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Designing Electrostatic Accelerometers for Next Gravity Missions

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Square cuboid electrostatic accelerometers sensor core have been used in various combinations in recent and still flying missions (CHAMP, GRACE, GOCE). ONERA is now in the process of delivering such accelerometers for the GRACE Follow-On mission. The goal is to demonstrate the performance benefits of an interferometry laser ranging method for future low-low satellite to satellite missions.
The electrostatic accelerometer becoming thus the system main performance limiter, we propose for future missions a new symmetry which will allow for three ultrasensitive axes instead of two. This implies no performance ground testing, as the now cubic proof-mass will be too heavy, but only free fall tests in catapult mode, taking advantage of the additional microgravity testing time offered by the updated ZARM tower.
The updated mission will be in better adequacy with the requirements of a next generation of smaller and drag compensated micro-satellites. In addition to the measurement of the surface forces exerted on the spacecraft by the atmospheric drag and by radiation pressures, the accelerometer will become a major part of the attitude and orbit control system by acting as drag free sensor and by accurately measuring the angular accelerations. ONERA also works on a hybridization of the electrostatic accelerometer with an atomic interferometer to take advantage of the absolute nature of the atomic interferometer acceleration measurement and its great accuracy in the [5-100] mHz bandwidth.
After a description of the improvement of the GRACE-FO accelerometer with respect to the still in-orbit previous models and a status of its development, the presentation will describe the new cubic configuration and how its operations and performances can be verified in the Bremen drop tower.