Paper ID: 34143
oral

SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies and Concepts (3)

Author: Mr. Jan Thimo Grundmann
DLR (German Aerospace Center), Germany

Mr. Patric Seefeldt
German Aerospace Center (DLR), Germany
Dr. Peter Spietz
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
Mr. Tom Sproewitz
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

DEPLOYABLE GOSSAMER STRUCTURES FOR FLEXIBLE PHOTOVOLTAICS

Abstract

In recent years the German Aerospace Center (DLR) developed gossamer structures in the Gossamer-1 project with a focus on solar sails also equipped with small thin-film photovoltaic arrays. With our new project GoSolAr ahead, the focus is now entirely on gossamer structures for huge thin-film photovoltaic arrays. Based on the previous achievements in the field of deployment technology and qualification strategies, new technology for the integration of thin-film photovoltaics will be developed and qualified with the goal of a first in-orbit technology demonstration. The time frame for this development is about five years.

The two major objectives of the project are the further development of deployment technology for a $25\,m^2$ gossamer solar power structure and the development of a flexible photovoltaic membrane. In contrast to the Gossamer-1 deployment approach, GoSolAr aims for a deployment driven from the central bus. The technology demonstration is supposed to employ the S2TEP bus system which is developed on-site in parallel. While the development of a bus system is in consequence not part of the GoSolAr project, there are special challenges when it comes to the development of huge solar arrays. The level of power required in the solar array application is about two orders of magnitude higher than for a sailcraft of the same size. The currents required to carry power off the thin-film structure at commonly used bus voltages result in a substantial harness cross-section. At the same time, there is a desire for higher voltages, e.g. to power electrical propulsion directly. In consequence the first system GoSolAr will be a low voltage system employing off-the-shelf small spacecraft power system technology. The development of high power systems will be studied in parallel and its implementation is left to future projects.

Using an established test strategy, a characterization of the deployment performance and deployment forces will be made based on a test-as-you-fly approach. It includes vibration testing, fast decompression, partial deployment under thermal-vacuum and full-scale ambient deployment on a test rig previously developed for Gossamer-1. The data gained can be used for further development and as input for mechanism and structure sizing. Examples for the application of those testing strategies are the previous DLR Gossamer-1 project, the ESA drag sail projects Deployable Membrane and Architectural Design and Testing of a De-orbiting Subsystem (ADEO) as well as the tether deployment of the HP3 experiment on the NASA/JPL Mars mission Insight.