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INDIRECT OPTIMIZATION FOR POWER-LIMITED ASTEROID RENDEZVOUS

Abstract

Owing to the higher specific impulse compared with chemical propulsion, solar electric propulsion (SEP) improves effectively the efficiency of deep-space transfers. Since the SEP-based spacecraft generates the power from solar panels, the engine input power varies as the function of the heliocentric distance. The power-limited low-thrust optimization becomes more challenging because the thruster should be operated within a bounded power interval. In this work, a robust indirect method is presented for solving time-optimal and fuel-optimal low-thrust transfers considering power constraint. In our method, the homotopy from energy-optimal problem to fuel-optimal problem is employed. The analytic derivative, homotopy method and switching time detection technique are integrated into an enhanced integration flowchart which adds branches to detect variations of power status. The compensation of the state transition matrix (STM) at discontinuous time is derived according to calculus of variations. Compared with previous works, accurate STM is calculated for the first time, to enhance the algorithmic robustness. A CubeSat mission for asteroid rendezvous is simulated to verify the proposed method.