An unsplit convolutional Perfectly Matched Layer improved at grazing incidence for the seismic wave equation

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The Perfectly Matched Layer absorbing boundary condition has proven to be very efficient from a numerical point of view for the elastic wave equation to absorb both body waves with non-grazing incidence and surface waves. However, at grazing incidence the classical discrete Perfectly Matched Layer method suffers from large spurious reflections that make it less efficient for instance in the case of very thin mesh slices, in the case of sources located close to the edge of the mesh, and/or in the case of receivers located at very large offset. We demonstrate how to improve the Perfectly Matched Layer at grazing incidence for the differential seismic wave equation based on an unsplit convolution technique. The improved PML has a cost that is similar in terms of memory storage to that of the classical PML. We illustrate the efficiency of this improved Convolutional Perfectly Matched Layer based on numerical benchmarks using a finite-difference method on a thin mesh slice for an isotropic material and show that results are significantly improved compared with the classical Perfectly Matched Layer technique. We also show that, as the classical model, the technique is intrinsically unstable in the case of some anisotropic materials.

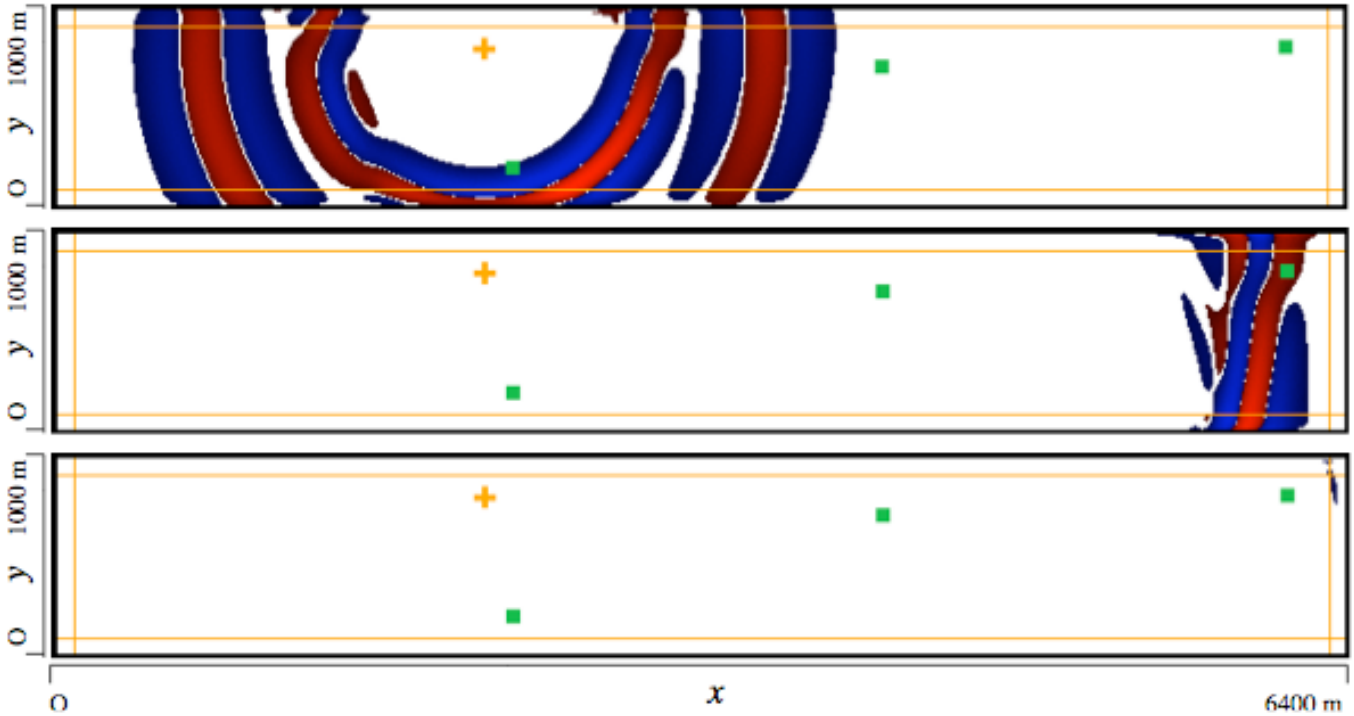

Figure 1: *Snapshots in a (x,y) plane of the v_y component of the three-dimensional velocity vector for a model corresponding to a thin slice with C-PML conditions implemented on the six sides. We represent the component in red (positive) or blue (negative) at each grid point. The orange cross indicates the position of the source. The four vertical or horizontal orange lines represent the edge of each layer PML. No spurious wave of significant amplitude is visible, even at grazing incidence.*