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THERMAL MODELING OF THE ADAPTIVE THERMAL CONTROL MICROSYSTEM OF THE SPACECRAFT

Abstract

In this paper materials containing principles of adaptive thermal control spacecraft microsystems assembling are presented. Adaptive Thermal Control Microsystem (ATCMS) is designed to meet the thermal requirements for the elements of the spacecraft without feedback or external control inputs used. Heat transfer between the outside of the spacecraft and the environment is mostly characterized by radiation heat transfer. Adaptive Thermal Control Microsystem provides a new approach to autoregulated management of the external surface thermal state of the spacecraft. Such approach is based on the principle of thermal beam actuators – bimorph structures, performing out-of-plane rotations of the hinge when its temperature changes. This fact allows the use of such devices as elements, functioning as an autoregulated optical screen of the spacecraft radiation surfaces. Such screens may limit the unregulated heat transfer between the spacecraft and the environment. Considering the low thermal conductivity of the actuator itself, its elements will be affected mostly by the radiation heat flow. Space objects (the Sun, the Earth) and the locating surface of an actuator itself may be considered as a source of thermal radiation in this case. At the same time there is a reciprocal re-radiation between the elements of the actuator. The developed heat mathematical model allows determining parameters of the thermal actuator to meet the boundary conditions of the specific application of ATCMS. A thermal model can be used for preliminary experiments on different modes of thermal actuators. This article presents the results of thermodeformational simulation of thermal actuator and thermal modeling algorithms of ATCMS. Also the advantages of using such systems for small area radiation surfaces when compared with the traditional systems are shown.