Paper ID: 38247
student

ASTRODYNAMICS SYMPOSIUM (C1)
Mission Design, Operations & Optimization (1) (6)

Author: Mr. Junhua Zhang
National Key Laboratory of Aerospace Flight Dynamic, Northwestern Polytechnical University, China, zhangjunhua@mail.nwpu.edu.cn

Prof. Jianping Yuan
National Key Laboratory of Aerospace Flight Dynamics,Northwestern Polytechnical University,Xi'an, China, jyuan@nwpu.edu.cn

THE OPTIMAL TRAJECTORY FOR OBSERVING NON-COOPERATIVE TARGET WITH KOZS CONSTRAINTS

Abstract

Nowadays, with the growing number of on-orbit spacecraft and debris, the proximity operations are studied by more and more researchers. The observing of spacecraft is the precondition, especially for non-cooperative spacecrafts. Therefore, to observe a target thoughtfully is very important. For a spacecraft, it always has its own sensor, such as onboard camera which is the most common. To observe the bottom of target, the view of sensor is needed to avoid. Additionally, the spacecraft is considered as rigid body (i.e., body with finite dimensions) in practice. Therefore, avoiding the target's sensor field of view and avoiding collision with the target must be considered.

In this paper, a transferring trajectory of a chaser from one side of a non-cooperative target to the other for observing a target while avoiding two keep out zones (KOZs). The chaser and target are on the same orbit. The initial position of chaser is assumed behind of target with angle . The first keep out zone (KOZ) is the target, and it is designed to be a sphere with finite radius. The radius R is slightly larger than the dimension of the target. Another KOZ is the target's sensor field of view cone. The apex of the cone is located on the centroid of target. The constraints of KOZs are given using the radius and the apex angle which can be changed in different cases. The goal is to transfer the chaser from the initial position to the final position to observe the bottom of target while avoiding the KOZs. The maneuver which combines radial and normal impulse/thrust is executed. The transferring trajectory is presented analytically under the Clohessy–Wiltshire–Hill dynamics model. Depending on some conditions, such as the apex angle of cone, the radius of sphere, the transferring trajectory is optimized. The optimal trajectory is presented analytically. Impulse and thrust are selected for the manners of maneuver. The transferring trajectories are thoughtful compared in two manners. Additionally, the trajectories with drift term and initial error of position and velocity are discussed. The simulation results give the optimal trajectory with the manners of impulse and thrust.

The method in this paper provides a manner to observe non-cooperative spacecraft thoughtfully with sensor whose line of sight is towards to earth's center. Comprehensive information is beneficial to approach and capture non-cooperative target. More KOZs can describe relative safe domain between chaser and target better.