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MASS PROPERTY IDENTIFICATION, MASS TRIM AND ACTIVE THERMAL CONTROL OF SPACECRAFTS BASED ON MECHANICALLY-PUMPED FLUID LOOP

Abstract

This paper studies several problems of deep-space craft control by multifunctional actuator and intelligent control algorithm. Due to the severity, variability and uncertainty of the space environment as well as fuel dissipation during long journey, spacecrafts desiderate mass property identification, mass trim and active thermal control for further travel into deep space. First, a design scheme of a combined mass-trim/thermostatic mechanism, namely Mechanically-Pumped Fluid Loop, is proposed on the structure of a single-phase fluid-loop thermal control actuator. The working principle is that fluid quantities of different reservoirs connected by fluid loop could be controlled to adjust the center of mass and momentum of inertia, and that annular flow accelerated by mechanical pumps will adjust heat by circulation. Second, a neural network algorithm is designed for the on-line identification of spacecrafts' mass property in view of this scheme, therefore using the mechanism to trim mass. Third, simulations are performed on the mass property variation of certain satellite, and the results proved the effectiveness of the neural network algorithm. Finally, further applications of the proposed mechanism are discussed, such as attitude control by fluid momentum exchange with spacecraft body, integrated utilization of propellant as working fluid, thermostatic manner for biological experiments on other planets, etc.