O106-001 **Room: 304** **Time: May 17 9:00-9:15**

Applications of optimally accurate time domain finite difference schemes to exploration seismology

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We use an optimally accurate time domain finite difference (FD) scheme to compute P-SV synthetic seismograms for a 2-D elastic medium. The optimally accurate scheme (2nd order in space and time) was derived by Takeuchi and Geller (Phys. Earth Planet. Inter., 2000) based on the theory of Geller and Takeuchi (1995). These papers and later studies have shown that optimally accurate schemes are far more cost effective (as measured by CPU time required to achieve a given level of accuracy) than conventional schemes (on the order of a factor of ten for 1-D, fifty for 2-D, and projected to be over 100 for 3-D).

The regions studied by exploration seismologists exhibit conditions such as water layers, a free surface, complex geometry (e.g. salt intrusions) and sharp velocity contrasts (salt vs. sediment). FD simulations must be able to handle such media accurately and efficiently. In this study we apply an optimally accurate FD scheme to a 2D P-SV problem of the type that arises in exploration seismology, and show that high accuracy and efficiency is achieved. The figures below show an example of an elastic FD computation using optimally accurate operators. The medium is a Poisson solid (lamda = mu), and a constant value of density is used. The left figure shows the structure model and P-wave velocity (the S-wave velocity is 1/1.732 of the P-velocity), and the right figure shows a snapshot of the horizontal component of the displacement. Dipping interfaces of internal boundaries are approximated by stair-case boundaries. The numerical operators at the boundaries are derived by 'overlapping,' as explained in the references cited above. For all outer boundaries, the free surface conditions are imposed (some areas in the left and right side are cut from the figures to save space). The source (shown by the triangle in the left figure) is a point force applied at the interface between the second and the third layers from the top, with force direction parallel to the interface.

The grid spacing is constant throughout the medium. The number of grid points per wavelength (based on the slowest shear velocity) is 19.0 and the Courant number (based on the fastest compressional velocity) is C = Vp $*$(Delta t)/(Delta z) = 0.83. As shown in the right figure , the waveforms are clean and not visibly contaminated by numerical artifacts. At internal boundaries and free surfaces, clear events can be seen. However small diffracted waves from the staircase boundaries can be seen in the top and the second layers. Such diffractions can be reduced by applying the scheme of Mizutani (Ph.D thesis, 2002) for handling inter-node lithological discontinuities.