IAF SPACE POWER SYMPOSIUM (C3)
Interactive Presentations - IAF SPACE POWER SYMPOSIUM (IP)

Author: Mr. Mac Malkawi
Blinc- Borderless lab, United States

LUNAR NIGHT SURVIVAL: SPACE SOLAR POWER FOR SUSTAINING MOON-BASED SPACECRAFT DURING PERIODS OF DARKNESS

Abstract

Survival of spacecraft on the Moon during lunar night presents a critical challenge due to the absence of sunlight necessary for power generation. This abstract explores the feasibility and effectiveness of utilizing space solar power (SSP) transmitted from a satellite stationed at the Earth-Moon Lagrange point L1 to sustain moon-based spacecraft during periods of darkness.

At the Earth-Moon L1 Lagrange point, a satellite equipped with solar arrays or solar concentrators can efficiently capture solar energy unimpeded by lunar shadowing, making it an ideal location for continuous power generation throughout the lunar day-night cycle. This collected solar energy is then converted into electrical power and transmitted via microwave or laser beams to lunar spacecraft positioned on the Moon's surface.

The concept relies on wireless power transmission technologies, which have been extensively studied and demonstrated for various space applications. Microwave power transmission, for instance, utilizes microwave beams to transmit power over long distances with high efficiency. Laser power transmission, on the other hand, employs laser beams for power transfer, offering potentially higher efficiency but requiring precise targeting and alignment.

Key considerations for implementing SSP for lunar night survival include the design and deployment of the satellite at the Earth-Moon L1 Lagrange point, as well as the development of efficient power transmission and reception systems on both the satellite and lunar spacecraft. Furthermore, robust energy storage systems onboard the spacecraft are essential to store excess solar energy received during the lunar day for use during the night.

Scientific principles governing SSP operation in this context encompass solar energy capture, conversion, and wireless power transmission. Photovoltaic or solar concentrator arrays on the satellite convert sunlight into electrical energy, which is then transmitted as microwave or laser beams to lunar spacecraft. Upon reception, this energy is converted back into electrical power for onboard systems, ensuring continuous operation during the lunar night.

In conclusion, the utilization of space solar power transmitted from a satellite at the Earth-Moon L1 Lagrange point offers a promising solution for sustaining moon-based spacecraft during periods of darkness. Through the application of wireless power transmission technologies and careful engineering considerations, SSP presents a viable means to overcome the challenges posed by the lunar night and enable extended-duration lunar exploration missions.