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Space Elevator Critical Technology Verification and Validation Testing (3)

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EFFECT OF TETHER DEPLOYMENT AND CLIMBER MOTION IN TETHERED SATELLITE SYSTEMS

Abstract

The landing of unmanned vehicles on gravitational celestial bodies including the moon and Mars for exploration is one of the goals in space development and it is expected that there will be active activities in the future. These orbital inputs have been carried out using the launch vehicle. However, it is considered that energy efficiency can be improved by using an orbital elevator in conjunction with this. This new space transport infrastructure is a large space flexible structure, and for its operation, a demonstration experiment is indispensable. Therefore, it is the tether satellite system STARS-Me that carries out experiments on the movement of climbers, which is a transport machine, using CubeSat, which is advantageous in cost and launch opportunities. The conventional tether has been deployed by the spring force used for separating the main satellite and the sub-satellite, and the gravitational inclination force which increases according to the tether extension distance. However, due to the short period of time during which the mission can be performed, the climbing movement should be started as soon as possible, so we adopted a bending stiffness higher than that used in the past for tethers. So that sufficient tethering force can be generated by the tether length that can be stored in CubeSat, we adopted the STARS-Me extension mechanism using a friction wheel. The big problem in operation of the tether satellite system is the rebound phenomenon in which the secondary satellite bounces back toward the main satellite due to the impact force at the completion of tether extension, and the influence on the stability of the whole system due to the movement of the climber. The experiments so far show that the acceleration and deceleration of the tether extension, the acceleration and deceleration of the steady speed, the movement of the climber and the degree of the steady speed affect the rebound phenomenon The next step is to verify the stability of the whole system on a wider test bed. Therefore, in this paper, a hydrostatic bearing type gravity compensator is used, to examine experimentally how the tether extension and climber movement on two-dimensional plane effect the entire system.