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Space Elevator as Transportation Infrastructure to Access Space (3)

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DEVELOPMENT OF SMALL MANNED SPACE ELEVATOR CLIMBER APPLYING HIGH-LOAD CROSS ROLLER MECHANISM AND UTILIZATION FOR GROUND FACILITIES

Abstract

One of the technical issues to realize the space elevator concept is the innovative development of drive mechanisms and control systems for climbers moving on tethers. Since the climber is usually propelled by the frictional force between the tether and the driving roller, it is desirable to devise a more efficient driving method. So far, driving experiments and challenges using small model climbers have been held all over the world, showing the development and technical solutions of many excellent climbers. However, in the development of a climber for space elevators for practical use, the weight of the climber itself is expected to be several tens to hundreds of tons, and the distance traveled by the climber is expected to be tens of thousands of kilometers. Compared to the specifications of the small climbers developed so far, the results are quite different. The purpose of this research is to establish a design method of a propulsion mechanism that can move a long distance even with a heavy load and to develop an experimental climber for a space elevator to solve the above problems. In addition, the developed propulsion mechanism will be utilized in ground facilities, and its usefulness and continuous improvement will be implemented. In this report, in order to achieve the above objectives, we first designed and manufactured a heavy-duty climber using a cross roller with high operating efficiency, and developed a small manned space elevator. Assuming a practical machine in the future, the climber mechanism has a rated propulsion force of 3kN, a maximum moving speed of 5 m/s, and a drive unit weight of 40 kg, and we have also manufactured a basket for carrying people. Currently, we are manufacturing an elevating facility 10 m above the ground at an indoor experimental site that enables performance testing of the developed climber. The climber mechanism developed with such specifications can be fully utilized not only in space but also in vertical transportation on the ground, so we are considering how to use it in ground facilities. Continuous development and operation are expected in the future. The developed climber mechanism and experimental results will be published in this manuscript and will be announced at the IAC-2021.