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ATTITUDE CONTROL SYSTEM OF A MICROSATELLITE BASED ON THE INVERSE PROBLEMS TECHNIQUE AND THE KALMAN FILTER

Abstract

As it is known, a reliable and robust attitude control system of a spacecraft is a critical task without which most missions cannot be performed. This circumstance imposes certain criteria on the development of the orientation system of vehicles in outer space. For a reliable control of the current orientation a combined attitude control system, sensor redundancy and backup systems are used. A combined system usually includes solar sensors and magnetometers for microsatellites. The main goal of this research is the analysis of the possibility to elaborate a reliable attitude control system for microsatellites. This system uses radiation heat flux sensors based on the inverse problems methodology. It can be used for verification or correction of the angular orientation of the vehicle. It seems natural to use various conditions of radiative heating at the surface of a spacecraft's elements with different directions to the Sun and to an irradiating or reflecting planet of the Solar system to estimate their angular position. In the case of usually slow variation of vehicle orientation in space, temperature measurements can be used to estimate integral radiative flux to various surfaces of specially designed thermal sensors at different convex surfaces of a spacecraft. Then estimated heat fluxes can be used to determine attitude of a spacecraft. To provide this approach it is required to solve one of the so-called inverse heat transfer problems, which is mathematically ill-posed and therefore rather complicated. Thus, the main efforts of the authors are focused on solution of this ill-posed problem. The traditional methods of the inverse problems regularization are modified to take into account special features of the heat transfer problems under consideration. In addition, it is a challenging issue because it is necessary to estimate a spacecraft attitude during spaceflight. To overcome this difficulty, the observation problem using the Kalman filter was considered.