A REDUCED BASIS METHOD FOR ELECTROMAGNETIC SCATTERING BY MULTIPLE PARTICLES IN THREE DIMENSIONS

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Abstract. We consider the development of efficient and fast computational methods for parametrized electromagnetic scattering problems involving many scattering three dimensional bodies. The parametrization may describe the location, orientation, size, shape and number of each scattering body as well as properties of the source field such as frequency, polarization and incident direction. The emphasis is on problems that need to be solved rapidly to accurately simulate the interaction of scattered fields under parametric variation, e.g., for design, detection, or uncertainty quantification. For such problems, the use of a brute force approach is often ruled out due to the computational cost associated with solving the problem for each parameter value.

We present an iterative reduced basis method based on a boundary element discretization of few reference scatterers to resolve the computationally challenging large scale problem, see [1]. In this approach, we compute (in an offline procedure) a selection of snapshot solutions considering only a single-scattering problem to assemble a reduced basis approximation space for each reference scatterer. In the online procedure, a configuration consisting of copies of one of the reference scatterers is considered where we use the previously assembled reduced basis spaces as approximation spaces for any choice of the parameters. The online evaluation of the interaction between two bodies is done by empricial interpolation of the kernel function which can be precomputed in the offline procedure. We compare our numerical results with directly measured results for some benchmark configurations and demonstrate the power of our method to rapidly simulate the interacting electromagnetic fields under parametric variation of the overall multiple particle configuration.

Keywords: PEC-scattering, multiple particles, electric field integral equation, reduced basis method

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References

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