

論文の内容の要旨

論文題目: A Study on Periodic Orbits around Collinear Libration Points
(ラグランジュ点近傍における周期軌道の設計と利用に関する一考察)

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The five dynamic libration points in a three-body system were firstly discovered by J. L. Lagrange. These points can keep their orientations with respect to the planets regardless of time and thus they draw attention as a relay port between the Earth and the outer space. A systematic research must be conducted but is currently insufficient on the use of the libration points of the Sun-Earth (SE) and Earth-Moon (EM) system to suggest the feasibility of the space hubs.

This dissertation first presents orbital control strategies to keep a spacecraft in the vicinity of the collinear libration point. Control laws utilizing a low continuous thrust or the solar radiation pressure to design a small-amplitude parking orbit are proposed.

Next, the transfer schemes between the Earth and the L2 point of the SE and EM system are investigated. The results explain the benefit of using the Moon swing-by to save the cost and show the relationship between delta-V and flight time of each type of transfer.

In addition, transfers between the libration points of the SE and EM system are discussed. The amount of delta-V, width of the launch window and flight duration for the several transfer schemes are summarized.

Finally, transfers to the interplanetary space from the L2 points are considered. Techniques of the trajectory correction using the solar perturbation or the Moon swing-by are proposed. Applying these strategies makes the spacecraft effectively increase its orbital energy.

The results obtained in each chapter of this dissertation support the argument that the libration points can be used as a transportation hub with a little cost and would be useful for the missions connecting the Earth with deep space.