An interplanetary mission to Near-Earth Objects (NEOs): Analysis of trajectories to Asteroid for Sample Return Mission Using Gravity Assists

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Asteroids exploration missions attract many scientists' interest, because asteroids hold key clues to understanding the origin of our solar system and the information of the planets. Since last century, human have carried out many deep space missions (DSI, NEAR) and gained a plenty of valuable experience. With many new asteroid missions in various stages of development (MUSES-C, ROSETTA) the situation regarding our understanding of these bodies can improve in the future. With the success of "Shen-Zhou" manned spaceship and the development of "Chang-Er" program, it will provide the great opportunity for Chinese development of the deep space exploration. The gravity assist is a proven technique interplanetary exploration, as exemplified by the mission Voyager etc. Here, a mission to Near Earth Asteroids (NEAs) sample return for the 2010-2020 is proposed, with the goal of selecting the potential candidates and studying schemes for the mission. According to the constraints of the mission, we search and present the optimal rendezvous and sample return opportunities for potential candidates. A direct transfer to the candidate is considered and also Earth gravity assist are used for the transfer to candidate. In addition, when the spacecraft passes through the asteroid belt, it will take advantage of asteroid flyby opportunities. In order to accomplish the multiple flyby asteroids and sample return, we first need to optimize the trajectory to candidate with planetary gravity assist and then search for asteroids that would pass close to this trajectory and refine the trajectory including more asteroid flybys. Finally, we analyze the trajectory characteristics and gave some key parameters, which would have a direct impact on communication system, power system, thermal control system of spacecraft and the optical instrument for science mission etc.