

ON STATION KEEPING OF SPACECRAFTS WITH SOLAR SAIL AROUND THE EARTH-MOON COLLINEAR LIBRATION POINTS X. Y. Hou^{1,2}, L. Liu^{1,2} and W. Zhang^{1,2}, ¹Astronomy Department, Nanjing University, Nanjing 210093, China, lliu@nju.edu.cn, ²Institute of Space Environment and Astronautics, Nanjing University, Nanjing University, Nanjing 210093, China.

Introduction: The conditional stability and fixed position of collinear libration points in the earth-moon system make them potential candidates for future moon explorations. Due to the essential instability of these points and various perturbations in the real solar system, orbit control is necessary for spacecrafts moving around these points. Spacecrafts sent to collinear libration points till now all fulfill their station keeping with impulsive maneuvers. However, station keeping strategies with continuous low-thrust were also studied in concept.

One alluring kind of continuous thrust is the solar radiation pressure. With the resurgence of solar sailing technology, various applications of solar sails in the collinear libration point missions have been studied, including station-keeping, transfer between orbits around collinear libration points and formation flying. Most of these studies are about the Sun-Earth+Moon system for which Circular Restricted Three-Body Problem (CRTBP) is a good approximation. For the Earth-Moon system, however, the circular restricted three-body problem is no longer a good approximation due to large gravitational perturbations from the sun. Besides, the geometrical configuration of the spacecraft with respect to the sun in the earth-moon system is different from that of the sun-earth moon system where the radiation body is one of the primaries.

With these differences, orbit design and control with solar sail around the collinear libration points in the earth-moon system should be different from those in the sun-earth+moon system. In our paper, a low-order analytical solution considering the gravitational perturbations from the sun for a sun-facing spacecraft were firstly constructed. Then a loose control strategy with solar sail was proposed. Two modes were considered. One mode is to keep the lightness parameter constant and change the yaw and pitch angle of the solar sail. The other one is to keep the yaw and pitch angles constant and change the lightness parameter of the solar sail. Some numerical simulations were made and the results were discussed in comparison