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ENHANCED ESTIMATION OF NEUTRAL THERMOSPHERIC DENSITIES WITH MICROSCOPE

Abstract

After more than 15 years of planning, developing, building, and testing, the French MICROSCOPE satellite was finally launched on 25th of April 2016. It is the first satellite testing the validity of the Weak Equivalence Principle (WEP) up to an accuracy of the Eötvös parameter of 1E-15. The payload comprises two differential accelerometers, each containing two test masses. Due to the drag-free system non-gravitational disturbances are cancelled thus allowing the test masses to follow a pure gravitational orbit. An initial evaluation of the first science data has already led to an improvement of the determination of the Eötvös parameter by one order of magnitude compared to the best values achieved by torsion balance experiments. However, for calibration purposes and for identifying residual couplings between test mass motion and external perturbations, simulations of the satellite system and the mission are necessary. We present our approach of a high precision analysis of the non-gravitational perturbations acting on MICROSCOPE by means of the High Performance satellite dynamics Simulator (HPS). This simulation tool is being developed by the Center of Applied Space Technology and Microgravity (ZARM) at the university of Bremen, Germany, in cooperation with the Institute of Space Systems (DLR-IRS) of the German Aerospace Center. Here the calculation of the non-gravitational effects includes the specifics of spacecraft geometry and illumination conditions thus allowing for highest modeling accuracy. Furthermore, we introduce an application for MICROSCOPE which can be used for any spacecraft employing high performance accelerometers to conduct aeronomy experiments. By accurately modeling all non-gravitational effects we achieve subsequent estimates of all accelerations acting on the craft. When the satellite is operated in non-drag free mode and other dynamical effects derived from the rotational behaviour are known, we can substract these estimated values from the accelerometer signal. By means of a fit of the atmospheric density parameter in the available drag model with respect to the residual acceleration we will improve the estimation on the thermospheric density. We will show details of the procedure as well as an application for the MICROSCOPE satellite after its primary science phase.