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Conceptualizing Space Elevators and Tethered Satellites (3)

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DESIGN OF REEL-TYPE TETHER DEPLOYMENT MECHANISM AND ANALYSIS OF TETHER DEPLOYMENT DYNAMICS IN THE MICROSATELLITE STARS-E FOR VERIFYING THE BASIC TECHNOLOGY OF SPACE ELEVATOR

Abstract

The Space tethers is the cable which connects space systems and is expected to be applied widely in the future space systems including space transportation systems such as space elevator and electronic dynamic tether (EDT). For verifying the important basic technologies of space elevator, the tether deployment and the climber movement along the tether on the orbitwe are now developing a microsatellite called STARS-E. We design STARS-E assuming it would be a piggy-back satellite on H-IIA rocket. The size of satellite is a 500 mm cubethe total mass is 50 kg. STARS-E consists of a Mother Satellite (MS), a Daughter Satellite (DS), a tether and a climber. At the present design, the tether diameter is 1.2 mm and length is 1.2 km with considering the NASA's safety standard for space debris. The deployment force of the tether is given by the separation of the MS and the DS using the spring force housed in the satelliteAfter the tether deployment is completed and the dynamics of satellites and tether are stabilized, the climber moves along the tether. During these sequences, the data of tether and climber dynamics will be acquired by the GPSs and cameras on the satellites and climber. The tether tension also will be acquired by the tension meter equipped in tether deployment mechanism. For moving the climber along tether, the twist of tether is undesirable. In addition, it is necessary to rewinding tether after finishing the mission for avoiding debris impact. From these requirement, we adopted a reel type mechanism as a tether deployment mechanism. A level wind mechanism that enables smooth recovery of the tether is also equipped in the tether deployment mechanism. The rotation of the reel during the tether deployment and rewinding is controlled by the motor attached at the reel. We also analyse the dynamics of tether to understand the tether behaviour during and after deployment for estimating the timing of the start of climber mission by applying the cable dynamics model for space elevator we are developing. Details of the design of STARS-E reel type

deployment mechanism and the analytical result of tether deployment dynamics will be shown at the congress.