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Status of Electrostatic Accelerometer Development for 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, which will produce an accurate model of the Earth's gravity field variation providing global climatic data during five years at least. The mission involves two satellites in a loosely controlled tandem formation, with a micro-wave link measuring the inter-satellites distance variation. Earth's mass distribution non-uniformities cause variations of the inter-satellite distance. 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 - ICU. In the Accelerometer Core, located in the Sensor Unit Mechanics, the proof mass is levitated and maintained at the 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 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 on ground and with drops in ZARM catapult.

The Critical Design Review was achieved successfully on September 2014. The Engineering Model (EM) was integrated and tested successfully, with ground levitation, drops, Electromagnetic Compatibility and thermal vacuum. The integration of the first Flight Model has begun on December 2014 and will be achieved on January 2015. The results of the Engineering Model tests and the status of the Flight Models will be presented.