Solar Climber

A Project Oriented Approach for Teaching Power Electronics

T. Friedli, S. D. Round, and J. W. Kolar
ETH Zurich, Power Electronic Systems Laboratory
T. Friedli, S. D. Round, and J. W. Kolar
ETH Zurich, Power Electronic Systems Laboratory
friedli@iem.ee.ethz.ch, kolar@iem.ee.ethz.ch

Introduction

The "Solar Climber", a model version of the space elevator, is a great project to introduce students to power electronics. The students are faced with the engineering problem of providing a vehicle from a solar panel. Apart from learning about and building a simple buck converter as their first power electronics system, they must also identify the interdependencies between a limited energy source, energy conversion efficiency, weight and climbing speed. E-Learning Tools such as JAVA applets are provided to deepen their understanding.

Energy Conversion

- Solar Panel
- Buck Converter
- Drive Unit
- Drive Unit
- Cables

Key problem: Powering a system from a limited energy source

Space Elevator Concept and Possible Realization

Cost Reduction
- Fuel: $1000/kg, Space Elevator: $200/kg

Learning Outcomes

Main Focus of Education
- Understanding of energy conversion
- Need for power electronic interface
- Use of modern design tools
- Experience in practical and team work

Challenges
- Power source to weight trade-off
- Weight to climbing speed trade-off
- Energy conversion efficiency

Solar Climber – Model Space Elevator

- Drive Mechanism
- DC Motor
- Buck Converter
- Converter constructed by the students

E-Learning Tools

- JAVA applet to visualize the light and load dependent characteristic of a panel
- Ansoft circuit simulator

Solar Climber Race in the High Voltage Laboratory

- Adjustment of the maximum power point tracking controller
- Solar Climber and cable system connected to the grid
- Commercially available daylight 2.5 kW xenon lamp (Arflux)

Conclusions

- Incorporates different aspects of electrical engineering
- Successful application of e-Learning tools
- Wide variety of modification possibilities
- Project work on an entire system
- Popularity of enrolment and positive feedback
- Reduced complexity project successfully applicable for college students

Further Information

Modeling the Space Elevator – A Project Oriented Approach for Teaching Experimental Power Electronics
[http://www.epesc.ethz.ch/pdf/friedli_EPEC03.pdf](http://www.epesc.ethz.ch/pdf/friedli_EPEC03.pdf)