

SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (4)

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RELATIVE DISTANCE ESTIMATION BETWEEN THE ASTEROID 4179 AND CHANG'E II BASED ON SPACEBORNE OPTICAL IMAGES

Abstract

China's Chang'e II satellite overflew the asteroid 4179 Toutatis on December 13, 2012. When the satellite was close to the asteroid, the spaceborne surveillance camera successfully implemented optical imaging, which is the first time in the international to detect the asteroid 4179 Toutatis at so close range. 3.2 kilometers is the current released closest relative distance between the Chang'e II satellite and the asteroid when flyby, which derived from measurement data of ground measurement and control system and the ground-based observation system. The ground measurement and control system is used to track the satellite trajectory by radio methods, and meanwhile the ground-based observation system is used to determine the asteroid orbit through multiple optical telescopes. When the Chang'e II satellite overflew Toutatis, the asteroid was about seven million kilometers far away from the earth. In such a long distance, it is obvious that there exists absolute measurement error in the terrestrial radio measurements and ground-based optical observations, thereby affecting the estimate accuracy of the relative distance. In this regard, the paper aims to build a model for analyzing and calculating the relative distance between the two moving targets on the basis of the obtained asteroid image sequence from the point of view of computer vision, which is according to the characteristics of the relative motion trajectory and the surveillance camera central projection imaging principle. Based on the model, we re-estimated the closest relative distance between the two targets by using the radio relative measurement information during the satellite close to and overflew the asteroid. The method took the advantage of the high precision of radio relative measurement information. The new result is 1.5 kilometers, which is less than the early released result. The reliability of the calculation can be proved, and the theoretical accuracy is better than 30 meters. Meanwhile, combining known geometric parameters of the asteroid 4179, the relative angle of dip between the asteroid and the Chang'e II trajectory when flyby can be calculated, which is nearly 33 degrees.