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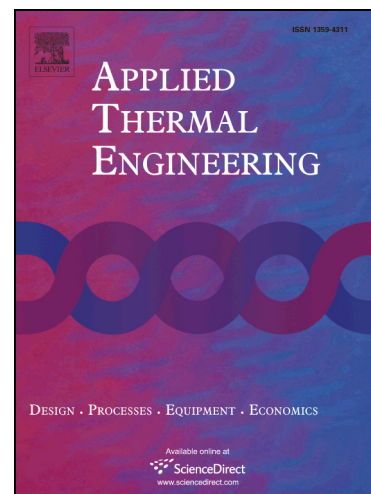
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Dynamic in-loop performance investigation and efficiency-cost analysis of dual heat sink thermal control system (DHS-TCS) with a sublimator for aerospace vehicles

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Abstract

Sublimator, as a highly efficient supplementary heat rejection device (SHReD), has been introduced to improve the performance of thermal control system (TCS). To evaluate the dynamic in-loop performance of sublimator, as well to reveal the potential optimal control strategies in particular scenarios, this paper proposes a sublimator-radiator dual heat sink thermal control system (DHS-TCS) configuration, of which the internal heat transfer mechanism model and the fast-prediction-oriented loop coupled model (FLCM) have been established. By these models, operation characteristics of sublimator, such as the allowed inlet temperature range of different sublimator area, heat rejection rate and expendable water consumption are discussed in details. Additionally, simulations of the dynamic in-loop performance of sublimator during on-orbit phase has also been conducted to compare temperature control efficiency (TCE) under different break condition temperature (BCT) settings. In order to evaluate the sublimator's performance thoroughly, the efficiency-cost analysis between parameters of TCE and expendable water consumption has been simulated in the perspective of economy. Calculation results show that choosing a proper BCT, at which the efficiency-cost ratio achieves maximum and the water consumption remains at a local minimum, is of great importance for efficient utilization of sublimator. The FLCM and the efficiency-cost analysis

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