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EXPLORING THE POTENTIAL OF DEPLOYABLE REFLECT-ARRAY FOR EFFICIENT WIRELESS POWER TRANSFER IN SPACE-BASED SOLAR POWER SYSTEMS

Abstract

Space-Based Solar Power (SBSP) is about harvesting solar energy in geostationary orbit using extensive photovoltaic panels and delivering this energy to Earth using a Wireless Power Transfer (WPT) system that works with a microwave spot beam. In order to minimize power loss when the radio beam travels through the atmosphere, frequencies below 10 GHz are typically selected. At such frequencies, to create a spot beam whose footprint is geographically confined to within a few kilometres from the centre, an extremely large radiating surface in orbit is required. Thus a GEO SBSP operating at 5.8GHz would require an antenna with a diameter on a kilometre scale. Most of SBSP concepts detailed in literature utilize a Direct Radiating Phased Array. Direct Radiating Arrays (DRA)) brings attractive benefits such as precise beam pointing thanks to the Retro-Directive beamforming method, high aperture efficiency and power density levels that are more suitable for passive thermal management. A drawback of DRA is the need for a huge number of radiating elements contributing to beam forming which requires a lot of electronic components for beam forming and steering and consequently increases the mass of the antenna. An alternative solution which is presented in this paper is a very large reflector antenna. We propose to have a very large deployable reflect-array on GEO that is illuminated by the smaller and distant DRA of the Solar Power Satellite of the SBSP. The reflect-array ensures the pointing and focusing of the beam towards the Earth. After a discussion of the benefits and drawbacks of this solution, the paper presents a preliminary design and expected performances of the antenna, as well as the overall benefits for the SBSP.