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ANALYSIS OF THE IMPACT OF TEMPORAL DISTURBANCES ON THE SCIENCE SIGNALS OF THE SPACE MISSION MICROSCOPE BY USING WAVELET TRANSFORMATION TOOLS

Abstract

The French space mission MICROSCOPE aims at a high precision test of the Weak Equivalence Principle (WEP) with a new level of accuracy. The satellite which is scheduled for launch in 2016 carries the T-SAGE (Twin Space Accelerometer for Gravitation Experiments) developed by ONERA to measure the differential acceleration of two test masses made of different materials (Platinum and Titanium). A violation of the WEP would induce a differential acceleration signal. The achievable accuracy of the WEP test depends on the resolution of the accelerometers and on the rejection of disturbing effects caused by internal and external influences like thermal radiation effects, solar radiation pressure, atmospheric drag etc. The MICROSCOPE team at the Center of Applied Space Technology and Microgravity (ZARM) develops tools for a detailed mission modelling and simulation in close cooperation with the French partners ONERA, OCA and CNES. The main goal is to perform pre-launch test runs of the data processing with consideration of all relevant influencing effects and to contribute to the data processing and data analysis. A Fourier transformation of the differential acceleration measurement data into the frequency domain allows the identification of the characteristic signals. The transformation of the whole time signal results in the best possible frequency resolution. On the other hand, temporal (non-stationary) signals could superimpose the none-disturbed signal representing a possible violation of the WEP. With the help of Short Time Fourier and Wavelet analysis tools it is possible to analyse these kinds of disturbances and to estimate the impact on the scientific results. The corresponding wavelet spectrograms are ideal tools to identify non-stationary signals. Wavelet analysis tools allow corresponding filtering to improve the interpretability of the scientific results. The mentioned tools and their applications to the MICROSCOPE mission are explained in this paper.