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A STUDY OF THE STATION KEEPING FOR SPICA MISSION USING DYNAMICAL SYSTEM THEORY

Abstract

Preliminary mission design of station keeping using dynamical system theory for the SPICA mission was studied. The SPICA (SPace Infrared telescope for Cosmology and Astrophysics) will be the first Japanese Lagrange point mission and this next-generation infrared astronomical satellite is likely to be launched into a Halo orbit around Sun-Earth L2 point in 2018. The vicinity of L2 point is an ideal place for the infrared astronomy because the radiative cooling could be effective and long observable area could be obtained due to the stable geometrical condition with respect to the Sun and Earth. Besides, placing the satellite on the Halo orbits allows us to keep the satellite away from the eclipse region because the L2 Halo orbit is not hidden inside the shadow of the Earth.

For the station keeping of Halo orbit with conventional way that the orbit error is corrected to the nominal orbit, the correction maneuver in the x direction of the rotating frame is dominant [1]. However, the shading constraint due to the current SPICA configuration to protect the telescope from the Sun does not allow us to fire the correction maneuvers in the x direction of the rotating frame simply. On the other hand, for the "loose" station keeping strategy of the Halo orbit, which controls the trajectories near the nominal path by eliminating the divergent component with the dynamical system theory [2], the direction of the correction maneuver is also restricted. However the restricted direction seems to be better than that of the conventional way for the SPICA shading constraint. Thus, in this study, we investigate the availability of the loose station keeping using the dynamical system theory considering the SPICA shading constraint. As a result, the amount of the correction maneuver is approximately 0.2 m/s/y, which achieve the mission requirement enough.

Reference

[1] K.C.Howell, and H.J.Pernicka, "Stationkeeping Method for Libration Point Trajectories," Journal of Guidance, Control, and Dynamics, Vol.16, No.1, 1993.

[2] Simo, C., Gomez, G., Llibre, J., Martinez, R., and Rodriguez, J., "On the Optimal Station Keeping Control of Halo Orbits," Acta Astronautica, Vol. 15, No. 6/7, 1987, pp. 391-397.