

Analytical Method for Satellite Projected Cross Sectional Area Calculation

Calculating the projected cross-sectional area (PCSA) of a satellite along a given direction is essential for evaluating the forces and torques induced by atmospheric drag and solar radiation pressure. The PCSA is also required for implementing attitude control modes such as Sun pointing or minimum-drag. This paper develops a new analytical method for calculating the PCSAs, the concomitant torques and the satellite exposed surface area, based on the theory of convex polygons. A scheme for approximating the outer surface of any satellite by polygons is developed. Then, a methodology for calculating the projections of the polygons along a given vector is employed. The methodology also accounts for overlaps among projections, and is capable of providing the true PCSA in a computationally-efficient manner. Using the Space Autonomous Mission for Swarming and Geo-locating Nanosatellites mechanical model, it is shown that the new analytical method yields accurate results, which are similar to results obtained from alternative numerical tools.