A Study on Fast Method of Moments for Large-Scale Reflectarrays

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1. Introduction

Large-scale reflectarrays are well-known as promising antenna technologies. One of the biggest challenges on the design of the large-scale reflectarrays is how to reduce its large computational cost. In this paper, a fast MoM for numerical analysis of the large-scale reflectarrays is proposed and its performance is demonstrated numerically.

2. Principles of Proposed Method

Usually, reflectarrays are designed so that its main beam focuses on a specific direction. Passive reflectarrays are composed of non-identical elements and geometries of the elements are found so that required amount of phase shift is achievable and their scattering fields are in-phase in a specific direction. Therefore, geometries of non-identical elements requiring the same amount of phase shift are the same everywhere in the reflectarrays. Under the assumption of plane wave illumination and uniform array spacing, it is expected that the same local periodicity is hold for the non-identical elements whose geometries are the same except for quantization error of geometries.

According to the above discussion, we propose a fast MoM for large-scale reflectarrays. The proposed MoM simply copies currents of non-identical elements in small-scale reflectarrays to those in large-scale reflectarrays. Owing to the common local periodicity, it is expected that the copied currents well approximate those of large-scale reflectarrays.

3. Numerical Results

As an example of a large-scale reflectarray, a reflectarray with Yagi-Uda elements shown in Fig.1 is numerically analyzed[1]. In advance of its numerical analysis, accuracy of the proposed method has been clarified via numerical analysis of small-scale reflectarrays but the results are omitted here. Fig. 2 shows the BRCS of the reflectarray with M=10,000 elements obtained by the proposed method. The total number of unknowns are 150,000 and full-wave analysis of the reflectarray was impossible because 360 GB of computer memory and long CPU time is necessary. On the other hand, the proposed method enables to analyze such large-scale reflectarray at the expense of small computational cost, e.g. 16 sec. of CPU time and 5.6 MB of computer memory.

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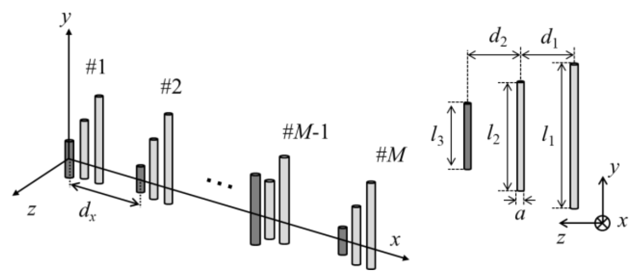

Fig. 1 An analysis model.

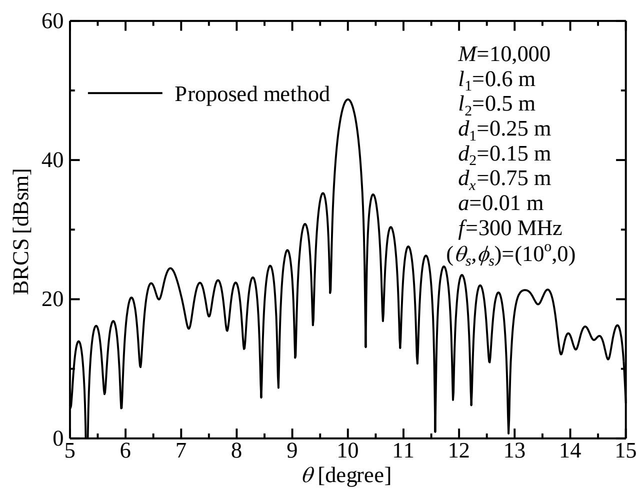

Fig. 2 BRCS of a large-scale reflectarray.

4. Conclusion

In this paper, a fast MoM for large-scale reflectarrays has been proposed and its effectiveness has been demonstrated numerically.

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References

[1] K.Konno, et al. IET Microw. , Antennas Propag., Vol. 12, no. 3 pp. 346-353, 2018