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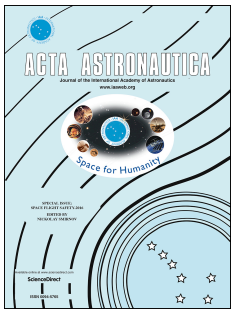

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Quasi-Model Free Control for the Post-capture Operation of a Non-cooperative Target

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Abstract: This paper investigates a quasi-model free control (QMFC) approach for the post-capture control of a non-cooperative space object. The innovation of this paper lies in the following three aspects, which correspond to the three challenges presented in the mission scenario. First, an excitation-response mapping search strategy is developed based on the linearization of the system in terms of a set of parameters, which is efficient in handling the combined spacecraft with a high coupling effect on the inertia matrix. Second, a virtual coordinate system is proposed to efficiently compute the center of mass (COM) of the combined system, which improves the COM tracking efficiency for time-varying COM positions. Third, a linear online corrector is built to reduce the control error to further improve the control accuracy, which helps control the tracking mode within the combined system's time-varying inertia matrix. Finally, simulation analyses show that the proposed control framework is able to realize combined spacecraft post-capture control in extremely unfavorable conditions with high control accuracy.

Key words: Post-capture control, Model free control, Non-cooperative target, Space debris removal, Space rendezvous and docking

1. Introduction

Non-cooperative space object capture and post-capture control has been a research topic of considerable and widespread interest in recent years. The capture targets vary from satellites under failure to space debris and large space structures in space assembly missions [1]. Due to the complexity and high risk of controlling such targets, guidance, navigation and control (GNC) system design for the active spacecraft (or the chaser) is significantly important to ensure mission success. A complete GNC framework and mission planning strategy for a non-cooperative target rendezvous mission was presented by Louembet [2], in which the hover trajectory and capture orbit were properly designed.

Since the dynamical parameters of the non-cooperative target, including the mass and the moment of inertia

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