IAF SPACE POWER SYMPOSIUM (C3)
Wireless Power Transmission Technologies and Application (2)

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RECEIV'AIR - BYPASSING OF ATMOSPHERIC ATTENUATION FOR SPACE BASED SOLAR POWER WITH AN AIRBORNE RECEIVER

Abstract

Due to diffraction limits, the use of sources on satellites with frequencies lower than 10GHz is leading to very large sources and receiver size. At 10GHz, antenna and receiver size should be of the order of 1km for power transmission from GEO. The use of higher frequencies allows a reduction of antenna/receiver size. However, due to high atmospheric attenuation, the use of RF sources over 10GHz is not possible due to transmission losses. Therefore, there is a large range of possible sources that has not been considered for Space Based Solar Power (SBSP). Indeed, most studies are usually considering a "ground based" receiver at sea-level. In order to reduce or bypass atmospheric limitation, a solution could be to set the receiver higher on a mountain or on a very high structure. However, achieving some kilometers of altitude with structures is not reasonable, while very high-altitude mountain locations are limited and not easily accessible. Some previous studies have considered a free-flying airship as a receiver performing frequency conversion coming with a high conversion efficiency cost, first from RF to electricity and then back to RF. In the Receiv'Air study, we proposed to use a tethered airborne receiver. The solution presents some advantages in comparison to classical SBSP ground segment:

- reduced dimension of space and ground antenna thanks to the use of higher frequencies;
- almost complete beam extinction by atmospheric absorption between airship altitude and ground, increasing safety for population and wildlife in case of beam depointing;
- lower ground footprint and material use, reducing impact on the environment.

This paper introduces the preliminary design of this receiving system composed of the airship, rectenna, power transmission cable and airship field. The proposed solution will be able to provide about 500MW of electrical power to the electrical grid.