

Study on a software retrodirective system for microwave power transmission

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A SPS (Solar Power Satellite) is one of the most important and clean power sources to solve global warming and energy problems. In a SPS model, the SPS transmits microwave by a phased array antenna of 1 to 2 km in diameter from the geostationary earth orbit to the ground rectenna of 2 to 5 km in diameter. It is necessary to measure the direction of the receiving point accurately and to achieve beam-forming to the direction in high accuracy. The required accuracy of the beam control is less than 0.001 degree.

A retrodirective antenna array has a property that it sends a power beam back to the direction of its originating source. We adopt a software retrodirective system that computationally calculates the direction-of-arrival of a pilot signal and the phase distribution of the transmitting phased array. A trial to make this system had been performed before [1]. The purpose of the present study is to make the software retrodirective system more highly accurate and evaluate the system experimentally.

First, we built up the basic software retrodirective system and measured its beam pattern and detected the main beam direction. As a result, the difference between the main beam direction obtained from the experiments and the direction of pilot signal transmitting antenna was 2.75 degrees. The difference was caused by estimation error of the direction of arrival.

Next, we added a beam direction correction system which measures the power distribution on the reception site to the software retrodirective system. As a result, the difference between the main beam direction obtained from the experiments and theory was improved to be 0.25 degrees by using this system.

Next, we propose that the method of calibrating the phase of each element. This is effective to solve the problem that the power transmission efficiency is decreased by the secular distortion etc. of the power transmission system.

Finally, we assembled these systems above and demonstrated that the accuracy of the beam direction was highly improved and the high beam collection efficiency was achieved.

REFERENCES

[1] Kozo Hashimoto, Hiroshi Matsumoto, and Miki Mayu, Software Retrodirective system for SPS (in Japanese), TECHNICAL REPORT OF IECE, SPS2003-15, 2004.