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# TRAJECTORY DESIGN OF ORBIT TRANSFER FROM THE ORBIT ABOUT SUN-EARTH LIBERATION POINT TO THE ASTEROID WITH HYBRID OPTIMIZATION METHOD

**Abstract**

Orbit about sun-earth liberation point has long been a focus of study, since the spacecraft ISEE-3 launched in 1978, some probes had been sent to the orbit for scientific purpose. The latest one of them is the Chinese probe "Chang'e-II" who is now running in a Lissajous orbit around Sun-Earth L2 point.

In this paper a strategy for trajectory design of orbit transfer from the Lissajous orbit about the Sun-Earth liberation point to the asteroid is presented. Because of huge number of asteroid candidates, which is up to more than 7,000, finding a solution of suitable asteroid candidates for the space exploration is a difficult task. To do this, the Lissajous orbit in which the satellite is running is divided into a number of segments first. In each segment, to reduce computational cost, an approximate model is used to solve Lambert's orbital-boundary value problem of all asteroid candidates. Using this method, after optimizing the parameters of fly duration and the position when the satellite start the maneuver, a set of asteroid candidates is obtained with the constrains of magnitude of maneuver velocity and distance of the asteroid to Earth when the satellite reach the target. The size of asteroids is also taken into account, because a larger asteroid will be easier for the sensors onboard the probe to find, so that scientist can use the probe to conduct scientific research planned in advance.

The optimization process is based on a population-based memetic algorithm combining global and local search. For the local search, once the candidates are selected, a direct transcription method which divides the trajectory into a number of elements is performed. With the constraints of continuity condition between the elements and boundary conditions, the data of the individual elements obtained during the process are optimized in parallel. Pareto-optimal solution is obtained with the a population-based multi-objective optimization algorithm of the EDA type (Estimation of Distribution Algorithms) searches thrust parameters aiming at minimize the fuel cost and distance of the target when the probe arrive at.. Some preliminary results show the achievable performance of the strategy searching the asteroids and corresponding orbit transfer.