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The seismic broad-band antenna of the Low Noise Underground Laboratory (LSBB, Rustrel, France): a tool for measuring the rotation ground motion.

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In the last 20 years, seismologists have recognized that a better sensing of the seismic wavefield is obtained by considering the rotational ground motions in addition to the translation measurements usually provided by seismometers. Even though recent technological developments have resulted in new portable rotation sensors with a sensitivity and a bandwidth suited to seismological applications requirements, the ground rotations have for a long time been estimated indirectly by dense seismic arrays.

The Low Noise Underground Laboratory (LSBB) includes a dense 3D seismic antenna composed of 6 STS2 broad-band seismometers since March 2005. From 2016, this array has been upgraded by the installation of about 10 new seismometers at the surface and inside the galleries of the laboratory. Thanks to these dense and small aperture seismic networks, the vertical and horizontal rotations of the ground motion have been estimated by finite difference approximation of the spatial derivatives of the local ground motions. These measurements provide the opportunity to conduct six degree of freedom (6DOF) analysis (3C translations and 3C rotations) to find out the direction of the wave propagation and to estimate the seismic wave local phase velocity.

The performance of this seismic array in deriving the local spatial gradient of the seismic wavefield, as well as the rotation tensor, will be illustrated by several selected seismic records such as the 2016 central Italy crisis (Amatrice and Norcia events) as well as the recent local Teil earthquake. In addition, the Array Derived Rotations (ADR) from the LSBB antenna are compared with the rotations measured by different kinds of rotation sensors including 2 prototypes of the new BlueSeis3A and a Lily Borehole Tiltmeter.