

SPACE POWER SYMPOSIUM (C3)
Interactive Presentations (IP)

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FEASIBILITY STUDY ON WIRELESS POWER TRANSMISSION FOR SOLAR ARRAY DRIVE
ASSEMBLY

Abstract

In spacecraft which have sun-oriented solar arrays, the power must be transmitted across Solar Array Drive Assembly (SADA) between the solar arrays and body of the spacecraft. Presently, power transmission across the SADA is mainly achieved by brushes sliding on slip rings. The brush wear limits the operational life while the debris can result in voltage breakdown in the slip ring. Thus, a great many of alternatives to the slip ring have been proposed: superconductive slip ring, liquid metal slip ring and roll ring. However, extensive testing or applications of these alternatives have not been accomplished. As the spacecraft power, voltage and life requirements increase, wireless power transmission methods might be feasible, especially when the space environment and the total spacecraft power characteristics are considered. This paper was focused on investigating the feasibility of a rotary power transmission structure using magnetic coupling inductive wireless power transmission(MCI-WPT) to improve the lifetime and reliability of SADA. Firstly, the basic structures and principles of MCI-WPT were analyzed and the leading theories for MCI-WPT were introduced. The major concerns with SADA in this power regime were the operational life, thermal design and reliability together with the need for DC to DC power conditioning electronics(power density, high voltage and transmission efficiency). Then two possible wireless power transmission approaches for SADA with the power level of 200kW had been discussed: Concentric Sleeve Configuration and Parallel Plate Configuration. Further study showed that the Concentric Sleeve Configuration with the MCI-WPT was the preferable approach which was more appropriate to spacecraft constraints. System characterization is accomplished by executing circuit design from analytical equations and simulations. Transmission circuits and configuration was also proposed and the prototype was implemented. The testing result indicated that the proposed structure had a high transmission efficiency. Finally a recommendation is given to the following development steps for SADA.