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Modern Day Space Elevator Transformational Strengths and their Applications (3)

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PERFORMANCEEXPERIMENTS AND OPERATIONAL SIMULATIONS OF SPACE ELEVATOR CLIMBER IN HIGH VACUUM SPACE ENVIRONMENT

Abstract

In the development of climber mechanisms and various control methods for space elevators that the authors have been working on, design methods have been presented quite well 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 change, ultra-vacuum, temperature change, debris collision, etc.), and climbers must be designed according to the environment. In particular, climbers capable of long-distance travel between geostationary orbit and Earth are required, and a drive mechanism and machine with excellent durability are needed. In the previous report, a small loop-type climber experimental apparatus was developed and installed in a vacuum chamber. In the experiment, the operating characteristics, temperature change, and durability of the climber under atmospheric pressure and low vacuum were compared. As a result, it was confirmed that although the effect of air was eliminated and the operating performance improved under low vacuum, problems such as a remarkable temperature rise in the drive unit were observed. However, the actual vacuum in space is even lower, and data under sufficient environmental conditions has not been obtained. Therefore, in this study, (1) Improved the experimental apparatus to realize a high vacuum environment more similar to the space environment, and conducted operational experiments using a mini-climber. The effects and problems (heat, parts, durability of equipment used, etc.) of the space environment and how to improve them were examined. (2) In order to understand the operational characteristics of the climber in response to changes in various space environment influences (gravity, under high vacuum, heat, etc.), the results of experiments under high vacuum and points to be improved, and climber performance under gravity changes when going from the earth to space were examined. For the content of (1), experiments are currently underway to change the environment from low vacuum to high vacuum, and the problems that occur (heat, parts, durability of the equipment used, etc.) and methods for improvement were implemented. In (2), based on the theoretical calculation results, we are verifying the performance in changes in gravity using mechanism analysis software. Details of the results are presented in this manuscript and will be presented at IAC-2024.