ABSTRACTS (MASTER THESIS)

Study on a Transmission Antenna of a Demonstration Experiment Satellite for Solar Power Station

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In this thesis, I study the requirements and performance of beam control for a satellite experiment to demonstrate wireless energy transfer technology on orbit for the purpose of Solar Power Satellite Station. Firstly, I show the requirements of the demonstration. In this demonstration, it is necessary to keep the beam direction accuracy within 0.2o I conducted practical experiments by using Advanced Phased Array System (APAS). I changed the beam direction from -30o to 30o, and measured the beam-direction errors. The error of beam-direction estimation became less than 0:055o with five-bits phase control. As the results, it is feasible to control the beam direction with an accuracy of 0:2o or less. Secondly, I evaluate the accuracy of the beam-direction estimation on the ground power receiving system. I show that the error of the beam-direction estimation is less than 0.1o on condition that the signal-to-noise ratio is limited -20 dB, with the least-square method and the spline interpolation. Thirdly, I propose a new method of reducing the side lobe only by controlling the phase of each antenna element. By controlling the phase of the adjacent pair antenna, the virtual power taper can be realized. I evaluate the performance of the proposed method, and it is shown that the side-lobe level is reduced to less than -30 dB by using this method. However, a directional gain depends on the types of taper distribution despite the same reduction level. Gauss distribution and Chebyshev distribution, and these distribution should be chosen properly according to the situation. I also investigate the real performance of the proposed method by some experiments. Although the side-lobe level in near field is higher than as expected, the proposed method reduce the side lobe effectively. The difference between experiments and the simulation results is caused by the misplacement of a receiving antenna, and the side-lobe level in far field is approximately the same with the simulations. Thus, the proposed method would be effective for reducing the side-lobe level in experiment. Finally, I show that the proposed method can be used for the satellite experiment.

Acknowledgements

Part of this research was carried out by use of Microwave Energy Transmission Laboratory (METLAB) as collaborative inter-university research facility and was supported by ISAS/JAXA.