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Analytical developments on 6C computation inspired by navigation algorithms

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The deployment of portable broadband rotational ground motion sensors in the field marks the beginning of 6 degrees of freedom simultaneous and co-located measurements in seismology, after decades of ground motion instrumentation measuring only translations. Regarding the computation of this new kind of data-set, there are obviously some analysis technics to inherit from navigation.

Hence, now seismology has also to solve the 6 equations system with 6 unknowns of dynamic motion. In a navigation system, it is computed real-time in onboard electronics, taking into account centrifugal forces, non-commutativity of rotations, and compensation of projection of gravity in accelerometers frame and Earth rotation rate in gyroscopes frame. For the moment, attempts at handling the merging of 6 components in seismology has remained mostly empirical, using cross-correlation maximization and other optimization methods.

In this study, we developed the analytical framework for seismological 6-C computation methods, derived from navigation-inspired methods to establish a stronger link between these algorithm expertises.