EGU22-8787, updated on 11 Aug 2022
https://doi.org/10.5194/egusphere-egu22-8787
EGU General Assembly 2022

PSD analysis and seismic event detectability of Distributed Acoustic Sensing (DAS) mesurements from several monitoring sites

Nasim Karamzadeh Toularoud[1], Jérôme Azzola[2], Emmanuel Gaucher[2], Thomas Forbriger[1,3], Rudolf Widmer-Schnidrig[3,4], Felix Bögelspacher[1], Michael Frietsch[1], and Andreas Rietbrock[1]

[1]Geophysical Institute (GPI), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany (nasim.karamzadeh@kit.edu)
[2]Institute of Applied Geosciences (AGW), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany
[3]Black Forest Observatory (Schiltach), Karlsruhe Institute of Technology and University of Stuttgart, Wolfach, Germany
[4]Institute of Geodesy, University of Stuttgart, Stuttgart, Germany

High spatial and temporal resolution of distributed acoustic sensing (DAS) measurements makes them very attractive in different applications in seismology, such as seismic noise analysis (e.g. Bahavar et al 2020, Spica et al 2020) and seismic event detection (e.g. Ajo-Franklin et al 2019, Fernandez Ruiz 2020, Jousset 2020). The quantity measured by a DAS is strain or strain rate of an optic fiber cable, which is related to the spatial gradient of displacement and velocity that is usually measured by single point seismometers. The amplitude (and signal to noise ratio, SNR) and frequency resolutions of DAS recordings depend on spatial and temporal acquisition parameters, such as i.e. gauge-length (GL) and derivative time (DT), the latter being of importance only if the device records the strain rate.

In this study, our aims have been to investigate, experimentally, how to adapt the averaging parameters such as GL and DT to gain sensitivity in frequency bands of interests, and to investigate the seismic event detection capability of DAS data under specific set up. We recorded samples of DAS raw data, over a few hours at the German Black Forest Observatory (BFO) and in Sardinia, Italy. We studied the spectral characteristics of strain and strain rate converted from DAS raw data, to analyze the sensitivity of DAS measurements to GL and DT. The power spectral densities are compared with the strain meter recordings at BFO site as a benchmark, which is recorded using the strain-meter arrays measuring horizontal strain in three different directions independently from the DAS (For details about the DAS measurement station at BFO see Azzola et al. EGU 2022). We concluded about the lower limit of the DAS noise level that is achievable with employing different acquisition parameters. Accordingly, we applied suitable parameters for continuous strain-rate data acquisition at another experimental site in Georgia, which is related to the DAMAST (Dams and Seismicity) project.

During the acquisition time periods at BFO and in Georgia, the visibility of local, regional and teleseismic events on the DAS data has been investigated. At both sites, a broadband seismometer is continuously operating, and can be considered as a reference to evaluate the event detection capability of the DAS recordings taking into account the monitoring set-up, i.e. cable types, cable

coupling to the ground, directional sensitivity and acquisition parameters. In addition, at BFO the DAS seismic event detection capability is evaluated comparing with the strain-meter array. Examples of detected seismic events by DAS are discussed, in terms of achievable SNR for each frequency content and comparison with the seismometers and strain-meter array.