EGU21-13988, updated on 07 Dec 2021
https://doi.org/10.5194/egusphere-egu21-13988
EGU General Assembly 2021

A sparsity-based adaptive filtering approach to Shear Wave Splitting

Hamzeh Mohammadigheymasi[1], Mohammad Reza Ebrahimi[2], Graça Silveira[3,4], and David schlaphorst[3]

[1]University of Beira Interior, Computer sciences, Portugal (hamzeh@ubi.pt)
[2]Dana Energy Company, Iran
[3]Dom Luiz Institute, Faculty of Science, University of Lisbon, Portugal
[4]Instituto Superior de Engenharia de Lisboa, Lisboa, Portugal

Shear wave splitting analysis is a frequently used tool to study elastic anisotropy from the lower mantle to the crust. Several methods have been developed to evaluate the splitting parameters, Φ (fast axis) and δt (delay time), including the correlation of wave components, minimization of covariance matrix eigenvalues, and minimizing energy on the transverse component. Despite massive progress in introducing sophisticated methods, still fundamental problems, related mainly to noisy data, interfering phases, length of the analyzed waveform, and stability and reliability of results, remain. This study presents a sparsity-based adaptive filtering method to magnify the SKS waveforms and suppress the unwanted noise and interfering phases. The study is an extension of Jurkevics (1988), computing the semi-minor and semi-minor axis of the polarized motion in the time-frequency domain using a regularized inversion-based approach imposing a sparsity constraint. Afterward, the elliptical particle motion caused by the split shear waves and correspond to high semi-minor amplitude is derived in the time-frequency domain. The information is used to design an adaptive filter in the time domain to amplify the SKS phase and suppress the noise and other phases having non-elliptical polarization. The regularized inversion-based approach enables obtaining a sparse time-frequency semi-minor map while handling noise problems in the time-frequency decomposition. Conducting synthetic simulations, we show that the proposed method increases the signal-to-noise ratio of the SKS phase in radial and transverse components, giving a better estimation of anisotropy parameters in the presence of noise and other interfering phases. Future work involves implementing the processing algorithm on real data recorded in São Tomé and Príncipe, Madeira, and Canary islands. This research contributes to the FCT-funded SHAZAM (Ref. PTDC/CTA-GEO/31475/2017) and SIGHT (Ref. PTDC/CTA-GEF/30264/2017) projects.