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IDENTIFICATION OF LUMPED PARAMETER SYSTEMS AND OPTIMAL EXPERIMENT DESIGN

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ABSTRACT

In the interaction processes between space structures, instruments or equipment and the environment as well as at contacting the mating surfaces of structures the heat transfer processes play important role. Very often numerical simulation of these processes drives us to a necessity of using a heat transfer mathematical model with lumped parameters. In this case, complex heat transfer is considered for a system of bodies. In case given the basic heat transfer equation is obtained from the analysis of the heat balance under the assumption that the engineering system can be divided into a finite number of isothermic elements. One of the main difficulties here is how to determine coefficients of the mathematical model, which provide its adequacy to real processes. Direct measurement of most characteristics of heat transfer is usually impossible, and their theoretical estimates are far not always true and often contradictory. That is why, a problem arises to determine the heat transfer characteristics of structures by means of calculations and experimentally. The purpose of this paper is to introduce a new method in the research of radiative and thermal properties of materials with further applications in the design of Thermal Control Systems (TCS) of spacecrafts. In this paper the radiative and thermal properties (absotivity, emissivity and thermal conductance) of a multilayered thermal-insulating blanket (MLI), which is a screen-vacuum thermal insulation as a part of the (TCS) for perspective spacecrafts, are estimated. Properties of the materials under study are determined in the result of temperature and heat flux measurements data processing based on the solution of the Inverse Heat Transfer Problem (IHTP) technique. Given are physical and mathematical models of heat transfer processes in a specimen of the multilayered thermal-insulating blanket located in the experimental facility. A mathematical formulation of the inverse heat conduction problem is presented too. The practical approves were made for specimen of the real MLI and other TCS.

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