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TwistPy: An open-source Python toolbox for wavefield inertial sensing techniques

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In the past decade, significant progress has been made in the acquisition and processing of seismic wavefield gradient data (e.g., recordings of ground strain and rotation). When combined with conventional multicomponent seismic data, wavefield gradients enable the estimation of local wavefield properties (e.g., the local wave speed, the propagation direction, and the wave type) and the reconstruction of spatially under-sampled seismic wavefields. However, the seismological community has yet to embrace wavefield gradient data as a new observable.

We present TwistPy (**T**oolbox for **W**avefield **I**nertial **S**ensing **T**echniques), an open-source software package for seismic data processing written in Python. It includes routines for single-station polarization analysis and filtering, as well as array processing tools. A special focus lies on innovative techniques to process spatial wavefield gradient data and, in particular, rotational seismic data obtained from dedicated rotational seismometers or small-aperture arrays of three-component sensors. Routines currently included in the package comprise polarization analysis and filtering in both the time domain and the time-frequency domain (for three-component and six-component data), dynamic tilt corrections, and beamforming (Bartlett, Capon, and MUSIC beamformers).

With TwistPy, we attempt to lower the barrier of entry for the seismological community to use state-of-the-art multicomponent and wavefield gradient analysis techniques by providing a user-friendly software interface.

Extensive documentation of the software and examples in the form of Jupyter notebooks can be found at <https://twistpy.org>.