SPACE POWER SYMPOSIUM (C3)
Wireless Power Transmission Technologies, Experiments and Demonstrations (2)

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STUDY OF OPTIMUM INTER-ELEMENT DISTANCE FOR RECTENNA ARRAYS.

Abstract

Rectenna array has two functions that receiving power by antenna and convert to DC using rectifier and it is used as earth reception site in Satellite Solar Power Systems(SSPS). To receive the power efficiently, many rectenna elements are arranged together to consist 'Rectenna array' and its size will be several kilometers by several kilometers in case of SSPS. Inter-element distance of rectenna array should be decided to have high reception efficiency and it will be varied to distance of adjacent elements and/or arrangement method.

In the previous work[1], its optimum inter-element distance value mentioned to be 0.8 λ. But, it is only one kind of antenna element (circular microstrip antenna) and one arrangement (rectangular arrangements). In this paper, we calculated optimum distance in three kinds of antenna element and two arrangements using Momentum and FEKO. Candidate antennas are rectangular microstrip antenna (Gain: 5.86 dBi), rectangular microstrip antenna with parasitic elements (Gain: 7.43 dBi) and dipole antenna with reflector(Gain: 5.56dBi). Also, we measured electrical effective aperture area (Ae) from its antenna absolute gain. Then, we evaluated ratio of Ae/Ap value as a function of inter element distance where Ap shows physical aperture area described in physical area of one antenna element inside the array.

Inter-element distance which shows maximum Ae/Ap is 0.6 to 0.7 λ in rectangular microstrip antenna, 0.7 to 0.8 λ in rectangular microstrip antenna with parasitic element, and 0.8 to 0.9 λ in dipole antenna with reflector, respectively. Thus, we resulted optimum inter-element value is changed as antenna type and array arrangement. This result will obtain one design guide for optimum rectenna array.

[1] M.Otuka, et.al."Relation between spacing and receiving efficiency of finite rectenna array", IEICE Trans on comm., B-II Vol. J73-B-II, No3, pp.133-139, Mar., 1990.(in Japanese)