MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Sciences Onboard the International Space Station and Beyond - Part 1 (6)

Author: Dr. Denis Zavalishin
Russian Space Systems, Russian Federation

Prof. A.V. Kruglov
Russian Space Systems, Russian Federation
Prof. Mikhail Beliaev
S.P. Korolev Rocket and Space Corporation Energia, Russian Federation
Prof. V.V. Sazonov
Keldysh Institute of Applied Mathematics, RAS, Russian Federation

ANALYSIS AND USE OF THE MICROACCELERATIONS MEASUREMENTS OBTAINED ON BOARD THE INTERNATIONAL SPACE STATION

Abstract

We present the results of the microgravity environment investigation on board the Russian Segment of the International Space Station (ISS) in the frequency range 02 Hz. We review the accelerations arising in different flight modes: in a quiet flight, during operations of docking and undocking, as well as burns of Service Module engines. The review is based on onboard accelerometer measurements, telemetry information about the station attitude motion and orbital data. We concentrate on the quasi-steady acceleration component (with frequencies 00.01 Hz), which is the most essential for some orbital experiments in physics of fluids and material science. The quasi-steady acceleration component was found by calculations basing on a few techniques for approximation of the station attitude motion. Telemetry values of the station angular rate and the quaternion of its attitude with respect to an inertial coordinate system were used for constructing that approximation. The calculation techniques based on kinematic equations of an attitude motions of an absolutely rigid body. This approach allowed to approximate the station attitude motion of any type and to find the quasi-steady acceleration at any point on board ISS as a function of time. The results of such calculations were used for testing onboard low frequency accelerometers. The coordinates of ISS center of mass were defined more exactly when the MAMS measurements were tested in this way. Also we used the described techniques for recalculating the low-frequency acceleration measurements from the point of the accelerometer location to the point, where experimental equipment was installed. Thus we prepared the realistic data for mathematical modeling a liquid motion in some space experiments. In particular, we generated the calculated analog of the real signals incoming into the convection sensor DAKON-M during the experiments on board ISS. The generated signals proved to be sufficiently closed to the real sensor output. So sensors of such kind can be used for monitoring low frequency accelerations on board spacecraft.

Processing the accelerations measurements obtained on board ISS allowed us to solve some applied problems of its control. In particular, we estimated the mass of ISS and coordinates of its center of mass, evaluated promptly the values of the momentums during the station reboost maneuvers. We carried out the spectral analysis of vibration accelerations with frequencies less than 2 Hz. For that purpose we investigated free and forced oscillations of the ISS body, caused by the dynamical operations carrying out.