



第 2 回

宇宙エレベーター
技術競技会

2nd Japan Space Elevator
Technical & Engineering Competition

JSETEC2010

Japan Space Elevator Technology and
Engineering Competition

Japan Space Elevator Association
Executive / Technical / Safety management committee

Japan Space Elevator Association (incorporated association)

- **Establishment** on April 1st, 2008 w/ 8 members

- **Activities**

- JpSEC : Japan Space Elevator Conference (Annual)
- JSETEC : Japan Space Elevator Technology & Engineering Competition (Annual)
- LASER : LEGO bricks and Space Elevator (Twice a year)

- **Meeting**

- Workshop (2 - 3 times / year)
- Skype meeting (Weekly)
- Social gathering and party :(6 times / year)

- **Membership**

- Number of members : 470 (Mar 31, 2010)
- Space and Science fiction enthusiasts
- Engineers in the aerospace, elevator, IT industry
- University teacher / student : Over 20 universities include Tohoku, Tokyo, Nihon, Tokai, Kanagawa, Kanagawa Institute of Tech., Shizuoka, Nagoya, Osaka, Kyushu, Kyushu Institute of Tech. ...



- Purposes

A. Comparison and validation of technologies and methods for improving performance of climbers

- Many people will try to enhance the performance of climber. Various approaches were taken and standard specifications and a target for development emerged through cooperation with participants.

B. Develop a vertical experimental environment for climbers

- Competition is also a joint experiment of a vertical tether system.
- JSEA and associate participants should think about the next enhancements for the experimental tether system.

C. Chance of introducing the proper impression of Space Elevator.

- Climbers and the tether provide a good visual image in order to understand the idea of the Space Elevator.





Schedule :

- August 8th (Sat): 9:00 am to 4:00 pm
- August 9th (Sun): 7:00 am to 3:00 pm

Field :

- “Futawa” field of Nihon University.
(25 km far from Tokyo)



Balloon :

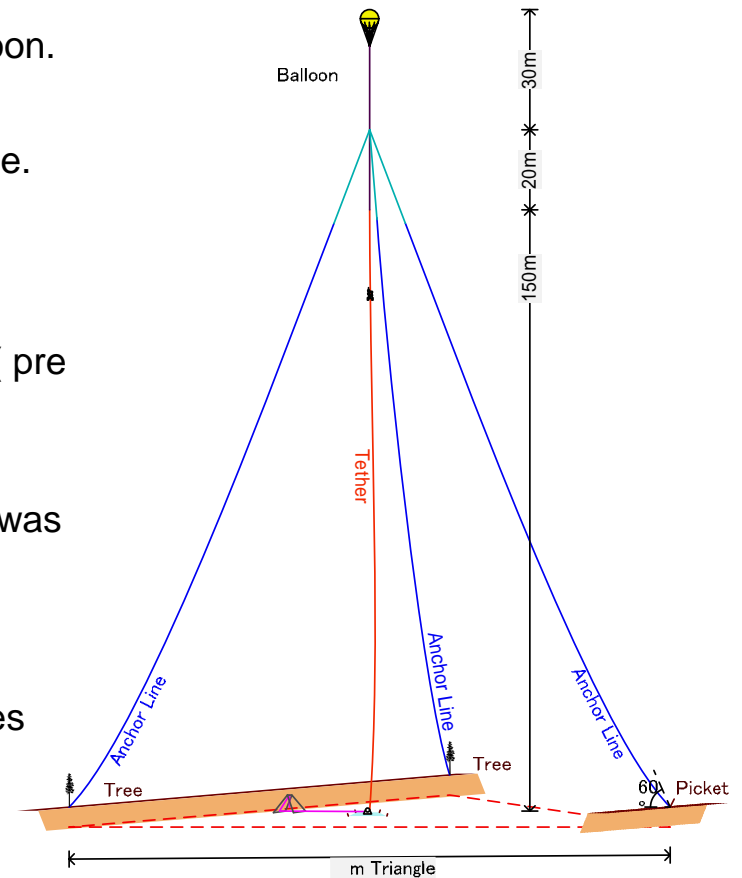
- Tether elevated by 2 Helium filled balloon.
- Main balloon has 39 kg buoyant force.
- Auxiliary balloon has 4 kg buoyant force.

Tether :

- 50mm width, 1.5mm thickness, 60g/m automobile polyester seatbelt material (pre heat-smooth process material).
- Belt color was almost white.
- 50cm long start (0m) and goal (150m) was marked by black paint.

Anchor Line:

- 3 x 200m, 10mm diameter vinylon ropes were used



Concept diagram

JSETEC 2009

Nihon University Futawa Field

Funabashim, Chiba



Regulation

- Average speed was measured by the 150m climbing time.
- 2 judges measured the start line and goal line passing time with stopwatch and binoculars..
- Estimated fudge factor was 0.5 second.
- Tether vibration, and twist caused by the wind was welcome. All teams had to make a strong and robust climber.

Climber specifications :

- Max Size 1m x 1m x 1m.
- Weight under 10kg.

Safety rule :

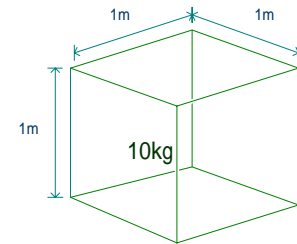
- Climber should descend safely after reaching the goal marker.
- Appropriate safety equipment was required for all in the field.
- All activities were monitored by the JSEA safety boss.

Energy source :

- DC battery and voltage upper limit was 12V.
- This regulation had not a logical reason, but configured to regulate the scale of the climbers.

Expected types of battery :

- Lithium-Polymer (LiPo)
- Nickel-Cadmium (NiCd)
- Nickel Metal Hydride (NiMH)
- Lithium Ion (Li-ion)



Participants

- Nihon University Aoki Lab.
- Nihon University Hatano Lab.
- Kanagawa University Egami Lab. (2 climbers)
- Shizuoka University Yamagiwa Lab.
- Nagoya University Volunteer from Dept. of Engineering
- Technische Universität München (TUM)
- Team Okuzawa (Individual)



Team	Time for 150m
Technische Universität München	52 Sec
Nihon Univ. Hatano Lab.	183 Sec
Kanagawa Univ. Egami Lab. #1	196 Sec
Kanagawa Univ. Egami Lab. #2	207 Sec
Nihon Univ. Aoki Lab.	278 Sec
Team Okuzawa	356 Sec
Shizuoka Univ. Yamagiwa Lab.	no record
Nagoya Univ.	no record

College of Science and Technology, Department of precision Machinery Engineering

Control : Radio / Micro computer control

Drive : Lithium-Polymer (LiPo), 1 Motor (2 options)

Size : L 350mm x W 220mm x H 300mm, AUW 7kg

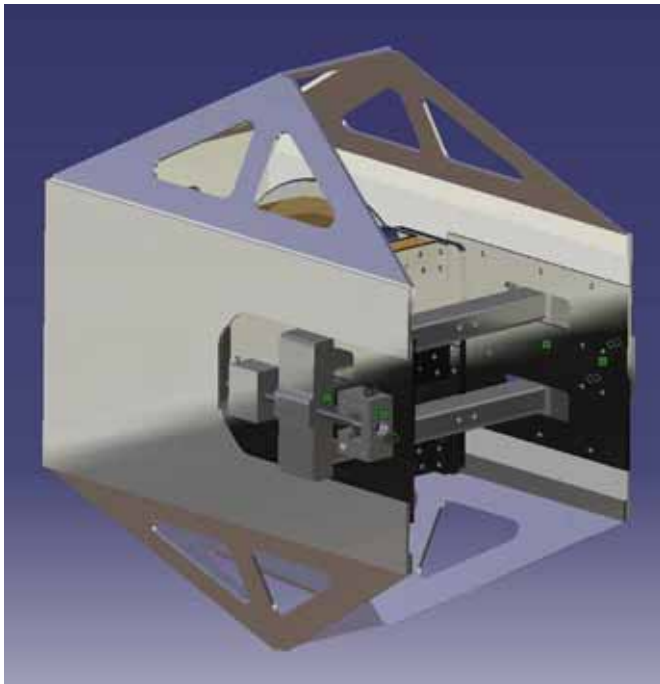
Cost / Production Period : ¥200,000 (\$2,310 / €1,544), 2 months

Features : - Choose from 2 types of motor

- 3 types of counter (driven) roller to test the contact area
- Pressure between tether and wheels can be adjusted by screw
- Driving roller brake for safety
- Utilizing the knowledge in the development of electric-bike race and UAV contest

2009





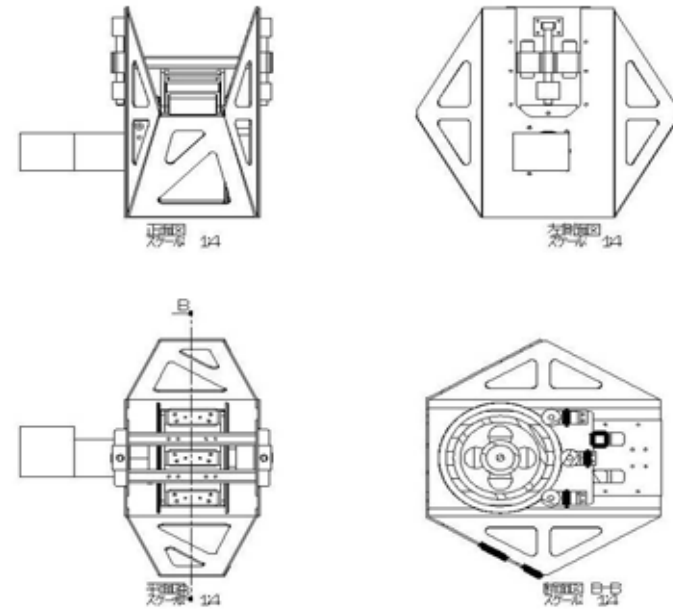
Overall view



In the field



3 types of counter roller



Orthographic Views

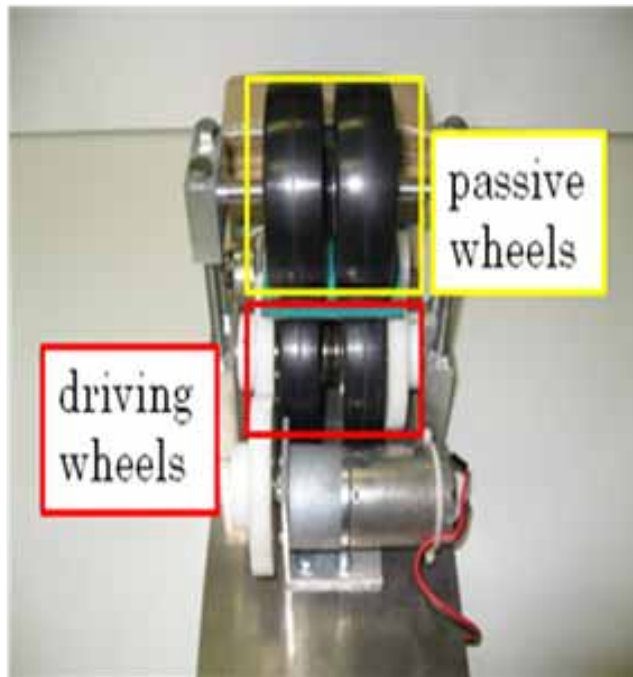
College of Science and Technology, Department of precision Machinery Engineering

- Name : “Sakurana”
- Control : Radio/Micro computer
- Drive : Nickel-Cadmium (NiCd)
- Size : L 380mm x W 230mm x H 260mm, AUW 3.9kg, 2 Motors
- Cost/Production period : unclear (diverted laboratory materials), 10 months

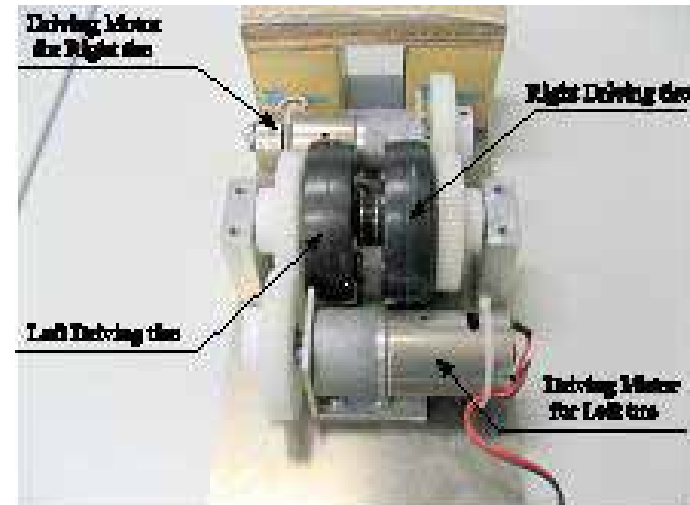
2009

- Features :**
- 2 driving rollers, 2 driven rollers
 - Difference of rotation speed of 2 parallel rollers control the direction of climber movement
 - Utilizing the knowledge in the development of rescue robot contest





Steering mechanism

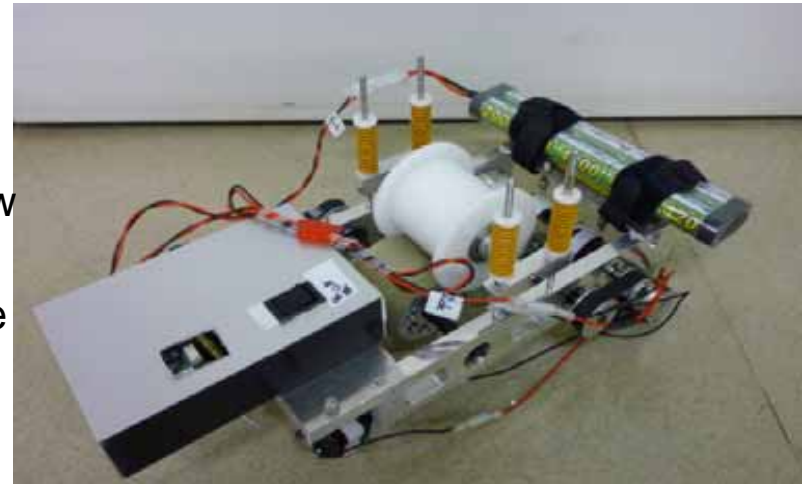


Steering mechanism

Faculty of Engineering, Department of Mechanical Engineering

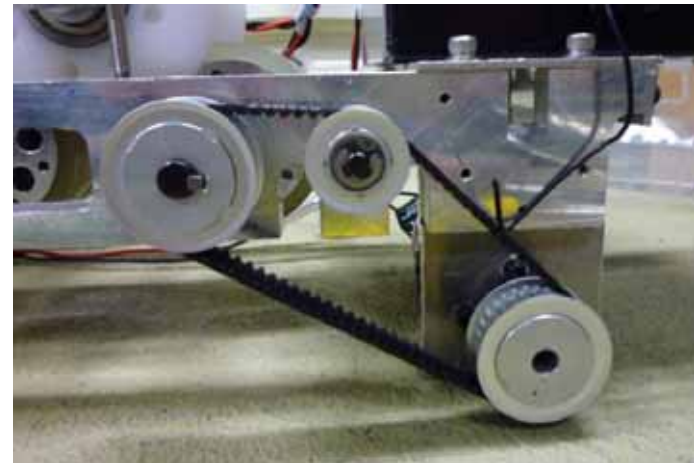
- Name : Team KSC-1"; Kanagawa univ. Space Climber #1
- Control : Radio/Micro computer
- Drive : Nickel Metal Hydride (NiMH) or Lithium Ion (Li-ion), 2 Maxon motor
- Size : L 304mm x W 190mm x H 170mm, AUW 4.1kg
- Cost/Production period : ¥200,000 (\$2,310 / €1,544), 5 months

- Features :**
- 2 driving rollers, 1 driven roller
 - Driving roller ; urethane coated
 - Driven roller ; ABS resin
 - Pressure between tether and wheels can be adjusted by screw
 - Gear reduction ratio (0.11-0.38) can be changed by replacing the pulley
 - Utilizing the knowledge in the development of ROBOCON

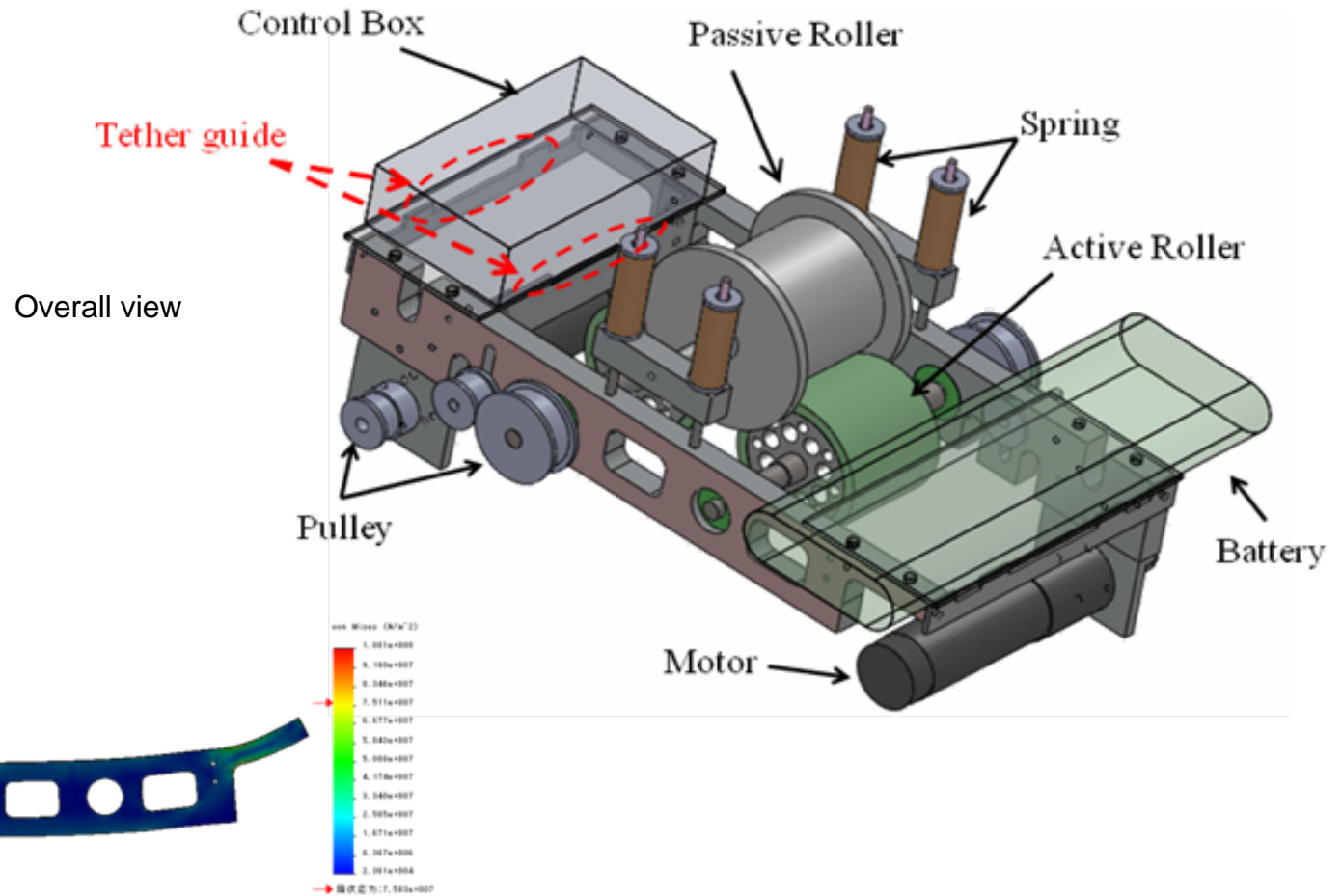




Pressure adjuster



Timing belt train



Results of frame FEM analysis

Faculty of Engineering, Department of Mechanical Engineering

- Name : Team KSC-1"; Kanagawa univ. Space Climber #2
- Control : Radio/Micro computer
- Drive : Nickel Metal Hydride (NiMH), 1 Motor
- Size : L 190mm x W 185mm x H 245mm, AUW : 2.98kg
- Cost/Production period : ¥50,000 (\$578 / €386), 3 months
- Features:
 - 4 driving rollers
 - Use inexpensive R/C car motor
 - ABS resin based panel, POM plastic gears
 - Teflon tether guide

2009





Rollers and motors

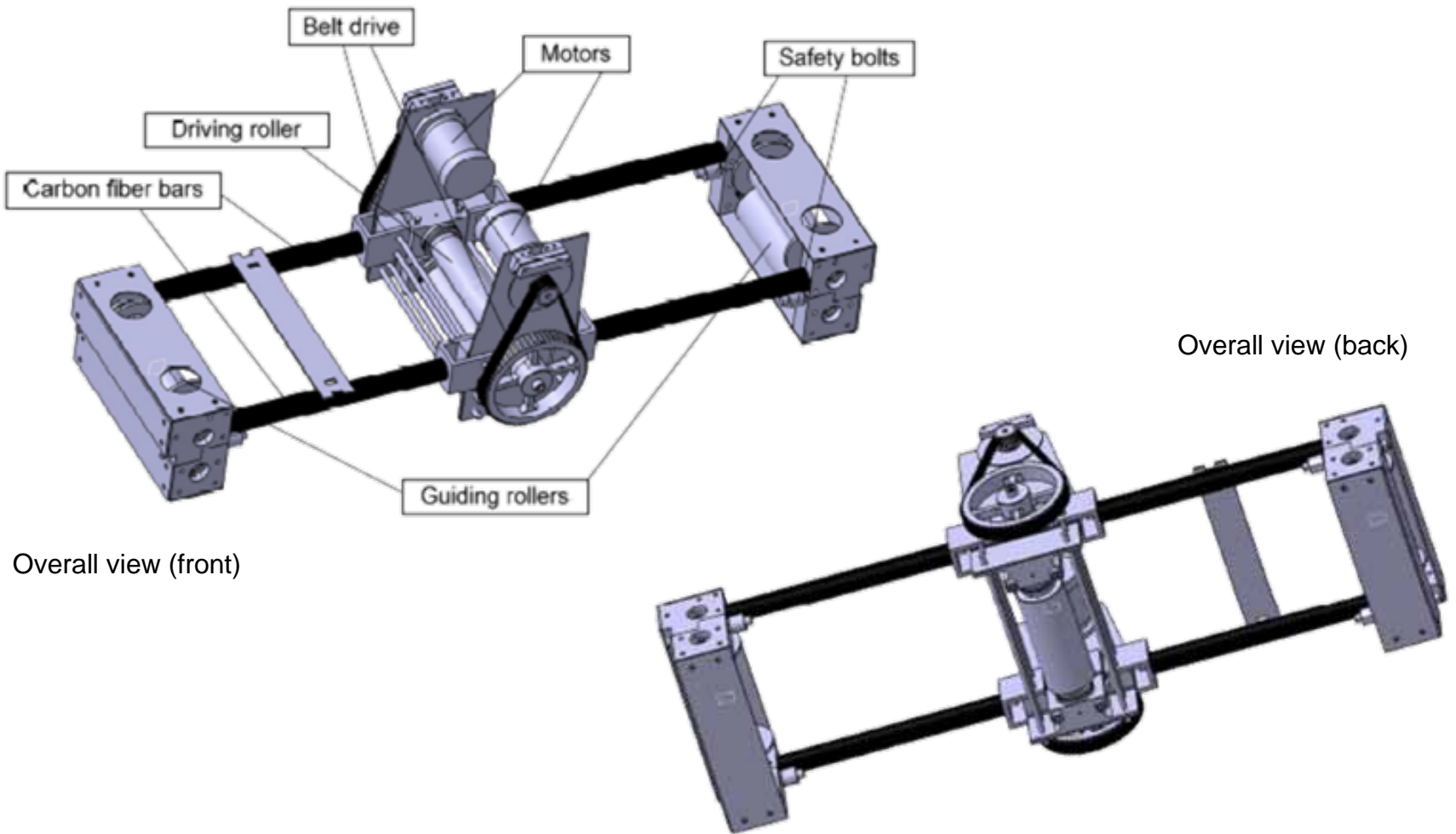


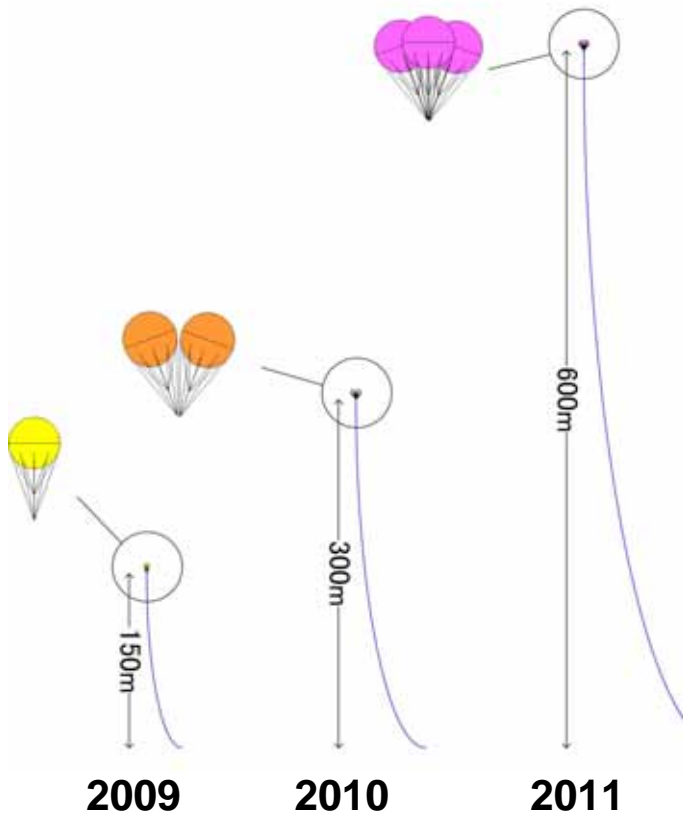
Drive gear train

Wissenschaftliche Arbeitsgemeinschaft für Raketen- und Raumfahrttechnik

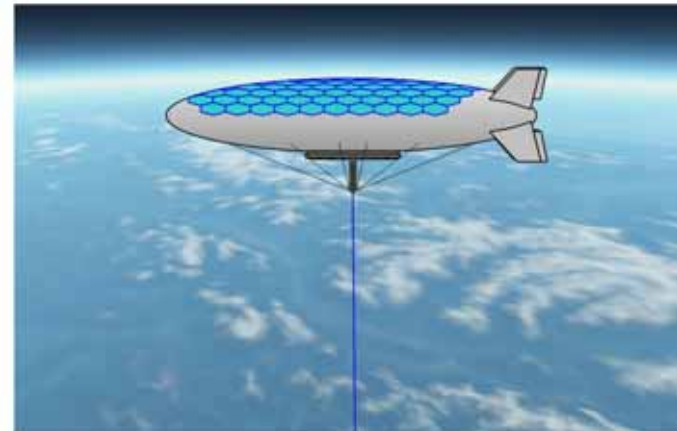
- Control** : Micro computer
- Drive** : Nickel Metal Hydride (NiMH), 1 Motor
- Size** : L 550mm x W 200mm x H 100mm, AUW : 5.3 kg
- Cost/Production period** : unclear, 20 months







Plans in the near future



**Stratosphere Platform
+
Tether Elevator
= Stratosphere Elevator > 30km**

2010 planned JSETEC event

- Schedule : Friday August 6 2010 to Sunday August 8 (in case of bad weather August 13 to 15)
- Place: Japan University's Futawa Campus

Objective

- To support technical experimentation and activities geared toward building a Space Elevator Climber model for a vertical belt tether based on the Edwards' Space elevator plan.
- To support technical experimentation and activities geared toward developing a vertical rope tether climber which could be used for a stratospheric platform which is considered a milestone in the path toward realization of the Space Elevator.
- Provide accurate factual information about potential plans for a Space Elevator to the any interested parties.

Competition Details

- The climbers will be judged on various points including speed of ascent.
- There will be competition points as well as experimentation points

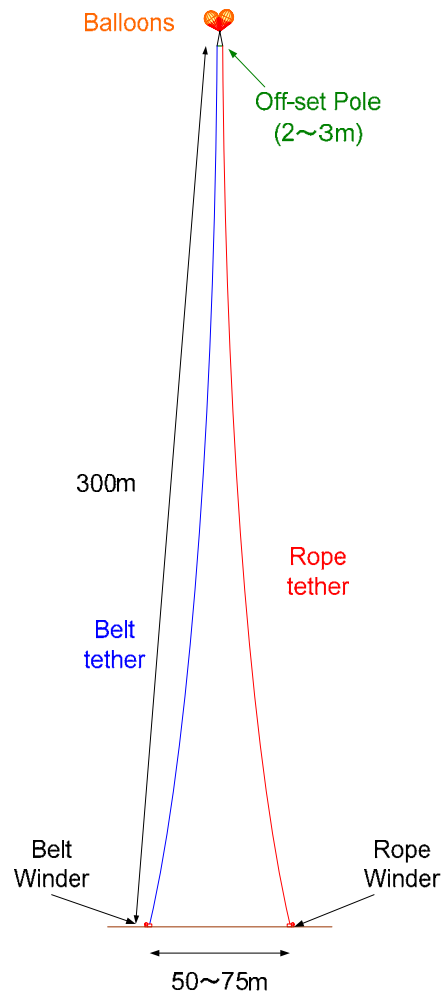
Collaborative Technical Experimentation and Verification

- Experimentation with 300m Tether
- Gather and share data including detailed Climber ascent data and environmental data, as well as details on installation of climber on the tether.



250-300m Vertical tether track setup and experimentation

- Scheduled on June 5-6 2010



Tether Competition and Wire Competition

- Wire competition in 2010 will be held as an open competition and is planned to be held as part of the primary competition from 2011.

Individual Competition Windows

- Preliminary ascent and descent as well as competition ascent and descent will be held in the same window. Multiple attempts are possible in the same window.
- Windows will be 30 minutes each.
- The competition window starts once teams leave the waiting area and finishes when they return to that same waiting area.
- Multiple attempts are possible in the same window. Teams will not be able to start a new climb when 5 or less minutes remain in the window.

Preliminary/test considerations

- Depending on the number of teams participating test runs may be held to ensure a smooth schedule.
- Movie : Prior to the competition, film of a test climber will be distributed so as to show the effects of the environment on the climber
- Initial day 50m preliminary test : 50m test runs may be held on the first day.

Points for Evaluation

- Competition Module Points
- Evaluation of Climber mechanism and control
- Ascent and descent speed (average ascent and descent speed), acceleration, and data collection
- Experimental Module Points
- Tether and Climber environmental data collection

Size and Weight Limitation

- 2m x 2m x 2m maximum dimensions
- Height dimensions may not change dynamically
- Climber parts may not separate during competition.
- Max. Weight 15kg (climber can not have a weight gain/loss of more than 5% before/after the competition)

Fail-safe Mechanisms

- Manual override push switch must be available to stop ascent/descent of the climber.
- Push switch must be located within 20cm of the tether attach point at the top and bottom of the climber so that if it hits the bumper it will be activated.

Control mechanism

- There is no limitation on the control mechanisms.
- If using a wireless device of some kind, the wireless signal strength and distance must be noted.
- If using a wireless device, the JSETEC administrators must be notified so as to prevent any interference from any other devices.
- All devices used must be legal for use in Japan.

Energy source

- There is no limitation on the energy source used. (But battery use is expected)
- Climbers are not allowed to acquire energy from any external source

Tether attachment mechanism

- When attaching the climber to the tether, the tether can not be detached in any way.

Participation Fee

- School student group/individual: 50,000 yen
- Receipt/Invoice will be addressed to the Group/Individual, but not to any business entity.
- University Research group/Business Entity or Group : 200,000 yen
- Receipt/Invoice will be addressed to the Business Entity or Group
- Fee includes tax, and should be deposited into the specified account (any applicable transfer fee will be paid by the participant)
- Participation fee includes basic insurance and lunch/drink for the 3 days of the competition (team is deemed to consist of 5 members)

Participation Application

- Deadline : June 25 2010
- Instructions : Please see our home page (www.jsea.jp) or contact info@jsea.jp
- Participation Fee should be paid at the time of completion of the application

Submit articles of agreement

- liability waiver
- Agreement of supporting JSEA public activity included in portrait rights

International contact person

Devin Jacobson : devinjacobson@jsea.jp

- Please contact him to ask your questions.

Thank you for your kind attention.

We ask for your cooperation in proceeding the next stage
of humankind.

Japan Space Elevator Association
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