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Two-level Preconditioning for Electromagnetic Scattering from Composite Conducting and Dielectric Objects

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A coupled surface-volume integral equation approach is used for the calculation of electromagnetic scattering with composite conducting and dielectric materials. This approach has high accuracy in solutions and can be accelerated by the multilevel fast multipole algorithm (MLFMA) to reduce the CPU time and memory. By using the method of moments (MoM), the coupled surface-volume integral equations are converted into discrete matrix equations. The near part of the resulting matrix consists of four block components. Due to this specific data pattern, we can construct two-level (TL) preconditioners to treat the conducting and dielectric parts more efficiently. The main purpose of this study is to show that the TL preconditioning is effective with the MLFMA and can reduce the number of Krylov iterations substantially by using subdivided domain of the near part matrix for each level. Our experimental results indicate that the TL preconditioning maintains the computational complexity of the MLFMA, but converges a lot faster, thus effectively reduces the overall simulation time for the coated material objects.