SPACE POWER SYMPOSIUM (C3)
Small and Very Small Advanced Space Power Systems (4)

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DEVELOPMENT OF A STEERABLE DEPLOYED SOLAR ARRAY SYSTEM FOR NANOSPACECRAFT

Abstract

A steerable deployed solar array system for 1-5 kg weight nanospacecraft is described in the paper, enhancing the achievable performance of these typically power-limited systems. The maximum delivered power of body-mounted photovoltaic systems is typically below 10 W in nanospacecraft-sized satellites. This is a strong limitation for these kinds of systems. Innovative and high performance, power intensive applications, such as electric propulsion, opening new scenarios to the nanospacecraft systems, require for high performance power systems. On the other hand, the current state of the art attitude control systems, developed for nanospacecraft applications, are able to guarantee accurate pointing capabilities. Hence, there is a solid basis for the development of deployable steerable solar panels for this class of satellites. The system proposed in this paper is based on a deployable solar panel system previously developed in cooperation between Laboratorio di Sistemi Aerospaziali of University of Roma "la Sapienza" and the company IMT (Ingegneria Marketing Tecnologia). The system proposed is a modular one, and suitable in principle for the 1U, 2U and 3U standard Cubesat bus, even if the need for accurate pointing control makes is typically preferred for 3U Cubesats. The size of each solar panel is the size of a lateral Cubesat surface. A single degree of freedom maneuvering capability is added to the deployed solar array in order to follow the apparent motion of the sun as close as possible, given the mission requirements on the spacecraft attitude. A relevant design effort has been devoted to make the system compatible with the Cubesat standard, being mounted outside from the external spacecraft structure, without requiring modifications to the standard. The small available volume is the major constraint, which forces to use miniaturized electric motor technology. The system design trade-off is discussed, comparing different deployment and motion control concepts and architectures, based on single or double motor implementations. The final selected architecture and the detailed design are illustrated in the paper. The system validation based on numerical simulations and prototype testing is discussed, showing the possible enhancements offered by the system in typical mission scenarios.