Joint inversion of receiver function and apparent incidence angles to investigate the crustal structure of Mars

Rakshit Joshi (1), Brigitte Knapmeyer-Endrun (2), Martin van Driel (3), Savas Ceylan (4), and Mark Panning (5)

(1) Max-Planck Institute for Solar System Science, Planets and Comets, Göttingen, Germany (joshir@mps.mpg.de), (2) Institute of Geology and Mineralogy, University of Cologne, Cologne, Germany (brigitte.knapmeyer-endrun@uni-koeln.de), (3) Institute of Geophysics, ETH Zürich, Switzerland (vandriel@erdw.ethz.ch), (4) Institute of Geophysics, ETH Zürich, Switzerland (savas.ceylan@erdw.ethz.ch), (5) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA (mark.p.panning@jpl.nasa.gov)

In order to retrieve the crustal structure of Mars beneath the landing site of InSight using seismic data, we propose using a joint inversion of receiver functions and apparent incidence angles, which contain information on absolute S-wave velocities of the subsurface. Since receiver function inversions suffer from a velocity depth trade off, we in addition exploit a simple relation which defines apparent S-wave velocity as a function of observed apparent P-wave incidence angles and ray parameter to constrain the parameter space.

Calculation of apparent incidence angles directly from the obtained receiver function by multiple filtering has the added advantage of being immune to the complexities of the P waveform and its coda, and filtering at longer periods provides information at increasingly larger depth. The forward calculation for receiver functions is done by convolving the impulse response of a layer stack with observed vertical receiver functions, while the Neighbourhood Algorithm is employed for the inversion part.

We present the results of applying this technique on selected Mars synthetics using both single events and multiple events at 30 to 90 degrees distances. The obtained results highlight a good fit for both the apparent velocity curves and receiver functions together with their convergence profiles.