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OPTIMIZATION OF A SPACE BASED HEAT PIPE RADIATOR

Abstract

Nowadays there is an increasing requirement in satellite weight reduction for cost reduction. Thermal control system designers have to face the challenge of reducing both the weight of the system and required heater power while maintaining equipments temperature within their design ranges. For a space based heat pipe radiator system, several researchers have published different approaches for weight optimization of the radiator system. These approaches can also be used for a thermal technology trade-off study.

This paper presents an optimization of a heat pipe radiator applied to a practical engineering design application. For this study, there was considered a communication payload panel. Optical solar reflector (OSR) radiator areas were calculated considering worst hot scenario, solar fluxes, heat dissipation and design temperature upper limit of the components, dimensions and thermal properties of the structural panel, optical properties and degradation/contamination on thermal control coatings. Temperatures of the components were also calculated to evaluate thermal gradient with the radiator. A proper heat pipe network was designed to minimize temperature gradient and increase the radiator efficiency. Constant conductance axially-grooved aluminum-ammonia heat pipes were selected for this application. The heat pipe network design is comprised of heat pipes embedded in the honeycomb panel and heat pipes mounted on the inner face of the panel.

A thermal model was developed to verify the panel thermal design and predict extreme temperatures of components and structure. In addition, the thermal model was parameterized for optimization purpose. Thermal control system requirements compliance was verified under both worst hot scenario and worst cold scenario by thermal analysis.