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WIRELESSLY POWERING SATELLITES USING LASER EMITTER

Abstract

This paper illustrates and explains the benefits of Laser-based Wireless Power Transmission system models including functional principles and mathematical formulation. Wireless power transfer is a possible solution to deliver continuous, convenient, and unlimited energy supply to satellites. Satellite industries traditionally use photovoltaic cells and nuclear generators to satisfy the demand for electricity required by spacecraft. Current power generation and management systems occupy a considerable portion of up to 10-25% of the satellite's mass. The concept of laser-based wireless power transmission from Space Solar Power Satellite can solve major problems. The current design of Space Solar Power Satellite primarily focuses on creating a massive satellite to generate and transmit gigawatts of energy to an Earth-based ground receiving antenna. This same idea can be adopted for spacecraft by developing a constellation of small-scale Space Solar Power Satellites to supply sufficient power to spacecraft within range. The theoretical modeling allows the analysis of power conversion or transmission for each individual unit in terms of the impacts of laser, transmission efficiency, and photovoltaic-cell thermal property. Maximum power transmission efficiency is calculated based on linear approximation of power conversation between electricity-to-laser and laser-to-electricity validated by numerical simulation. This efficiency variation depends on the selection of Laser, transmitter, transmission distance, and photovoltaic cells; exactly the same as increasing the maximum transmission efficiency of information in a wireless communication network. Consequently, this paper not only gives insight into wireless power transmission in general but also adequate guidelines of the satellite to satellite power transmission system design in practice.