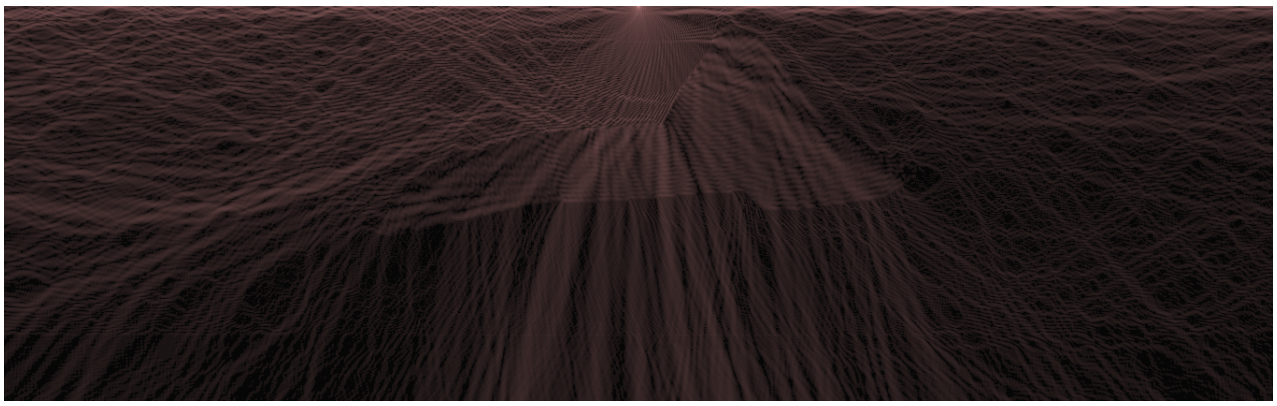

Figure 1: P-Wave in ground.