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IMPACTOR TARGETING MANEUVER SYSTEM FOR 2016HO3 PROBE

Abstract

Asteroid 2016HO3 is considered as the most stable quasi-satellite of Earth and has been a new focus of mission target. China plans to launch a probe mission to this asteroid, consisting of a mother flyby spacecraft and an impactor spacecraft. The impactor spacecraft hits the target with a high speed to make a crater. Then the mother flyby spacecraft can observe and take high-resolution images of the crater for scientific research.

Impacting probe missions puts forward a higher requirement for navigation and guidance to ensure a precise impact. Nowadays, with the improvement of on-board computers and sensors for navigation, especially with advanced optical technology, autonomous optical navigation system has become a significant method for navigation. AutoNav system is the first autonomous optical navigation system used in Deep Impact mission, which made a precise impact to Temple 1.

However, the size of 2016HO3 is likely between 40 and 100 meters, which is nearly 1/100 of the size of Temple 1 (14km*5km*5km in size). The extremely smaller size of target poses significant challenges for navigation and guidance because the asteroid-relative trajectory accuracy should be improved better than 40 meters. Moreover, the time for impactor targeting maneuver is also limited because cameras can only capture the smaller-sized asteroid 2016HO3 from a closer distance.

Therefore, based on the requirement for navigation and limitation of volume and fuel, we present a new model and algorithm for impactor targeting maneuver system for 2016HO3 probe. The model has a thrust unit, consisting of 10 propulsion devices towards different directions, which can couple attitude and orbit control, a ranger-finder and a fixed on-board camera. The target is tracked by 'following bright spot' algorithm. By processing images taken by on-board camera and data taken by ranger-finder, the impactor can compute asteroid-relative position and velocity. Then impactor targeting maneuver system will determine the direction and duration of maneuver, which can make the impactor slew to a proper attitude to point to the nucleus of target. At last, we conduct a few numerical simulations with different impacting speeds for validation. The results of simulations are encouraging, and the proportion of a successful impact is above 99.2 percent.