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EFFICIENT THERMAL CONTROL FOR HIGH-DISSIPATING MULTI-PAYLOADS IN SMALL SPACECRAFT

Abstract

At the University of the Bundeswehr Munich, a technology demonstration mission named SeRANIS -Seamless Radio Access Networks for Internet of Space is developed as a hybrid space project, which is a combination of the New Space and Conventional Space approaches. The SeRANIS mission has multiple payloads (>10) that are densely packed in the small satellite Athene-1. The trend towards high-density packaging of multiple payloads with high heat dissipation onto small satellites presents extensive design challenges for thermal control. Due to this trend, thermal management for small spacecraft has gained more significance. The use of typical passive thermal control methods for high-dissipating payloads have a considerable impact on mass and volume in the mission SeRANIS, which affects the limited budgets available.

In this paper, an efficient thermal control solution for multiple payloads with high heat dissipation over several operational scenarios is investigated. The primary goal of the proposed thermal design is to minimise the use of heating power and maximise the use of internal satellite heat fluxes. This is achieved by optimizing the use of surface coatings, materials, and payload configuration, which in turn reduces the mass impact, development time, and cost. This can serve as a guideline for universities planning to handling similar complex missions with shorter development times.

The paper presents the development and verification process of creating the Athene-1 thermal model in ESATAN-TMS, under the purview of a fast-paced Hybrid Space approach. Furthermore, the results of a first evaluation of the thermal control method designed using in ESATAN-TMS are outlined and discussed.

This paper aims to provide a novel solution for the thermal management of multiple payloads in a complex technology demonstration mission.