Solar Sail Propulsion Sensitivity to Membrane Shape and Optical Properties using the Solar Vectoring Evaluation Tool (SVET)

Anthony Ewing – Ewing Research, Nashville TN

Abstract

Solar sail propulsive performance is dependent on sail membrane optical properties (*e.g.*, reflectivity) and on sail membrane shape (*e.g.*, billow). Assumptions of a flat, perfect reflector can result in errors which can affect spacecraft control, trajectory analyses, and overall evaluation of solar sail performance. A MATLAB® program has been developed to generate sail-shape point cloud files for two current sail designs. Simple parabolic profiles are assumed for sail shape under solar pressure loading. The shape point cloud files are then input into the Solar Vectoring Evaluation Tool (SVET) software, developed by SRS Technologies for NASA, to determine the propulsive force vector, center of pressure, and moments about the sail body axes as a function of sail shape and optical properties. Also, the impact of the *center-line angle*, due to non-perfect optical properties, is addressed since this constrains sail force vector cone angle and is often overlooked when assuming ideal-reflector membranes. Preliminary sensitivity analysis using these tools aids in determining the key geometric and optical parameters that drive solar sail propulsive performance.