MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

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DEVELOPMENT OF THE ACCELEROMETER SENSOR HEADS FOR THE GOCE SATELLITE: ASSESSMENT OF THE CRITICAL ITEMS AND QUALIFICATION

Abstract

The ESA GOCE satellite has been successfully launched the 17th of March 2009. Its objectives are to determine the gravity field anomalies with an accuracy of 1 mgal (10-5 m.s-2), and to determine the geoid with an accuracy of 1 cm at a spatial resolution of 100 km. To meet the required accuracy and resolution, the concept of gradiometry at low altitude is employed for the first time in space. The satellite payload is a gradiometer, composed of 3 pairs of 3-axis, servo-controlled, capacitive accelerometric chains, developed by ONERA. The accelerometeric chains are composed of 6 accelerometer sensor heads, 3 front-end electronic units and 1 gradiometer/accelerometers interface electronic unit. Each accelerometer sensor head is organised of the main following parts: - A gold-coated silica cage in which a 320g parallelepipedic Pt-Rh proof-mass, is electrostatically controlled to zero in its 6 degrees of freedom; - A 5 μm conductive gold wire to polarise the proof mass; - An interface base plate providing the external reference frame of the accelerometer; - A vacuum system to maintain the vacuum level inside the accelerometer sensor head.

The development of the accelerometer sensor head required several specific tests and analyses: - Ultrasonic machining of the cage elements; - Vibration tests to check the strength of cage including the gold wire; - Tribology tests to define the material and the coating of the mechanical stops limiting the proof-mass free motion (15 μm)inside the core; - Static fatigue analysis of the core.

In the paper, we will present the critical items of the design and the specific qualification approach implemented, as rendered necessary by the peculiarity of the accelerometer sensor head and which has guaranteed the success of their in orbit life.