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Estimation in Seismic Arrays via Deep Augmented MUSIC Algorithm

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Seismic waves are emitted by events such as earthquakes, explosions, or other movements of materials within the Earth. The International Monitoring System comprises of a global network of seismic stations intended to identify and locate such events. The accurate estimation of the back-azimuth, or the angle of arrival, of these seismic signals remains a key challenge. Over the last decades, many azimuth estimation algorithms have been proposed. Additionally, recent years have witnessed a dramatic success of machine learning algorithms. Hybrid model-based/data-driven methods, such as the newly proposed deep augmented MUSIC (DA-MUSIC) algorithm, combine the advantages of both worlds. In this work, we implement and test the performance of the DA-MUSIC method on seismic data. The estimator's performance is compared to those of: 1) Broadband MUSIC; 2) Classic MUSIC; 3) Maximum Likelihood Estimator; 4) Beamformer; and 5) a Random decision. We use data recorded by the GERES array located in the Bavarian Forest, Germany, and data obtained by the MMAI array in Israel. We study different challenging scenarios corresponding to array mismatch, broad frequency ranges, and limited measurement windows. The results show that DA-MUSIC outperforms existing methods and indicates versatility and robustness, allowing the application to real seismic data.

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Promotional text

In this work, we implement and test the performance of the deep augmented DA-MUSIC method on real seismic data and demonstrates that it outperforms existing methods.

Oral preference format

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