# 1.5 EVALUATING THE PERFORMANCE OF ROTATIONAL SENSORS ACROSS DIFFERENT SOURCE TYPES: EARTHQUAKES, EXPLOSIONS, AND VIBROSEIS SWEEPS

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**ABSTRACT**

Complete seismic wavefield description requires incorporating rotational motions in addition to translation and strain. The blueSeis-3A (exail), a recently introduced portable fiber-optic gyroscope designed specifically for seismological applications, offers high sensitivity for direct rotation measurement. To assess the performance of these rotational sensors, we utilized two distinct datasets collected from the same region.

In the first dataset, we deployed six rotational and three translational instruments in a tightly grouped configuration between August 26th and September 2nd, 2019, at the Fürstenfeldbruck observatory. We analyzed the self-noise characteristics of these instruments, examining their correlation, coherency, and probabilistic power spectral densities. Additionally, we investigated coherent noise spectrograms within four distinct groups and discussed observations related to the ML 3.4 Dettingen Earthquake that occurred on August 29, 2019.

In the second dataset, we aimed to further assess and compare the rotational sensors. In November 2019, we conducted an active experiment in the same region, involving the detonation of five explosions with varying yields and characteristics, as well as the operation of a vibroseis truck generating 480 sweep signals across a broad frequency range spanning from 7 to 120 Hz at 160 different locations. We estimated back azimuths for both the explosions and the sweeps.

When estimating the back azimuths of explosions, using only rotational sensors yielded favorable results. However, utilizing vertical rotation rates and transverse acceleration also proved feasible, particularly when we observed the presence of SH-type energy caused by scattering. The accuracy of these estimates depended on factors such as the signal-to-noise ratio, distance from the source, and the yield of explosives. Unlike conventional methods that rely on P waves, our approach for tracking vibroseis movements relied on S waves, as rotational sensors are primarily capable of recording S-type waves. Notably, for distances exceeding 700 meters, the method relying solely on rotational sensors exhibited substantial deviations, underscoring the need to select the appropriate method for calculating the back azimuth based on the source type.

In summary, our findings indicate that using a single rotational sensor to estimate the direction of various source types (e.g., earthquakes, explosions, and vibroseis sweeps) can be successful, taking into account the associated method limitations.

**Keywords:** Portable rotational sensor, active experiment, huddle test