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Simulation of seismic wave propagation with high-resolution finite-volume methods on unstructured triangulations

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The numerical simulation of seismic wave propagation is based on the solution of the elastic wave equations. The computational domain is discretized by point or cell meshes of variable regularity but with a structured relation between the discrete neighbours. Higher resolution is usually achieved by raising the order of the numerical method used (Finite Differences, Spectral Elements or others) and by reducing the grid size. We present a high-resolution finite-volume method for propagating elastic waves in unstructured triangular grids based on a Runge-Kutta time discretization in combination with a 3^{rd} order WENO reconstruction in space.

The grids used are generated by creating contours with nodes to adapt to the shapes of known inhomogeneities in the medium and then using Delaunay triangulation to fill the computational space. Boundary conditions in this schemes are naturally implemented by the use of non-invasive methods, by adding so-called “ghost cells” that don’t modify any of the physical values of our computational domain. An extension to arbitrary high order finite volume schemes (ADER-schemes) in space and time is also addressed and results of both schemes are compared.