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THREE-DIMENSIONAL ANALYSIS OF A COUNTERWEIGHT TYPE SPACE ELEVATOR

Abstract

A system of the space elevator mainly studying at present is the climber type in which a cable is connected between the ground and space station and the payload is transported by the climbers ascend and descend along the cable [1]. However, this type of the system has problems, such as the difficulty of energy supply to climbers and the low lifetime because of the abrasion of cable and climber wheels in the operation. In this study, we try to investigate the possibility the establishment of counterweight type space elevator which has the possibility to overcome the problems in the climber type space elevator but is not studied in the past. The counterweight type is used as a normal elevator in the ground. To apply such type to space elevator, we consider the system which consists two cables, a guide cable that withstands tension applied to the structure and a moving cable that connects two gondolas at both ends, hung on the wheel in the space station, and transports the payload in the gondolas by driving the wheel. Such system hasadvantages such as that the energy necessary to operation can produced at the station by solar power and the operating energy itself can be reduced by using the potential energy of the gondola. The problem with this system is the interference between cables, and the dynamics of the cables in this system must be clarified to show the possibility of this type of system. In this study, we analyzed the cable dynamics by using the point mass cable model developed in our group when the counterweight type is applied between the GEO station and the ground, and the energy necessary to actual operation was also calculated. As a result, the ascent side cable swings in the west direction and the descent side cable swings in the east direction by Coriolis force, however, the interference between the cables can be avoided by arranging gondolas in the north and south directions. The energy required for operation was reduced compared to conventional space elevators. The detail will be shown in the conference.

[1] Ishikawa, Y., Otsuka, K., Yamagiwa, Y. and Doi, H., Effects of Ascending and Descending Climbers on Space Elevator Cable Dynamics, Acta Astronautica, Vol.145, pp.165-173,2018.