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SPACE POWER SYMPOSIUM (C3)
Space-Based Solar Power Architectures / Space & Energy Concepts (1)

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INVESTIGATION OF THE ROTATION ADJUSTMENT STRATEGY OF SPACE SOLAR POWER STATION BASED ON THE SYMMETRICAL TWO-STAGE FLAT REFLECTED CONCENTRATOR

Abstract

Space Solar Power Station (SSPS) based on the symmetrical two-stage flat reflected concentrator(STFC), solving the problem of power management and electricity transmission, is an attractive configuration. However, at the same time, it brings the new problem of operation complexity due to the complex relative rotations of the different parts. The rotation adjustment strategy of SSPS based on STFC is investigated in this paper. There are mainly three parts in this configuration: two primary off-axis concentrators, two inclined flat mirrors and the sandwich panel with solar cell on one side and microwave antennae on the other side, and all the parts are mechanically connected. two primary off-axis concentrators are connected by the Y-truss, and the sandwich panel is connected by the Z-truss to the middle of the Y-truss. Analysis suggests that for the SSPS based on the STFC in the geosynchronous orbit, the following constrains must be satisfied: firstly, the primary off-axis concentrator continually keep track of the sunlight; secondly, the solar flux from the two flat mirrors and concentrated on the solar cells must be uniform across the whole panel and during the whole life time; thirdly, the antennae must keep its face to the earth's surface to transmit microwave energy; fourthly, adjustment energy cost must be as little as possible. The rotation adjustment strategy consists of three aspects: Y-truss, primary concentrator and flat mirror. Y-truss can

be perpendicular to ecliptic plane, equatorial plane and change with the seasons. In the first case, Y-truss rotates two dimensionally about the focus of the concentrator, and the track in the earth fixed coordinate system is a conical surface with the constant half cone angle of 23.5 degrees, which leads to the highest energy cost. When Y-truss is perpendicular to equatorial plane, the symmetry axis of concentrators and sunlight are not at the same line, and the solar flux can hardly converge on the solar cell except for the vernal equinox and autumnal equinox. The best value of the Y-truss track cone angle varies as a sin function of the time. Two primary concentrators rotate synchronously once a day on the Y-truss axis to track sunlight. Two flat mirrors rotate about their own centers and are asymmetric when Y-truss is not perpendicular to Z-truss.