SPACE POWER SYMPOSIUM (C3)
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MAKING THE FIRST STEPS TOWARDS SOLAR POWER FROM SPACE – MICROGRAVITY EXPERIMENTS TESTING THE DEPLOYMENT OF LARGE ANTENNAS

Abstract

Concepts for solar power from space have received renewed attention over the past year. High costs for fossil fuel during most of 2007 and 2008 have contributed to increasing the interest not only in traditional renewable energy sources but also in options usually considered as rather "exotic". Solar power from space is one of these. Given the potential size of such an endeavour, it is particularly important to demonstrate its feasibility and convince critics via concrete demonstrator projects targeting key technologies.[1]

The construction of a light-weight very large structure as needed for transmitting antennas and the demonstration of wireless power transmission over very large distances are two of these key technologies. The present paper presents two experiments Furoshiki 2 and Suaineadh addressing these two key technologies.

Furoshiki 2 is a follow on from the successful Furoshiki-1 experiment carried out in 2006, where a 140 m2 net was deployed using a complex deployment mechanism. This new experiment's main goal is to deploy a much larger net in micro gravity (500 - 1000m2). The secondary goals of the experiment are the demonstration of wireless energy transmission from space to earth via retrodirective antennas, possibly enough to lit a small LED and to demonstrate the ability of autonomous robots to operate in the micro gravity environment on such a net. The experiment consists of a mother section with four daughter sections attached to it and a net interconnecting each of the elements. The complete package can be deployed using a simple control technique, that utilizes the spin rate of the rocket and a reaction wheel. This approach has, among others, two fundamental advantages: The structure stiffness and dynamical stability can be obtained without having the mass penalties of any supporting structure. The number of sensors and actuators required to deploy and stabilize the structure can be minimized, reducing the system complexity.[2] Design work is ongoing and the estimated launch date will be between September and December 2010.

Suaineadh is an experiment that has been selected to be launched under the REXUS sounding rocket programme. While Furoshiki-2 will test the deployment of an unprecedentedly large structure, Suaineadh is going to investigate and test the full net deployment dynamics on a homogeneous, small meshed net. The experiment aims to deploy a scaled net (4m2) in milli gravity and stabilise it by exploiting centrifugal forces and a reaction wheel. A simple mock up of the experiment will be constructed during 2009 and

ground based testing is expected to confirm the theoretical and numerical simulations made during 2007 and 2008. The currently foreseen launch date is June 2010.

The ability to deploy and control large lightweight structures in space could be beneficial to a variety of space applications in addition to solar power from space such as telecommunication platforms, GEO based high-resolution Earth observations spacecraft and space-based astronomy. The two experiments described in the present paper intend to make first steps in this direction and lead the way to further research into large space structure construction.

[1] Mankins, J. Approaches to strategic research and technology (RT) analysis and road mapping, Acta Astronautica, Vol. 51. No. 1-9, pp. 3-21, 2002

[2] Melnikov and Koshelev, Large space structures formed by centrifugal forces, Earth space institute book series, 1998.