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LIGHTFORCE: AN UPDATE ON ORBITAL COLLISION AVOIDANCE USING PHOTON PRESSURE

Abstract

We present an update on our research on collision avoidance using photon-pressure induced by ground-based lasers. In the past, we have shown the general feasibility of employing small orbit perturbations, induced by photon pressure from ground-based laser illumination, for collision avoidance in space. Possible applications would be protecting space assets from impacts with debris and stabilizing the orbital debris environment. Focusing on collision avoidance rather than de-orbit, the scheme avoids some of the security implications of active debris removal and requires less sophisticated hardware than laser ablation. In earlier research we concluded that one ground based system consisting of a 10 kW class laser, directed by a 1.5 m telescope with adaptive optics, could avoid a significant fraction of debris-debris collisions in low Earth orbit. This paper describes our recent efforts, which include refining our original analysis, employing higher fidelity simulations and performing experimental tracking tests.

We investigate the efficacy of one or more laser ground stations for debris-debris collision avoidance and satellite protection using a physics-based simulation to investigate multiple case studies. The approach includes modeling of laser beam propagation, the debris environment including actual trajectories and physical parameters, and resulting photon pressure. In contrast to earlier research the focus is now on satellite protection. We also present the results of experimental laser debris tracking tests. These tests track potential targets of a first technical demonstration and quantify the achievable tracking performance.