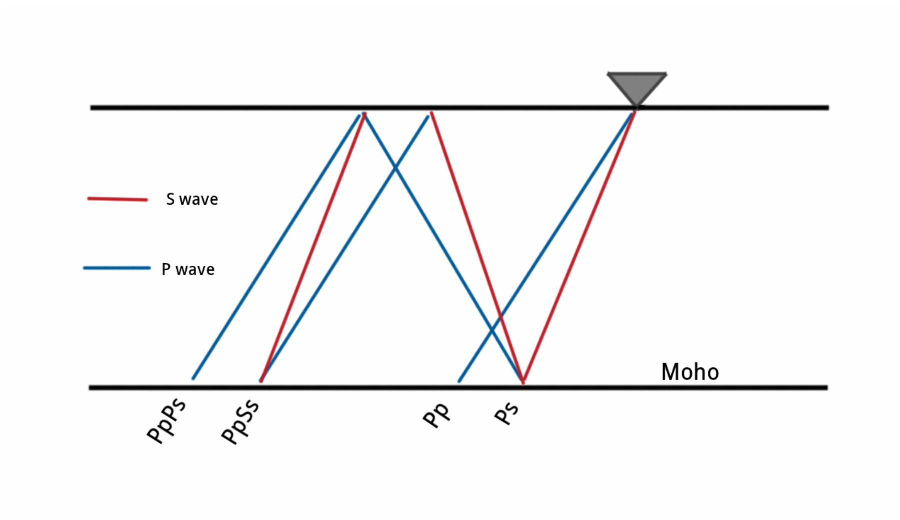
Seismograms from a seismic station are deconvolved into receiver functions which, in good conditions, contain impulsive energy at the times of the phase arrivals. The phase arrivals of interest are the direct phase t_{Ps} and two distinct reflected phases t_{Pps} and t_{Pss} which have reflected off the free surface and Moho before being recorded at the seismic station. t_{Pps} spends two legs of it's journey as a P-wave while t_{Pss} spends only one leg as a P-wave, see figure below. The difference in velocity between a P-wave and S-wave allows the use these arrivals as distinct data.



The parameter search for Vp, Vs and H is accomplished by breaking the problem into two smaller subproblems. First the reflected phase travel time equations **(2)** and **(3)** are divided by the direct arrival phase **(1)** to remove the dependence on crustal thickness H, **(4)** and **(5)**. A gridsearch over deconvolved receiver functions is performed looking for optimal values of V_p and $\frac{V_p}{V_s}$ using equations **(4)** and **(5)** and an estimate for the direct phase travel time t_{Ps} .

Second, the best estimates for V_P and $\frac{V_p}{V_s}$ are chosen and used in a 1D line search using equations **(1)**, **(2)** and **(3)** for H.

These best parameter estimates are used to solve the three travel time equations **(1)**, **(2)** and **(3)** for the best estimate of a phase arrival for each receiver function and are plotted on a series of receiver functions for verification.

$$t_{Ps}(p_i) = H\left[\sqrt{\left(\frac{V_p}{V_s}\right)^2 - p_i^2 V_p^2} - \sqrt{1 - p_i^2 V_P^2}\right] \tag{1}$$

$$t_{Pps}(p_i) = H\left[\sqrt{\left(\frac{V_p}{V_s}\right)^2 - p_i^2 V_p^2} + \sqrt{1 - p_i^2 V_P^2}\right] \tag{2}$$

$$t_{Pss}(p_i) = 2H\sqrt{\left(\frac{V_p}{V_s}\right)^2 - p_i^2 V_p^2} \tag{3}$$

$$t_{Pps}(p_i) = \frac{\sqrt{\left(\frac{V_p}{V_s}\right)^2 - p_i^2 V_p^2} + \sqrt{1 - p_i^2 V_P^2}}{\sqrt{\left(\frac{V_p}{V_s}\right)^2 - p_i^2 V_p^2} - \sqrt{1 - p_i^2 V_P^2}}\, t_{Ps}(p_i) \tag{4}$$

$$t_{Pss}(p_i) = \frac{2\sqrt{\left(\frac{V_p}{V_s}\right)^2 - p_i^2 V_p^2}}{\sqrt{\left(\frac{V_p}{V_s}\right)^2 - p_i^2 V_p^2} - \sqrt{1 - p_i^2 V_P^2}}\, t_{Ps}(p_i) \tag{5}$$