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SPACE POWER SYMPOSIUM (C3)
Space-Based Solar Power Architectures – New Governmental and Commercial Concepts and Ventures (1)

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FRACTIONATED SOLAR POWER SATELLITE FOR REGIONAL COVERAGE

Abstract

The paper presents an analysis of a fractionated architecture for a solar power satellite (FSPS) designed to deliver power to local ground users in remote areas. The fractionated SPS architecture is based on a formation of small satellites, each equipped with a laser system and deployable arrays. The output power considered from each spacecraft ranges from few hundred Watts to few kW.

The concept is derived from an analogous system for asteroid deflection with laser ablation. The satellites in the formation would continuously beam power onto a designed spot on the surface of the Earth to provide a total of few kW level of power to disaster regions, military camps or users in remote areas. One advantage of a fractionated architecture is that some systems are not completely scalable (laser, thermal control, power distribution and control), and might require specific technology developments if high level of power outputs are needed from a single spacecraft.

The paper presents an analysis of different possible orbits and formation configurations for a fractionated SPS system, plus an integrated optimization of spacecraft system design and orbit selection. A number potentially interesting existing orbital solutions will be considered ranging from standard Sun-synchronous low altitude orbits, to Molniya orbits, to heliotropic orbits. Additional solutions will be assessed, such as the use of natural and/or controlled high elliptical sun-synchronous orbits.

A trade-off between the system and mass complexity, and the power delivered to ground is performed to better understand both which types of services this system can deliver, and to which needs, user or otherwise, it can address. In particular, the number and size of the spacecraft, level of power installed on-board of each spacecraft and ground coverage (time in view, accessible areas, etc.) will be key parameters in the trade-off analysis.

The paper will present also a preliminary analysis of the application of the fractionated architecture to a Moon scenario in which a rover or lander requires power during the lunar night.