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A BACKUP SYSTEM OF A SATELLITE ORIENTATION BASED ON INVERSE PROBLEMS TECHNIQUE

Abstract

One of the important task of spacecraft design is reliability of an orbital control systems. To increase a reliable control of current orientation a combined system can be used. The suggested approach is to use a backup or replacement system which can be used to verify or/and correct the orientation of satellite. Such system can be based on measurements of the heat flux incidents at the structure elements of different orientations with respect of direct solar radiation, planetary (infrared) irradiation, and solar radiation reflected from the planet. In the case of a small angular velocity of the vehicle, the temperature measurements can be used to distinguish different integral (over the spectrum) radiative flux to various surfaces of a specially designed thermal sensor. Determining of the spacecraft orientation based on the evaluation of the external radiative heat fluxes leads to the necessity in solving two inverse problems: first, the heat fluxes to the surface of the spacecraft are determined by internal temperature measurements, and then the angular position of the apparatus is obtained by estimated heat fluxes. In most practical cases, the direct measurement of heat fluxes is impossible. The only one way to overcome these difficulties is an indirect measurement. Mathe-matically, this approach is usually formulated as a solution to the inverse problem: by the direct measurement of the system state (temperature) is necessary to determine the properties of the external action (external heat fluxes). . The known methods of the inverse problem regularization are modified to take into account special features of the heat transfer problem under consideration. The resulting algorithm is verified using the typical case problems. It was demonstrated that sufficiently accurate results can be obtained on the bases of a constrained set of relatively simple temperature measurements. The latter enables us to consider the method suggested as a perspective way to elaborate a series simple backup/replacement system of an approximate retrieval of a spacecraft current orientation. Also, there is a problem of thermo-ballistic analysis, which includes the task of indication of solar radiation, radiation reflected from the surface of the planet and the emission of surface, which will require the installation of three heat flux sensors on different surfaces of the spacecraft.