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Electrostatic Accelerometer for the Gravity Recovery and Climate Experiment Follow-On Mission (GRACE FO)

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The GRACE FO mission, led by the JPL (Jet Propulsion Laboratory), is an Earth-orbiting gravity mission, continuation of the GRACE mission, that will produce an accurate model of the Earth's gravity field variation providing global climatic data during five year at least. The mission involves two satellites in a loosely controlled tandem formation, with a micro-wave link, and optionally a laser link, measuring the inter-satellites distance variation. Non-uniformities in the distribution of the Earth's mass cause the distance between the two satellites to vary. This variation is measured to recover gravity, after subtracting the non-gravitational contributors, as the residual drag. ONERA (the French Aerospace Lab) is developing, manufacturing and testing electrostatic accelerometers measuring this residual drag applied on the satellites.

The accelerometer is composed of two main parts: the Sensor Unit (including the Sensor Unit Mechanics – SUM – and the Front-End Electronic Unit – FEEU) and the Interface Control Unit. In the Accelerometer Core, located in the Sensor Unit Mechanics, the proof mass is levitated and maintained in a center of an electrode cage by electrostatic forces. Thus, any drag acceleration applied on the satellite involves a variation on the servo-controlled electrostatic suspension of the mass. The voltage on the electrodes providing this electrostatic force is the measurement output of the accelerometer.

The Preliminary Design Review was achieved successfully on November 2013. The FEEU Engineering Model is under test. Preliminary results on electronic unit will be compared with the expected performance. The integration of the SUM Engineering Model and the first ground levitation of the proof-mass will be presented.

The impact of the accelerometer defaults (geometry, electronic and parasitic forces) leads to bias, misalignment and scale factor error, non-linearity and noise. Some of these accelerometer defaults are characterized by tests with micro-gravity pendulum bench and with drops in ZARM catapult. The post-processing needed to achieve the performance, in particular with regards to the temperature stability, will be explained.