Paper ID: 38417
oral

24th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Nano/Pico Platforms (6B)

Author: Prof. Masahiro Nohmi
Shizuoka University, Japan

STARS-ELEVATOR MISSION PLAN FOR TETHER DEPLOYMENT AND CLIMBER TRANSLATION

Abstract

STARS (Space Tethered Autonomous Robotic Satellite) project purposes to evaluate and to verify a space mechanical control system by a university satellite. The first satellite of the project was "STARS," which was launched by the H-IIA rocket in 2009. It was a mother-daughter satellite, a tethered satellite, and also a robotic satellite. The second satellite of the project was "STARS-II," which was launched by the H-IIA rocket in 2014. It was also a tethered satellite as well as STARS, however tether was 300m long (5m long on STARS) and Electro Dynamic Tether (EDT). The third satellite "STARS-C" was released from ISS on December 19, 2016, and it is now under operation. It is a 2U Cubesat and they are connected by 100m long Kevlar tether. Currently, the project is developing an orbital elevator satellite named "STARS-E" which is the fourth satellite. Its primary objective is to demonstrate orbital space elevator. Tether is planned to be extended for more than 1km, and a climber translates on it. It consists of mother and daughter satellites, and also one climber. Mother and daughter satellites will be launched under docking condition. Then, mother and daughter satellites will be separated on orbit, that is, tether will be extended. After long tether extension stabilized by the gravity gradient, the climber translates on it. Breadboard Model for STARS-E was already developed. It includes: a reel mechanism for tether deployment which controls tether extension actively using the gravity gradient force rather than passive control by spool mechanism; a climber which was developed based on the technologies accumulated in the space elevator challenge in Japan; and Structural Breadboard Model for mother and daughter satellite having separation mechanism and attitude control system for a tethered body in order to avoid tether being tangled up during its extension. On the other hand, it is pointed out that long tether extension is potentially dangerous with respect to space debris problems. Orbital debris analysis is needed to assess the potential hazard of tethered systems considering both an intact and severed system. Then, STARS-E mission has been evaluated for minimizing space debris problem. Here, note that this work was supported by JSPS KAKENHI Grant Number 15H02224.