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A NOVEL LASER PROPULSION SYSTEM FOR MICROSATELLITE LAUNCH

Abstract

With the demand of space exploration, utilization and exploitation is increasing, and the limitations of the conventional launch vehicles with chemical energy propulsion are emerging. Humans are seeking new ways to enter space more affordably and quickly. The laser propulsion system uses the interaction between high-energy laser and working medium to generate thrust. The working medium absorbs laser and forms high temperature plasma. The specific impulse is more than 2000s, and a high thrust can be obtained. And the working medium is separated from the laser supply system, which not only improves the launch efficiency (more than 10In this paper, a novel laser propulsion system suitable for microsatellite launch is proposed. The laser propulsion system consists of a ground-based laser system, a laser vehicle (named lightcraft) and a relay mirror. The ground-based laser system emits high-energy laser beams to the lightcraft to provide energy. Lightcraft is a launch platform for microsatellites. In the atmosphere, the thrust is generated by the interaction between the laser beam and the air. Outside the atmosphere, the thrust is generated by the interaction between the laser beam and the propellant (water). The lightcraft's thruster is designed for airbreath-rocket combined mode, which consists of a fairing, a parabolic reflector and an annular nozzle. The parabolic reflector focuses laser beam on the wall of the annular nozzle to form an annular ignition line, which turns air or water into high-temperature and high-pressure plasma and forms detonation waves. When the detonation wave interacts with the wall of the annular nozzle, it generates thrust to push the lightcraft. The fairing protects the payloads and effectively reduces the air resistance in atmospheric flight. As an external compression inlet, it also provides air for laser thruster and converts airflow's kinetic energy into potential energy. When the lightcraft's flying direction is changed from vertical to horizontal, the laser beam is repositioned by a relay mirror deployed on the orbit and turned to the horizontal direction to the lightcarft, which solves the problem that the existing laser propulsion system cannot receive the laser because of a large incident angle.This proposal has passed the multi-disciplinary simulation of laser energy, pneumatics, power and trajectory. It can achieve single-stage-to-orbit and the launch efficiency is more than 12%.