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True amplitude cross-correlation imaging condition for Reverse Time Migration

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Reverse Time Migration has gained popularity the last decade and is now extensively used for imaging of active source seismic reflection data and also earthquake data recorded on dense arrays.

In Acoustic Reverse Time Migration the image is formed by using a classical imaging condition involving time and spatial cross-correlations of forward modeled pressure and reverse-time extrapolated measured data. The image at a given position is interpreted as a wavefield due to virtual sources at depth, but is incorrectly scaled with a factor rougly inversely proportional to the cosine of the scattering angle.

We use results from seismic interferometry to show that the true reflectivity can be obtained by a simple modification of the classical imaging condition. The correct expression for the reflectivity is obtained by cross-correlation of derivatives of the forward modeled wavefield with the backward extrapolated data.

By using finite-difference or finite-element schemes the implementation of the modified imaging condition is straightforward and only requires a simple diffrentiation of the forward wavefield.

For analysis of the reflectivity in terms of contrast velocities and denities the modification will obviously be important. This kind of analysis assumes that the estimated reflectivity has the correct angle behaviour.