Paper ID: 62906
oral
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

Author: Mr. Evgeny Chebakov
Moscow Aviation Institute (National Research Institute, MAI), Russian Federation,
ChebakovEvgeny@yandex.ru

Prof. Aleksey V. Nenarokomov
Moscow Aviation Institute, Russian Federation, aleksey.nenarokomov@mai.ru
Prof. Dmitry Reviznikov
Moscow Aviation Institute, Russian Federation, reviznikov@inbox.ru
Mrs. Irina Krainova
Moscow Aviation Institute, Russian Federation, igrid@mail.ru

DETERMINATION OF SPACECRAFT ATTITUDE BASED ON THE HEAT FLUX ANALYSIS

Abstract

Compared to large satellites, on-board electronics of microsatellites, such as microprocessors, are more exposed to radiation and high-energy particles. This problem can lead to single-event upsets, which might generate false commands such as thruster firing or switching heaters on or off. In some cases, these upsets cause the loss of a spacecraft orientation and endanger the whole mission. This makes important to elaborate a reliable and robust attitude control system which will enable us to correct and recover the spacecraft's attitude after a failure. It must have a simple design, low mass and power consumption. In this paper we suggest a new method of determination of spacecraft's attitude that could form the basis of such a system. In order to develop it we use various conditions of radiative heating at the surface of spacecraft's elements with different directions to the Sun and a planet which a satellite orbits to estimate their angular position. To provide this approach we need to solve inverse problems of heat transfer, which are mathematically ill-posed and therefore are rather complicated. The traditional methods of the inverse problems regularization are modified to take into account special features of the heat transfer problems under consideration. In order to estimate the spacecraft's attitude during spaceflight the suggested approach was supplemented by the Kalman filter. It was shown that one can obtain sufficiently accurate results on the basis of a constrained set of relatively simple temperature measurements.