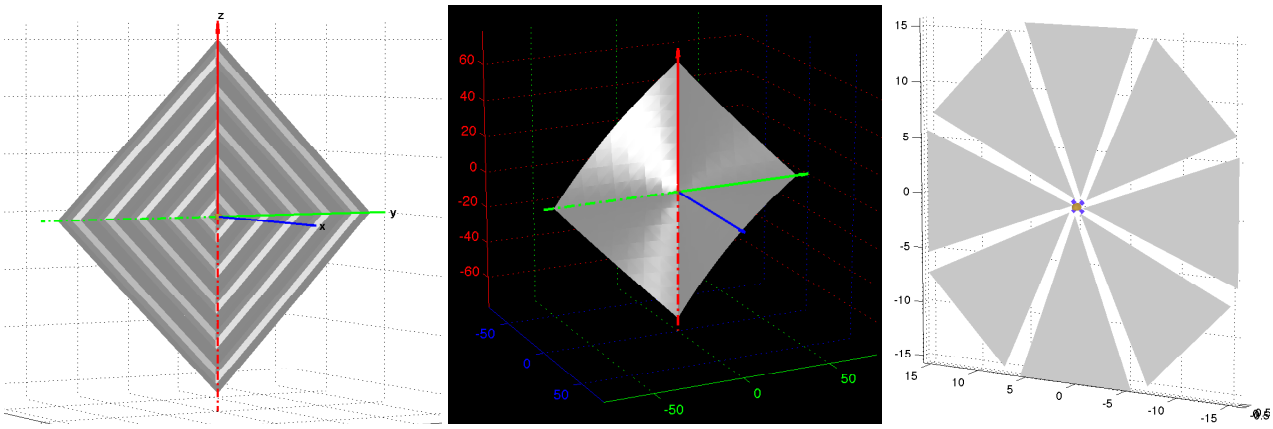
Princeton SATELLITE SYSTEMS

Solar Sail Module

for the Spacecraft Control Toolbox, Professional Edition



The Solar Sail Module provides specialized functions for modeling sail attitude control systems and trajectories. PSS has been developing sail analysis software since 2004 for both NASA's In-Space Propulsion program and the SBIR program. Our high-fidelity disturbance model enables users to simulate complex sail shapes without resorting to analytical approximations. You can study the nonlinear effects of different sail material properties and propellantless actuation schemes. The combination of these special sail CAD and dynamics models with control design tools from the core toolbox provide a complete sail attitude and orbit control analysis solution!

Highlights

- Attitude control with vanes, moving mass, and rotating boom
- Sail disturbance function with a combined optical and thermal solar pressure force model
- Locally optimal control for geocentric and heliocentric orbits
- Simulations of integrated guidance and attitude control
- Mission examples such as Solar Polar Imager, interstellar heliopause
- Deployment dynamics with time-varying inertia
- Numerical trajectory optimization using simplex or genetic algorithms
- Flat and striped square sail designs, sails with billow, bladed designs
- Visualization functions for guidance angles, sun and planet geometry

Sail Designs

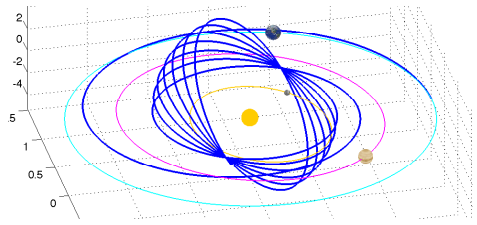
The Solar Sail Module has examples of several common sail configurations, including square, circular, and bladed designs. There is a function producing a striped quadrant and capability for modeling billow as a function of planar location. Sails are modeled as a triangular mesh for use in disturbance computations.

Propellantless Attitude Control

Sail control mechanisms such as sliding masses and a gimballed boom can be modeled in detail. A boom can be modeled with two-body dynamics and gimbal rotation constraints. Vanes can easily be handled as additional membranes.

Trajectory Analysis

McInnes' locally optimal control laws are modeled for geocentric and heliocentric orbits. Orbits can be propagated using a single or multi-body gravity model. An example is a patched trajectory from the two locally optimal laws for semi-major axis and inclination, from NASA's Solar Polar Imager concept.



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