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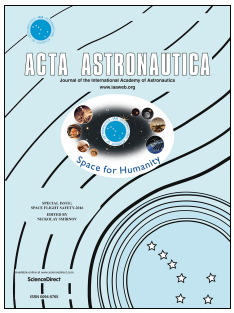

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Integrated guidance and control for microsatellite real-time automated proximity operations

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Abstract

This paper investigates the trajectory planning and control of autonomous spacecraft proximity operations with impulsive dynamics. A new integrated guidance and control scheme is developed to perform automated close-range rendezvous for underactuated microsatellites. To efficiently prevent collision, a modified RRT* trajectory planning algorithm is proposed under this context. Several engineering constraints such as collision avoidance, plume impingement, field of view and control feasibility are considered simultaneously. Then, the feedback controller that employs a turn-burn-turn strategy with a combined impulsive orbital control and finite-time attitude control is designed to ensure the implementation of planned trajectory. Finally, the performance of trajectory planner and controller are evaluated through numerical tests. Simulation results indicate the real-time implementability of the proposed integrated guidance and control scheme with position control error less than 0.5 m and velocity control error less than 0.05 m/s. Consequently, the proposed scheme offers the potential for wide applications, such as on-orbit maintenance, space surveillance and debris removal.

Keywords: Autonomous proximity operations, Microsatellites, Trajectory planning and control, Complex constraints, Real-time implementability

1. Introduction

Autonomous guidance and control in the proximity of non-cooperative target is becoming increasingly important in the future because this technology enables several critical technologies of many space missions such as

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