Application of dynamic tilt correction with direct measurements of rotation

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Sensitivity of classical seismic sensors to tilt (rotation around horizontal axes) is a well known and up to now unsolved problem. Especially for long periods ($> 10\,\mathrm{s}$) and strong ground motions, tilt causes a base line drift, that is hard to quantify and introduces errors in analysis of data recorded, for example, on the ocean bottom or during building monitoring. 6 degrees of freedom (6DoF) seismology observes the classical 3 components of translational motion in addition to 3 components of rotational motion. One major advantage of this approach is the possibility to directly measure tilt motion and to correct translational acceleration recordings for tilt contribution. Here, we describe and discuss new methods for dynamic tilt correction with directly measured rotational motions (recorded with a blueSeis3A, manufactured by iXblue, France). Simple correction in the time-domain as well as frequency-domain correction with a coherency threshold and correction using wavelet-coherency show their advantages and disadvantages in reproducible, well controllable laboratory experiments, in a synthetic experiment with simulated near-field recordings of volcanic long period events and in their application to real-world data sets from building monitoring and ocean bottom seismology.

PIONEERS H2020-SPACE European project: 6DoF ground motion sensors for planets and asteroids

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PIONEERS is a H2020 granted project starting from January 2019. It is aimed at entering a new realm of planetary exploration with an innovative ground motion instrumentation concept relying on high precision sensors based on optical interferometry, and on 6 degrees of freedom measurements (6DoF, 3 components of translational motion and 3 components of rotational motion). Three main scientific objectives are in the focus of 6DoF sensor design: (1) lander-surface interactions (observing the trajectory and rebounds of the lander from release by the mother spacecraft to final rest on the surface of the planetary body), (2) rotational dynamics of planetary objects (observing the trajectory of a planetary object in space) and finally (3) 6DoF seismology (observing the trajectory of a point on the target object's surface during the passage of a seismic wave). Within the framework of the PIONEERS project two 6DoF instruments will be developed. The first instrument is a very low noise engineering model dedicated to imaging the internal structure of terrestrial planets. The second one is a high TRL, reduced scale version of the same instrument dedicated to the exploration of small bodies, in order to support planetary defense and asteroid resources applications. With PIONEERS, we expect to provide substantially more precise science return from planetary space missions compared to missions with usual seismometers.