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PRELIMINARY STUDY ON SYSTEM AND MISSION SEQUENCE DESIGN FOR TRANSFORMER MISSION

Abstract

Transformer, which has been studied mainly by JAXA, is a completely new system of a spacecraft. The spacecraft consists of a number of body components which are connected to each other by actuatable joints and can be transformed into various body configurations to exhibit multifunctionality. Furthermore, by actively utilizing the transformability, an advanced orbit and attitude control can be performed. In particular, the transformability enhances ability of solar sailing, which enables the spacecraft to maintain an artificial periodic orbit around the Sun-Earth L2 (SEL2). The artificial periodic orbit is an orbit that is much smaller in size than conventional halo orbits and can take full advantage of SEL2's stationary thermal environment. In addition, the angular momentum of the entire spacecraft will be kept nominally zero, which enables the spacecraft to perform rapid attitude reorientation using nonholonomic properties of the attitude motion when transforming.

This presentation describes the initial results of the system design of the Transformer spacecraft. Since the Transformer has a completely different structure from conventional spacecrafts, its system design requires a unique design philosophy. First, since the body configuration of a spacecraft greatly varies depending on the mission phase and mission requirements, feasibility of thermal, communication, and power design must be established in each situation. Second, because the relative geometry of body components frequently changes, the subsystems must be carefully distributed so that the power and communication interfaces are as simple as possible. In the presentation, we will describe the current status of the design study based on these unique design requirements.

The mission sequence from the launch to the insertion of the artificial periodic orbit around SEL2 is also described in this presentation. Epsilon launch vehicle (JAXA) is used for launch and its limited delta-v capability is compensated by using a stable manifold after a lunar swing-by. The size of the artificial

orbit and its manifold tube is much smaller than conventional halo orbits, which almost uniquely specifies the epoch of the swing-by every month. The phasing orbit is used until the swing-by, and it reinforces the robustness of the swing-by operation. The presentation shows results of the trajectory design and how it is reflected to the system design of the spacecraft.