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DEVELOPMENT AND EXPERIMENTAL STUDY OF HYBRID DRIVE CLIMBER FOR SPACE ELEVATOR TO BE APPLIED IN SPACE ENVIRONMENT

Abstract

The mechanism of a space elevator climber (so-called a mechanism that moves on a tether connecting the earth and space by driving rollers) and various control methods have been developed considerably in the technology to be examined on the ground. However, there are many problems to be solved in the actual space environment (gravity change, ultra-vacuum, temperature change, debris collision, etc.), and it is necessary to design climbers according to the environment. In particular, a climber that can travel long distances between geostationary orbit and the Earth is needed, and a drive mechanism and airframe with excellent durability performance are required.In previous research, mobility experiments and challenges using small model climbers have been conducted around the world, and many excellent climbers have been developed. However, the results obtained here are partial results under the earth environment, and are quite different from the specifications of a climber that can be used in the space environment at altitudes exceeding 100 km. In this study, a climber utilizing the drive mechanism proposed in the previous paper (a hybrid mechanism combining opposed and crossed types) is used as the basic drive mechanism, and the design of the climber that can be applied in the space environment and various conditions are presented to investigate the solution. The following results were obtained from the experiments under the assumption of space environment. (1) Performance test of the climber with metal rollers. (2) Operation experiment of the climber in an ultra-vacuum environment. In experiment (1), the performance of urethane rollers, which are often used in ground climbers, was compared with that of metal rollers. It was confirmed that metal rollers can provide sufficient frictional force by controlling the pressing force, and that the application of metal rollers is feasible. In experiment (2), the small loop type climber experimental apparatus was developed and the apparatus was sat in a vacuum chamber. Experiments on the climber operating characteristics, temperature change, durability, etc. are currently underway, and further development for practical use of the climber is planned. In this paper, the operating characteristics, durability and design method of the developed climber will be reported based on the results of the experiments in the space environment.