A CONTAMINATION-FREE ULTRAHIGH PRECISION FORMATION FLIGHT METHOD BASED ON INTRACAVITY PHOTON THRUSTERS AND TETHERS

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We propose a revolutionary method that enables ultrahigh precision satellite formation flying with intersatellite distance accuracy of nm (10^{-9} m) at maximum estimated distances in the order of tens of km. The method is based on an innovative ultrahigh precision intracavity photon thruster able to provide continuously adjustable impulses from pNs (10^{-12} Ns) to mNs with an impulse precision of pNs between microsatellites, and tethers. The thrust of the photons are amplified by as much as 20,000 times by bouncing them between two mirrors located separately between pairing satellites, and a 10 W photon thruster is capable of providing thrusts up to 1.34 mN with currently available components. A crystalline-like structure of satellites is proposed to be formed by the pushing-out force of the intracavity lasers and the pulling-in force of the tether tension between satellites.

The proposed intracavity thruster does not require propellant, thus is contamination free, ideal to mission that require large apertures composed of highly sensitive sensors. It has a thrust to power ratio as high as 10^{-4} N/W, 5 orders of magnitude larger than that of microwave scattering forces (10^{-9} N/W). The weight of the proposed system with 10 W lasers for 100 kg spacecrafts is estimated to be in the order of several kgs, orders of magnitude lighter than that of the electromagnetic system.

The Phase I will focus on investigating several critical issues for designing a laboratory-scale demonstration and full-scale engineering studies and design for Phase II. Specifically, the device, such as a laser interferometer, for measuring distances between the satellites, and the method of its integration with the laser cavity thrusters will be investigated. Furthermore, the method of integrating the laser cavity thrusters with tethers will also be investigated, and collaborative arrangements with tether and simulation specialists will be established.