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Wireless Power Transmission Technologies, Experiments and Demonstrations (2)

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ORBITAL POSITION, TRANSMISSION PATH AND SPACECRAFT ATTITUDE DETERMINATION FOR A SOLAR POWER SPACECRAFT

Abstract

A constellation of solar power spacecraft (SPS) to provide power to orbital assets or ground locations (on Earth or another planet) requires software to determine what the most efficient configuration of the spacecraft is (to service all required clients with the required service level) and how to achieve this configuration. Previous work that has been performed to determine how to efficiently route communication between spacecraft in orbit has been adapted to this end.

This paper presents a brief overview of several mission concepts that involve the use of multiple spacecraft to collect and transmit solar power to other consumer spacecraft. It assesses the needs of multiple prospective scenarios for these missions. Based on this, an algorithm for attitude control of these spacecraft is presented and evaluated.

This algorithm makes tradeoffs between servicing multiple (possibly conflicting) orbital consumer needs, attitude change costs and constellation sustainability. The adaption of the constellation to the failure, degradation or replacement of a node is considered and evaluated in various scenarios (with multiple levels of customer failure tolerance).

The orbital-serving-orbital model is expanded upon in two different directions. First, the option of retransmission is considered. With this option, an SPS that is not able to generate enough power to service its customer needs can request that an adjacent SPS forward it excess power (via the high-density microwave transmission). Second, mission concepts where ground locations are serviced (in addition to orbital ones) are also considered. The performance of the software is evaluated for each of these additional cases (and a case combining both options).

The paper concludes by considering the processing requirements imposed on the spacecraft by this software, across the various cases and options presented. The technical feasibility of its utilization is assessed. A distributed approach is compared to other prospective approaches including a centralized (ground or orbital) controller and human-driven ground control. Performance under the aforementioned scenarios is considered under each approach.