

TRANSFER TRAJECTORY OPTIMIZATION OF KINETIC IMPACTOR TECHNOLOGY BASED ON MULTIPLE SPACECRAFT

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ABSTRACT

Asteroid impacts may be the cause of several extinctions of life on the earth. Preventing severe asteroid meteorite impact catastrophe and improving asteroid defense capabilities are the challenges that mankind has always faced. Researchers have proposed various asteroid defense methods, of which only kinetic impactor technology is applied in reality. Because of the wide disparity between asteroid and deflection impactor in mass, although the collision velocity in kinetic impact is extremely high, the velocity change caused by impact is minute, only a few millimeters per second or even less. The deflection effect of a single spacecraft is finite, and only increasing the impact speed has feeble influence on enhancing asteroid deflection distance. In order to the goal of planetary defense, this paper, taking Apophis as an example, proposes a multi spacecraft kinetic impact defense scheme, and studies the deflection effect of multi spacecraft impact scheme to change the near-Earth distance of Apophis in 2036 in the case of a ten-year or five-year early warning time. The paper also evaluates the defense effect and select the defense window by using the two-body model. In addition, the two-pulse transfer and small thrust transfer scheme are adopted for the spacecraft and the interception orbit is optimized through the bang-bang control and other method in the paper. Last but not least, the correctness and optimality of the simulation results in this paper are demonstrated at the same time. From the simulation results, the kinetic energy impact defense method of multiple spacecraft can significantly improve the maximum deflection distance of asteroids. Improving the mass of impactors can reduce the number of spacecrafts in this scheme, and the time series of multiple spacecraft impact has a strong correlation with the final deflection distance.