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Ho we almost built a Climber

WARR Space Elevator

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Our Climber is a consequent further development of its award winning predecessors. It has been highly optimized for high payload capacity and easy handling and thus features low weight and cutting edge construction materials. Due to severe assembly problems its application is not certain.

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8.19.2011

1. Introduction

Due to the fact, that this is not our first Climber our expectations and aims where ambitious. Nevertheless whether we succeeded or not still has to be demonstrated.

2. The development-process of your Climber

2.1. Concept

Our goal was to build a Climber with an outstanding weight –payload ratio to fit the requirements of the EUSEC. For this reason we soon abandoned the idea of a fast moving climber in favor of a slow but heavy lifting solution made of aluminum and carbon fiber reinforced plastic. Due to our experiences at the "Japan Space Elevator Technical & Engineering Competition" [i] in 2009 and 2010 it should be easy to mount and resistant to influences like wind or a slack and an inconsistent tether.

2.2. Design

The climber mainly consists of motor block, pressure unit, rope guides and the CFRP structure between all these parts.

The motor block houses a strong electric motor, the gear and the driving wheels. It is made out of a single piece of u-profile to reduce the amount of individual parts and to ensure stability. The gear uses an belt transmission for weight reasons and has a transmission ratio of ????? to counter high starting torques. The shape of the driving wheel is molded to fit the rope at the best and is coated with an inner tube to increase friction and reduce pressure.

The pressure unit is attached to the motor block and uses screws in combination with pressure springs. The contact pressure can be exactly adjusted by the use of two screws. We decided to use springs since our experiences with our previous climbers showed that without suspension damage of driving wheels is certain.

The main function of the two rope guides is to keep the rope from jumping off the driving wheels by providing close guidance. The construction is kept simple by the use of low friction PTFE sliders instead of complicated moving parts like wheels. The Sliders can easily be exchanged if abrasion gets too high. For easy mounting the rope guide can be opened by the use of a single lock bolt. The rope guide is also an important structural part of the climber as it also being used to attach the payload and therefore has to withstand the weight of about 5kg. Nevertheless we managed to keep it lightweight by the use of aluminum and extensive reduction of nonfunctional material.

We decided to use CFRP as structural material for its supreme mechanical performance in combination with low weight and easy processing. It is also used to carry all electronic parts as well as the battery.

2.3. Manufacture

Although we wanted to rely on as many standard parts as possible and could perform basic jobs in our workshop we still had several costume parts to be made. Not wanting to spend too much on manufacturing costs we were looking for industrial partners. We have contacts to a training workshop of ebiz[ii] in Passau, an education center. They were willing to do most of the job for us. Since not all parts had been designed prior to a deadline that was marked by the beginning of this year's summer holiday for the apprentices we had yet to look for another company. Fill[iii], an Austrian machine building company, was willing to perform machining on the rest of the parts. In the final stage of assembly there had to be found several workaround s for problems created by faulty constructions and wrong standard parts. Institutional workshops at our campus proved extremely useful and quick in this respect.

2.4. Assembly, Integration & Testing

Because of several issues assembly is still taking place at the moment. As mentioned above many

2.5. Project Management

At the beginning of the development many meetings were held to find the best solutions to meet our requirements. Nevertheless these discussions where mainly general and did not prepare us for the problems that were still to come. With the challenge getting closer this turned into an atmosphere of “someone else but not me will surely have done it before it’s too late”. In terms of project management there’s still improvement opportunity.

3. Conclusions

Our concept showed great promises but had to deal with a huge amount of problems due to just in time manufacturing (if you want to put it nicely). The architecture is groundbreaking for us and its design will surely incorporate in the development of its successor.

4. Reference

[i]

[ii] http://www.ebiz-gmbh.de/

[iii] http://www.fill.co.at