SPACE POWER SYMPOSIUM (C3)
Technologies and Experiments related to Wireless Power Transmission (2)

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ASSESSMENT OF NEAR FIELD WIRELESS POWER TRANSMISSION FOR FRACTIONATED SPACECRAFT APPLICATIONS

Abstract

The modular design of a fractionated spacecraft is intended to avoid drawbacks inherent to monolithic designs such as subsystem failure, expensive designs, underestimated costs, expensive launches and over-complex systems.

Since the first engineering proposal of fractionated spacecraft in 1984 by P. Molette et al, various studies have matured the concept [Brown and Eremenko, 2006; LoBosco et al., 2008]. For instance, the Defense Advanced Research Projects Agency (DARPA) conducted a study on fast, flexible, fractionated, free-flying spacecraft in 2008 [Shah and Brown, 2008]. The study aimed at developing the concept with the purpose of creating a new paradigm in space systems.

Although substantial analysis has been performed related to system studies and market / manufacturing oriented assessments, these have not yet converged into a solid technical concept. Since the power systems represent one of the main mass and volume drivers of spacecraft, one of the key technologies required for truly fractionated architectures is the ability to distribute power wirelessly between spacecraft depending on the respective power needs over time.

Wireless power transmission has been studied and experimented on a laboratory scale since the 1960s, focusing on transmission over large distances [Brown, 1961]. Current concepts for wireless power focus on the use of lasers or microwave power transmission. These choices have been motivated largely by the required large distances for the intended applications. The application to fractionated spacecraft represent a different paradigm for the analysis of the most suitable wireless power transmission technology since the distances are considerably smaller. Therefore, for short-range power, near field wireless power transmission becomes possible.

The present paper analyses the current state of the art and expected progress in near-field power transmission for its use within fractionated spacecraft and compares it with the alternatives of lasers and microwaves. In this analysis, a special emphasis is given to very small spacecraft down to cubesat sizes.