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Spectral ratio comparison between translation and rotational records from induced seismic events.

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The seismic observations of the rotational signals are a field of seismology that is constantly developed. The recent research concerns sensors technology and its potential application in seismic tests. This study presents the results of a comparative analysis of rotational and translational seismic records using the horizontal-to-vertical spectral ratio (HVSR) method. In terms of translational signal ratio, we have used the name of HVSR, but in terms of rotational component spectra, we have introduced a torsion-to-rocking spectral ratio (TRSR) which corresponds to horizontal rotation spectrum to vertical rotation spectrum. It has to be noticed that rotation in the horizontal axes has a vertical character and rotation in the vertical axis has a horizontal character.

The comparison was carried out between velocity signals of translational and rotational records, as well as, between acceleration signals respectively. All seismic data were recorded by two independent sensors: the rotational seismometer and translational accelerometer at the Imielin station, located in the Upper Silesia Coal Basin (USCB), Poland. The seismic data composed of three-component seismic waveforms related to 56 recorded tremors which were located up to 1,5 km from the seismic station and they resulted from the coal extractions carried out in the neighboring coal mines. The rotational acceleration was obtained by numerical differentiation and the translational velocity was produced by numerical integration.

The conducted spectral analyses allowed to estimate the range of frequency in which the rotational HVSR and the corresponded translational HVSR are comparable. The analysis of HVSR/TRSR curves (in the selected frequency range of 1Hz to 10Hz) showed a strong correlation between the spectral ratios for the velocity signals (translational and rotational) in the frequency range of 1Hz to 2Hz. Respectively, the comparison of the accelerometer signals indicated the correlation between HVSR/TRSR curves in the frequency range of 1Hz to 3Hz. Moreover, both of the TRSR (for velocity and acceleration) showed additional maxima in the same frequency range of 3Hz to 5Hz. These relatively high-frequency maxima did not correspond to translational spectra.