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# DESIGN OF PERIODIC ORBIT INCLINED TO THE SUN LINE AROUND AN ASTEROID WITH IMPERFECTLY REFLECTING SOLAR SAIL

**Abstract**

Asteroid exploration missions have become more and more sophisticated in recent years, but to carry out these missions, spacecraft must be able to reach their destinations. However, the amount of propellant that can be loaded onto a spacecraft is limited, and the payload capacity limits the range of reach and the operational period of the mission. These problems must be addressed in order to further expand the range of exploration missions in the future. Solar sails, which generate thrust using solar radiation pressure instead of propellant, may be one solution. One of the first tasks for asteroid exploration missions is to stay in the vicinity of an asteroid, and one of the methods is to create an orbit around the asteroid. Generally, orbits in the restricted three-body problem can be easily designed by using of the symmetry of dynamics about a line between 2 celestial bodies. In particular, in the vicinity of an asteroid, there are two colinear equilibrium points for the Hill 3-body problem with an identical linear solution, and families of periodic orbits exists around the L2 point. However, the design of orbits that do not have symmetry about the sun line is difficult because state variables will increase. The same symmetry with respect to the sun line holds when perfect reflection of the sail surface is assumed, but it is no longer valid when imperfect reflection is considered. In this study, we consider the imperfect reflection of a realistic solar sail and design orbits that has no symmetry with respect to the sun line of its shape.To obtain an initial estimate of the orbit, the L2 equilibrium point, whose position is shifted as the attitude angle of the solar sail changes, is used.When the clock angle of the solar sail is changed, L2 is shifted away from the sun-asteroid line. Therefore, the symmetry of the dynamics is no longer ensured, but the displacement created by the asymmetry is small. A perfectly closed periodic orbit is designed by slightly adjusting the attitude of the solar sail and correcting the orbit.