Derivation of efficient and accurate operators for computing synthetic seismograms for arbitrarily shaped fluid-solid boundaries

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We have derived a numerical operator for the media with arbitrarily shaped fluid-solid boundaries that does not coincide with a regularly spaced numerical grid. We use this operator combined with previously derived optimally accurate O(Delta x^2) finite difference operators to obtain an optimally accurate numerical solution. To compute synthetics for a fluid-solid boundary that does not coincide with a regularly spaced numerical grid, we define extra nodes that coincide with the boundary. But, we do not need to know the explicit values of the displacement to derive numerical operators. We can derive numerical operators for the local grid cells which contain fluid-solid boundary using taylor series expansion of displacements and using the criterion for optimal accuracy of eq. 2.20 of Geller and Takeuchi (1995,GJI). We can calculate the synthetic seismograms of optimal accuracy to O(Delta x^2).

We show the theory for a 1-D case and present numerical examples for 1-D and 2-D cases.