17th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Space Debris Detection, Tracking and Characterization (1)

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COMPUTING SURFACE BRIGHTNESS INTEGRALS OF ARTIFICIAL AXISYMMETRIC SPACE OBJECTS FOR PHOTOMETRIC LIGHT CURVES

Abstract

Light curve inversion (LCI) has proven valuable in using photometric measurements to optimize various physical parameters of a resident space object (RSO) such as rotational period about its own spin axis, pole orientation and others. Other characteristics such as shape and size are dependent on the surface brightness. LCI has been developed significantly for asteroids, although not foolproof for artificial RSOs. On the contrary, the minimal studies performed for satellites utilize a priori information on attitude and a simplified geometric model such as a cuboid. Investigation of artificial space objects such as rocket bodies and satellites, both active and defunct, require a more complex polyhedron to estimate its shape. Various methods compute the light curves of irregularly shaped bodies at arbitrary viewing angles and illumination geometries by integrating brightness. The more conventional approach is to compute surface integrals by polyhedral approximation with triangular facets (ie. Delaunay triangulation) of differing sizes based on the mesh and summing it over the facet areas. One of the more efficient methods, based on Lebedev quadratures, is function integration employed in light curve simulation. The unit sphere has shown faster computational times than polyhedral sums and an increased accuracy regardless of noise in the data. It requires no collocation of the surface into a polyhedral approximation. Simulating a rocket body or satellite with a non-convex surface uses a superposition of surface brightness functions. The synthetic light curves at varying angular rotational speeds using interpolated surface reflectance properties across the facets generated via simulation are compared to the reference. This paper investigates the feasibility of using function integration for asteroids and rocket bodies using spherical and axisymmetric models with composite brightness functions respectively.