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DISTRIBUTED COOPERATIVE SPACECRAFT SURROUNDING CONTROL WITH INPUT SATURATION AND COLLISION AVOIDANCE

Abstract

For the task of multiple service spacecraft observing the target cooperative spacecraft, a tube-based model predictive control strategy is proposed to solve a surrounding control problem considering input saturation and collision avoidance. Firstly, the relative orbital dynamics model of spacecraft formation is established. The target cooperative spacecraft is regarded as the single leader of the system and multiple service spacecraft are followers. The leader and followers are connected by an undirected graph. Secondly, the sum of the quadratic form of the state and control input is selected as the performance index function for optimization to obtain the near optimal strategy. Then a local robust feedback controller can be designed to ensure the actual system state of the disturbance to be in the tube invariant set centered on the nominal system state considering that all the spacecraft are affected by external disturbances. The control problem with input saturation and collision avoidance of spacecraft is able to be transformed into a standard quadratic programming form with constraints which can handle the above constraints in the rolling time domain optimization process of model predictive control. The stability of the closed-loop system can be guaranteed by Lyapunov theory. The relationship of each spacecraft in the system is represented by graph theory. All the designed algorithms are distributed and able to be implemented by using local measurement. The proposed control strategy is applied to the system. Simulation results are provided to show the effectiveness of the proposed method.