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OPTIMAL DESIGN AND ANALYSIS OF MULTI-IMPULSE HOVERING ORBIT FOR EARTH SATELLITE

Abstract

On-orbit servicing has evoked great interesting of space agencies as it enables on-orbit assembly, maintenance of equipment, replenishment of consumables, upgrade and repair et al. Design and optimization of trajectory to approach and inspect the target satellite is a key technology for on-orbit servicing.

In this paper, the hovering orbit with multiple impulses inside a fixed zone relative to the target satellite is investigated. The relative motion of hovering orbit with multiple impulses is constructed in the classical Clohessy-Wiltshire (C-W) equations. A global optimization algorithm, Differential Evolution, is applied to get the optimal solution. Excepting water-dropping hovering of two impulses, other hovering formation constructed by 3, 4, 5, and 6 impulses are also designed and optimized. The benefits from the increment of impulse number for reducing fuel consumption and rising continuing time of hovering orbit are analyzed firstly based on the optimization orbits. The relationship between the sum of velocity impulse and hovering time for each kind of multi-impulse hovering orbit is also constructed. It will be the key information for a tradeoff between fuel consumption and inspect time in a fuel-limited mission. The result presented in this paper explored the advantage and feature of multi-impulse hovering when increasing the number of impulse by designing optimal hovering orbit.