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SPACE PROPULSION SYMPOSIUM (C4)
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LIGHTFORCE: REFINED LASER PROPULSION FORCE MODEL

Abstract

Photonic propulsion has long been contemplated as an energy efficient mechanism for propelling spacecraft. The idea was first considered with respect to using solar radiation pressure, but recent years have seen the development of artificial light – lasers – as a pressure source. This work examines the force model for a medium-powered ground-based laser propulsion system as applied to small-medium space debris objects in low Earth orbit. Application of such a system could allow for collision avoidance among otherwise uncontrolled orbital debris objects. This class of objects is least likely to be neutralized through alternative methods such as active debris removal. The force model delineated here is an improvement on the simplified model first presented in Mason et al. (2011). The model reexamines earlier assumptions such as absence of specular reflection for debris orbiting above 600 km and neglect of thermal re-radiation forces. The result is a set of general equations, solved here for two geometrical scenarios, which can be used to determine the magnitude and direction of the total photonic propulsion force and an upper limit of the thermal re-radiation force for any arbitrary target surface. An adapted High-Precision-Orbit-Propagator and historical Two-Line- Element data are used to assess the effect of photonic propulsion on actual debris objects. Depending on objects properties results of these analyses can show significant divergences in respect to prior models.