

Title: Accelerated Calderón preconditioning for Maxwell transmission problems

Abstract: We investigate a range of techniques for the acceleration of Calderón (operator) preconditioning in the context of boundary integral equation methods for electromagnetic transmission problems. Our objective is to mitigate as far as possible the high computational cost of the barycentrically-refined meshes necessary for the stable discretisation of operator products. Our focus is on the well-known PMCHWT formulation, but the techniques we introduce can be applied generically. By using barycentric meshes only for the preconditioner and not for the original boundary integral operator, we achieve significant reductions in computational cost by (i) using "reduced" Calderón preconditioners obtained by discarding constituent boundary integral operators that are not essential for regularisation, and (ii) adopting a "bi-parametric" approach in which we use a lower quality (cheaper) H-matrix assembly routine for the preconditioner than for the original operator, including a novel approach of discarding far-field interactions in the preconditioner. Using the boundary element software Bempp ([this http URL](http://www.bempp.org)), we compare the performance of different combinations of these techniques in the context of scattering by multiple dielectric particles. Applying our accelerated implementation to 3D electromagnetic scattering by an aggregate consisting of 8 monomer ice crystals of overall diameter 1cm at 664GHz leads to a 99% reduction in memory cost and at least a 75% reduction in total computation time compared to a non-accelerated implementation.