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Periodic Fisher Scoring Method for DOA Estimation for Seismic Signals

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Seismic waves are sound waves emitted by, for example, an earthquake or an underground explosion. Accurate estimation of the back-azimuth, i.e. the direction of arrival (DOA), of a seismic signal to the detecting station, is required for the accurate localization of seismic events. This is especially important in the case of seismic arrays, which comprise a substantial portion of International Monitoring System primary stations. In this research, we develop a new low-complexity DOA estimation method, the iterative periodic Fisher's scoring. In our simulations, we use synthetic data that was generated assuming the configuration of the MMAI seismic array and noise characteristics. We compare the performance of the proposed method, the maximum likelihood estimator, and the conventional Fisher scoring as well as the cyclic Cramér-Rao lower bound. Simulation results show that the proposed periodic Fisher's scoring estimator has a lower mean cyclic error and lower computational complexity than the classical method, and it is more stable around the edges of the range [-pi,pi]. Moreover, under a misspecified model, where the noise is assumed to be white (i.e. uncorrelated between the sensors), while it is colored (i.e. correlated), our methods significantly outperforms the existing methods.

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Promotional text

The work introduces a new iterative method, periodic Fisher's scoring for estimating seismic array back-azimuth.

Oral preference format

in-person

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