Electromagnetic Scattering from Arbitrary Shaped Multiple Objects by Superposition Solution Combined with Method of Moments

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The problem of electromagnetic scattering from multiple objects includes many important applications, such as frequency selective surface, electromagnetic bandgap structure, photonic crystal structure, metamaterial structure, and so on. These structures are composed of small objects periodically arranged in two-dimension or three-dimension. Another example is electromagnetic scattering by raindrops. In this case, the model is composed of small objects randomly distributed.

Thanks to the superposition solution combined with Mie's theory, we can analytically calculate electromagnetic scattering from multiple spheres. The calculation is not simple, because we have to treat the additional theorem to transform a spherical harmonic from one coordinate origin to another. This method is only applicable to spherical objects.

In order to solve the problem of electromagnetic scattering from arbitrary shaped multiple objects, we employ the method of moments (MoM) instead of Mie's theory. Namely, we calculate electromagnetic scattering from arbitrary shaped multiple objects by the superposition solution combined with MoM.

The scheme of numerical calculation is as follows. First, we consider the i-th object as excited only by the incident wave. Solving by MoM, we obtain the first order of scattering. Then, we consider the i-th object as excited by the waves of the first order of scattering from the entire objects excluding i-th object. Solving by MoM, we obtain the second order of scattering. We proceed in this manner to the m-th order of scattering, where m-th order of scattering is enough small.

Since MoM is applied into each object, we can avoid solving a linear equation in large number of variables. The interactions among multiple objects are included in scattering fields and the number of order of scattering. In this method, time-consuming part is not solving linear equation but calculation of scattered field.