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Improving linearity and uniqueness in seismological receiver function inversion

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The inversion of receiver functions into 1D velocity stratification is *notorious* for its *nonlinearity* and its *lack of absolute S-velocity recovery*.

We present a 1D-stratified inversion of receiver functions which is practically independent of starting model and for which prior values of S-velocity are not required.

Linearity improvement: Layer thickness is defined in fixed travel time difference between P- and S-waves. This is different from classical parameterization in fixed vertical distance. Synthetic tests show that linearity is improved dramatically.

Uniqueness improvement: Analysis of the receiver function at varying degrees of low pass filtering defines a spectrum of polarization angles of the incident P-wave. The classical relation by Wiechert (1907), *VS = sin(iP_app/2)/p,* defines the S-velocity of a halfspace from the polarization angle, iP_app, of a P-wave with know horizontal slowness, p, at the free surface. The combination of Wiecherts relation and the spectrum of polarization angles defines a novel transform of the receiver function which allows robust extraction of absolute average levels of S-velocity at depths.

As demonstrated on both *synthetic and observed data,* the resulting 1D-inversion of receiver functions becomes practically independent of starting model, and prior values of velocity are not required. The improved linearity and uniqueness also helps the analysis of the remaining propagation of observational errors.

These improvements should help applications ranging from crust and upper mantle studies using teleseismic data to local S-velocity estimation using local earthquakes in seismic hazard studies.