TFAWS 2021 Paper Abstract

Authors: Abby Zinecker, Brittany Spivey, Jonah Smith

Topic Area: Passive Thermal

Title: Using Thermal Desktop to Determine Equivalent Solar Hours on Spacecraft Surfaces

Equivalent solar hours (ESH) are the duration of exposure of a surface to solar radiation, particularly ultraviolet (UV) radiation. Because UV light causes degradation to optical properties of surfaces, the determination of ESH is important to calculate end of life (EOL) optical properties for spacecraft external surfaces. A higher ESH value generally correlates to greater UV degradation experienced by the surface, resulting in an increase in solar absorptivity. This paper details a novel approach for calculating ESH using Thermal Desktop. Since the ESH value is useful for thermal analysts, this technique is beneficial in order to quickly perform the analysis internally with tools readily available without relying on external support and funding. The example presented in this paper shows how this method was developed and used for NASA's lunar Gateway spacecraft.

This tool allowed analysts to calculate ESH for the transit, assembly, and operational phases for Gateway utilizing each of the program’s planned configurations throughout its 15-year lifetime. ESH values were calculated using the Monte-Carlo ray tracing capability of Thermal Desktop using both direct solar heating and indirect solar heating (due to reflections from other surfaces). The output of this analysis includes an ESH gradient map across the spacecraft. Post-processing of these results enabled identification of the average and maximum ESH on critical surfaces such as radiators. These final ESH values for each surface are then used for determination of EOL optical properties.