Toward the realization the Space Elevator.

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[Aoki bravo A]

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A new climber which was mede for aprticipating in EuSEC and JSETEC in 2011, was able to achieve some result. This climer's concept is to have expensibility for the stratosphere to an altitude of around 20km as the orbit. Moreover, the target of this climer is a speed: 10m/s and payload:10kg for participating in JSETEC and EuSEC. The climber achieved about 450m and win third prize at JSETEC on Augast 7, 2011.

1. Introduction 2
2. The development-process of your Climber 2
3. Conclusions 4
4. Reference 4

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1. Introduction

Our team studies the space elevator climber. This team has 7 person of the students at Nihon University College. The members studies expansive area of engineering works. For example, Machine engineering, information engineering, and electric engineering. Our team has participated in The JSETEC (Japanese Space Elevator technical & Engineering Competition) for 3 times and the climber was ever able to make run up and down at 250 meters by 2010. I think the Space Elevator climber development will let any people go to space easily in the future. However, the Space Elevator System is too large scale for individual to make it. Therefore, it is necessary to communicate with other teams and share some information of the space elevator in EuSEC in order to realize it.

2. The development-process of your Climber

2.1. Concept

The produced climber is adopted the method going up and down by friction between the rope and roller. The object of this climber is to have extensibility for some sensors for the stratosphere elevator as preliminary steps for the space elevator. This system employs machinery that autonomously ascends and descends by means of a balloon launched into the stratosphere to an altitude of around 20km as the orbit, where the weather is comparatively stable, and the systems utilizes atmospheric observations, remote sensing, and a communications relay station for emergencies. Moreover, the target of the climber is a speed: 10m/s for JSETEC (this competition's distance is 600m) and payload: 10kg for EuSEC (including weight of the climber).

2.2. Design

The climber was designed for using friction caused by presser power by the upper roller and lower roller. It originated from the springs.

The climber was constituted by frame $\alpha$for extensibility. This method can set up a new part easily.

Fig1. shows the design of the drive roller. It can be taken apart for changing material of the tire and this method can choose a better friction for the slipping between the roller and rope. Fig2.shows drive roller's tire. Standard product "urethane washer" was used as the tire. Therefore, it is easy to get different friction factors.

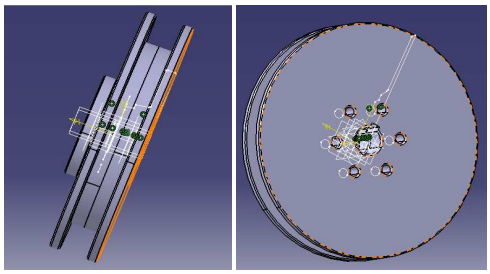

Fig.1 drive roller (Wheel)

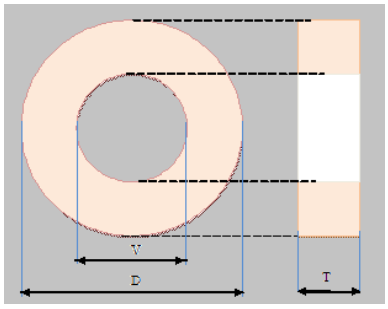

Fig.2 drive roller(Tire)

The karabiner hook was used to lead the rope for preventing for the rope to be out of roller .the karabiner hook was adapted to rope guide because it is easy to hold the rope and it has enough strength (it is used for saving life).

The climber has a lot of sensors to fulfill the concept. CCD camera, digital camera, Watt meter, angle sensor, and Rotary encoder were used for checking the climber condition. Triaxial accelerometer, Aerotonometer were used for atmosphere observations etc.

(a)CCD camera (b) Wattmeter

Fig.3 Sensor

Table1 Dynamic efficiency

Component	Manufacturer	Specification	No. of pcs
Motor	NEU MOTERS	Neu 2230/1YF	1
Roller (Drive)	MISUMI	Urethane:30.50.70.90 Thikcness:20mm	1
Roller (Driven)	MISUMI	Aluminum Dimeter:45mm	1
Battery	HYPERION	VX 35C Li-Po Battery LG335 – 4500 – S12S	1

2.3. Manufacture

The climber was designed by 3D-CAD. The versatile standard parts were used to the basic parts to facilitate to replace if the components get broken. Moreover, the several components were manufactured by hand working at the college workshop.

2.4. Assembly, Integration & Testing

The climber was tested at about 14.5 meters up outside at our college on July 31, 2011. Fig.4 shows the power consumption was 11.35[kWh] to run up 14.5m. Fig.5 shows the max speed of the climber was 0.94[m/s]. Fig.5 shows the slipping between the roller and rope. The average slipping score on running up was 37.57[%].

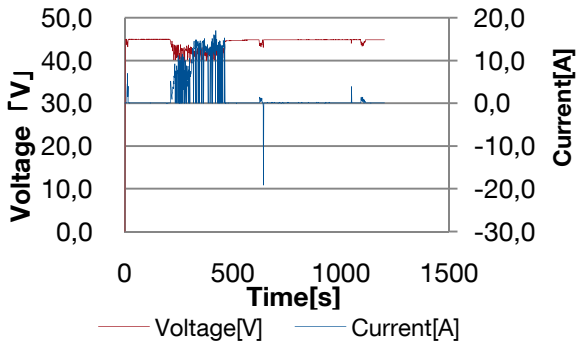

Fig.4 Current and voltage

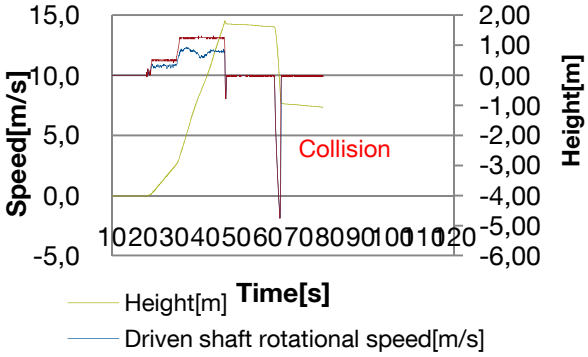

Fig.5 Rotation speed and height

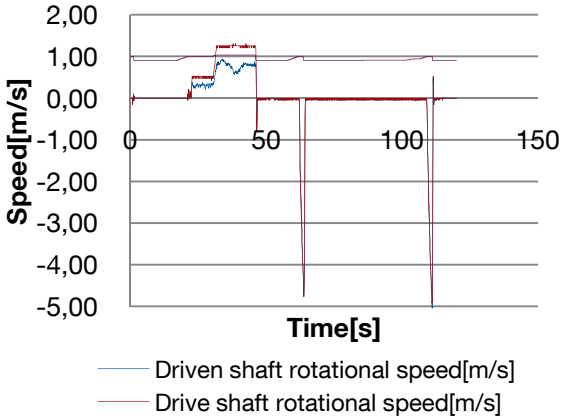

Fig.6 Rotation speed and pulse

Moreover, it was tested at about 450 meters up outside at JSETEC on August 7, 2011. Fig.7 shows the power consumption was 37.03[kWh] to run up 450m. Fig.8 shows the max speed was 4.38[m/s]. Fig.9 shows the slipping between the roller and rope. The average slipping score on running up was 10.52[%].

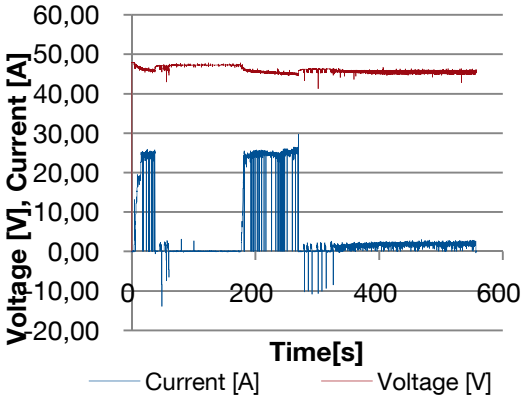

Fig.7 Current and voltage

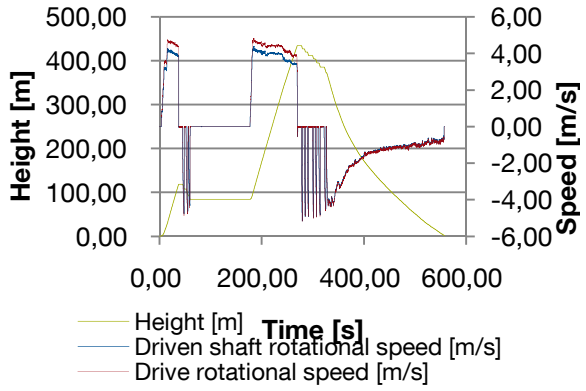

Fig.8 Rotation speed and height

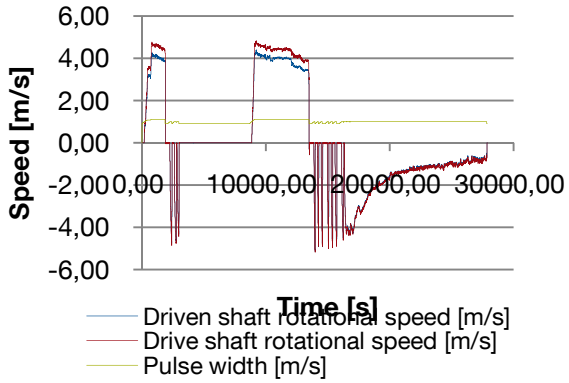

Fig.9 Current and voltage

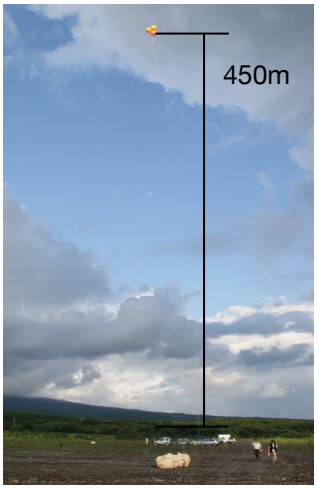

Fig.10 Outside landscape test

2.5. Project Management

Our team is the space elevator research team of Nihon University. The team is composed of four graduate school students and three undergraduate students. This team consists of two labs which excel at design machinery and electrical control. The team develops the climber of the space elevator.

Fig.11 Team Member

Moreover, the team determined some milestones, and the team is investigating other applications for the space elevator climber development, such as the Basic research on a stratosphere elevator and development of the prove climber for wire maintenance. Our team's fund is the Aoki lab of Nihon University. And our target is also to make the climber which is suitable for going up and down over a long distance for participating in JSETEC on August, 2011.

3. Conclusions

The climber was made for running long distance and carrying high weight and getting many kinds of data. In the experiment above, the max speed was 4.38[m/s], the power consumption was 37.03[kWh]. The climber achieved to run up and down till about 450 meters at JSETEC and received the third prize of 16 teams.

4. Reference

1) Yoshio Aoki, Akihisa Tabata, Kento Suzuki, Nobuto Yoshino, "Dynamic Response and Safety Design of the Space Elevator", Proceedings of 27th International Symposium on Space Technology and Science, 2009-g-24, July, 10, 2009.

2) Nobuto Yoshino, Yoshio Aoki, "Development of a Probe Climber of the Space Elevator". Proceedings of 27th International Symposium on Space Technology and Science, 2009-g-28, July, 10, 2009.

3) JSEA website, http://jsea.jp/ .

4) Liftport Group website,
http://www.liftport.com/ .

5) Bradley C. Edwards “THE Space Elevator”