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Passive Seismic Marchenko Imaging

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In recent years, seismic interferometry (SI) has been widely used in passive seismic data, it allows to retrieve new seismic responses among physical receivers by cross-correlation or multidimensional deconvolution (MDD). Retrieval of reflected body waves from passive seismic data has been proved to be feasible. Marchenko method, as a new technique, retrieves Green's functions directly inside the medium without any physical receiver there. Marchenko method retrieves precise Green's functions and the up-going and down-going Green's functions can be used in target-oriented Marchenko imaging, and internal multiples related artifacts in Marchenko image can be suppressed.

Conventional Marchenko imaging uses active seismic data, in this abstract, we propose the method of passive seismic Marchenko imaging (PSMI) which retrieves Green's functions from ambient noise signal. PSMI employs MDD method to obtain the reflection response without free-surface interaction as an input for Marchenko algorithm, such that free-surface multiples in the retrieved shot gathers can be eliminated, besides, internal multiples don't contribute to final Marchenko image, which means both free-surface multiples and internal multiples have been taken into account. Although the retrieved shot gathers are contaminated by noises, the up-going and down-going Green's functions can be still retrieved. Results of numerical tests validate PSMI's feasibility and robustness. PSMI provides a new way to image the subsurface structure, it combines the low-cost property of passive seismic acquisition and target-oriented imaging property of Marchenko imaging, as well as the advantage that there are no artifacts caused by internal multiples and free-surface multiples.

Overall, the significant difference between PSMI and conventional Marchenko imaging is that passive seismic data is used into Marchenko scheme, which extends the Marchenko imaging to passive seismic field. Passive seismic Marchenko imaging avoids the effects of free-surface multiples and internal multiples in the retrieved shot gathers. PSMI combines the low-cost property of passive seismic acquisition and target-oriented imaging property of Marchenko imaging which is promising in future field seismic survey.

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