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SPACE SYSTEMS SYMPOSIUM (D1)
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STUDY OF HEATER ELECTRIC POWER CONTROL WITH AUTONOMOUS DISTRIBUTED CONTROL

Abstract

Spacecrafts have many heaters. When many heaters turn on at the same time, the total power consumption of system also gets large and then there is a possibility that the power resource runs short. Therefore, it is important to distribute the power to each heater appropriately and control the power consumption of heater.

HAYABUSA mission adopted “Server client system. ”A server was installed and controlled allocation of electric power by communicating with each heater. However, there were some problems. First, when the number of heaters gets large, the time to communicate with heaters also gets large. Second, it is impossible to test the control unless all devices are available. Therefore, it takes a long time to develop a spacecraft. Third, since a plurality of high-cost servers are required, the cost is very large to combine redundancy.

In order to solve the problems, this paper proposes”Autonomous distributed system.” In this system, a transmitter is located instead of a server. Each heater calculates its own power allocation with the information which the transmitter broadcasts. By using this system, even if the number of heaters gets large, the time to communicate does not change, and short-time control is possible. Besides, as the transmitter only broadcasts the total power consumption and each heater does not have to know the states of other heaters, the test of the control algorithm can be performed separately and the time to develop a spacecraft can be shortened. Moreover, it does not need an expensive server.

In this system, each heater determines whether to turn on or off based on the Eq.(1)

$$C_{i,k+1} = C_{i,k} - \Delta \mathrm{P}_k \times \frac{1}{Q_i} \tag{1}$$

Where i is a heater number, k is a step number, C is the variable which represents the state of a heater, ΔP is the difference between the target value and total power consumption, and Q is the priority of a heater. Each heater judges whether or not to turn on based on whether C is larger than the threshold value or not.

This paper demonstrates that it is possible to control power consumption and temperature of heaters by both a simulation and an experiment. Comparing these two results verifies the utility of this control

scheme. In the experiment, ZigBee, which is a wireless unit, is used to broadcast from the transmitter to the heaters.