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EVALUATION OF THE COUNTERWEIGHT TYPE SPACE ELEVATOR: IN THE CASE APPLIED TO THE ALTITUDE UPPER THAN GEO

Abstract

As the transportation method of space elevator, the climber type is mainly studied at present. However, this type of system has problems, such as the difficulty of supplying energy to climbers and a short lifespan owing to the abrasion of the cable and climber wheels during operation. To solve such problems, we proposed a novel counterweight-type space elevator. This system consists of two cables: a guide cable that withstands the tension applied to the structure and a moving cable that connects two gondolas, one at either end of the cable, attaches to a driving wheel in the space station, and transports the payload in the gondolas by driving the wheel. In the preceding study [1], we analyzed the cable dynamics and energy consumption at the operation when the counterweight type is applied to the altitude lower than GEO, and showed that such type has an advantage compared with climber type from an energy consumption point of view when applied this system to low altitude where the potential energy effectively can be used. In this study, we evaluate the performance of counterweight type space elevator when applied this system to the altitude upper than GEO. As the result, we could show that the power consumption of the counterweight type space elevator is lower than that of climber type for all operating region of altitude upper than GEO. We also found that there is the optimal cable cross-section area for the gondola mass, and the abrupt acceleration of gondola is occurred in the operation when the cable cross-section area is not designed as the optimal value, but such unstable state can be reduced by the appropriate control of cable moving speed. The detail will be shown in the conference.

[1] Okino, T., Yamagiwa, Y., Arita, S., Ishikawa, Y. and Otsuka, K., Three-dimensional Analysis of a Counterweight Type Space Elevator, Acta Astronautica, Vol.185, pp,132-139, 2021.