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The Modern Day Space Elevator as a Permanent Transportation Infrastructure (3)

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DEVELOPMENT OF INITIAL SPACE ELEVATOR DESIGNED FOR SPACE ENVIRONMENT AND CONSIDERATION OF EFFICIENT OPERATION PLAN FOR CLIMBER DRIVE SYSTEM

Abstract

In the development of climber mechanisms and various control methods for space elevators that the authors are currently working on, a considerable number of design methods have been presented within the scope of ground-based studies, and experiments and verification studies are underway. However, there are many problems to be solved in the actual space environment (gravity changes, ultra-vacuum, temperature changes, effects of radiation, etc.), and climbers must be designed according to the environment. In particular, climbers capable of long-distance travel between geostationary orbit and the Earth are required, and drive mechanisms and aircraft with excellent durability are required. Until now, by operating high-altitude experimental equipment and small loop-type climbers, the operating characteristics, temperature changes, and durability of climbers under atmospheric pressure and under high vacuum of 0.01 Pa or less have been compared. As a result, although the operating performance improves in high vacuum due to the absence of air influence, problems such as a significant temperature rise in the drive unit were confirmed. Therefore, in this study, in order to develop a space elevator climber that takes into account the conditions in such a space environment, research and development were carried out with a focus on the following points. (1) The experimental equipment to realize a high vacuum environment closer to the space environment, and conducted an operation experiment using a mini-climber was improved. The effects and problems of the space environment (heat generation and release, performance of each part, durability of the equipment used, etc.) were analytically examined, and methods for improving them were considered. (2) With the aim of designing and developing a drive mechanism for an initial climber for the space environment, we attempted to design a small climber for several people, analyzed the moving altitude and average speed considering gravity, developed a drive system, and considered an efficient operation plan. Regarding the contents of (1), we are currently conducting experiments by changing the environment from low vacuum to high vacuum, and have identified problems that arise (heat, parts, durability of the equipment used, etc.) and implemented methods for improving them. In (2), we present a feasible operation plan based on the experimental and theoretical analysis results. Details of the results will be introduced in this manuscript and will be presented at IAC-2025.