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Up-dated configuration of the planar electrostatic gradiometer GREMLIT for airborne geodesy

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The knowledge of the gravity field of the Earth has been considerably improved thanks to global positioning satellites constellations and to space gravity measurements from recent GRACE and GOCE missions. But the spatial resolution of those gravity data essentially addresses the large and medium wavelengths of the field (down to a resolution of 90km) and it is therefore essential to complete them at the shorter wavelengths in particular in the areas where spatial distribution and quality of ground data remain quite uneven like in high mountain or coastal areas. Taking advantage of technologies, formerly developed by ONERA for the GRACE and GOCE space missions, the GREMLIT airborne gravity gradiometer is more particularly developed to cover the land/sea transition zone with a uniform precision, and a spatial resolution expected higher than from classical airborne gravimetry. Built using a configuration with eight planar proof-masses at the corners of a cube, the gradiometer is mounted on a dedicated stabilized platform which is controlled by the common mode outputs of the instrument itself to achieve a sufficient rejection ratio of the perturbations/vibrations induced by the airborne environment in the horizontal directions. The levitation of the proof-masses along the normal gravity and the vibration isolation of the platform are designed to allow the instrument to support between +2.5 g and 0 g along the vertical axis. The gradiometer differential measurements along the two horizontal axes provide the necessary information to extract the six components of the gravity gradient tensor at the location of the instrument. Well suited to sustain the proof-mass levitation in the Earth's gravity field, the planar configuration of each accelerometer also presents an intrinsic linearity of the horizontal control loops which minimizes the aliasing due to high frequency vibrations or motions generated outside the measurement bandwidth. The compactness of the gradiometer design ensures excellent dimensional stability, good thermal homogeneity and makes the conception of the stabilized platform easier. The detailed error budget of the gradiometer instrument associated with the estimated performance of the platform and the assumed characteristics of the additional attitude, rate and position sensors lead to expect a performance objective between 0.1 and 1 Eötvös taking into account the difficulty of measurements onboard an aircraft by comparison to the particularly conducive satellite measurement environment.