“Time-reversal” inversion of InSight seismogram for quake estimation

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We re-define time-reversal inversion (back projection) operator that can infer the source location. When we have a good coverage of seismic stations and a robust knowledge on the structure, a classical time-reversal, which cross-correlates observed data and synthetic Green’s functions should work. Due to a poor configuration of one-station seismology in InSight project, however, we need to explicitly include the inverse of the full Hessian matrix in order to detect quakes. We have proven this with synthetic tests using 1D Mars models with/without regolith layers on the top of the planet with an explosion source exerted on the surface. We then applied this method to the real data, especially that of “A” quality, with a set of vertical Green’s functions with an explosion source on the surface in order to roughly estimate the distance, which matches the catalog given by the Marsquake Service. We then extend this method for refining the solution using Green’s functions for all the components.

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