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PROCEEDINGS

Efficient Calculation Model and Guidance Law of Non-Contact Plasma Plume De-Tumbling

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ABSTRACT

Dramatically increase of the amount of the failed satellites is posing a serious threat to the normal orbiting satellites. To avoid potential collisions, it is important to remove the failed satellites, and the first step is to detumble these uncontrolled targets. This study proposes an efficient calculation method for the failed satellite de-tumbling system. The plasma plume generated by Hall effect thruster on chaser is used as non-contact de-tumbling medium, which reduces fuel consumption and collision risk [1]. The plasma plume is composed of a variety of particles with strong disorder, so it is difficult to calculate the plume de-tumbling torque. In order to solve the problem of complex plume calculation and difficult implementation of onboard computer, neural network is used to establish an efficient calculation model of de-tumbling to realize efficient and high-precision de-tumbling calculation. Traditional guidance laws are difficult to deal with diverse and complex tumbling states, therefore this study uses genetic algorithm to establish the optimal plume pointing guidance law for various motion states based on the efficient calculation model. According to the relative position and attitude between the target and the chaser, the trajectory and plume direction of the chaser can be obtained through the guidance law. The de-tumbling torque and its variation trend are introduced as disturbances into the model predictive control (MPC) algorithm, which can approach the desired trajectory and attitude of the chaser quickly. Finally, numerical simulation results indicate that the proposed neural network-based efficient model can reduce the model computing time by 90% and the optimal guidance law can stabilize the target in various motion states.

KEYWORDS

Plasma plume de-tumbling; neural network; optimal guidance law; model predictive control

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