A WELL-CONDITIONED BOUNDARY INTEGRAL FORMULATION FOR ELECTROMAGNETIC SCATTERING AT COMPOSITE OBJECTS

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Abstract. We consider time harmonic electromagnetic scattering at an object that has piecewise constant permittivity and assume that all homogeneous parts of the scatterer are curvilinear polyhedral Lipschitz. We focus on the corresponding electric field integral equation. Since we have to cope with unbounded domains, boundary element approaches are a convenient tool for numerical treatment. The classical first-kind approach, the so-called PMCHWT formulation, see e.g. [1], is the most popular boundary integral equation method to solve this kind of problem. For a Galerkin discretisation with low-order edge elements, it leads to ill-conditioned linear systems for which no effective preconditioning strategy is available yet.

Based on so-called multi-potentials, we establish a second-kind single trace boundary element approach for the Cauchy trace of the total field on the union of material interfaces. In contrast to the classical first-kind approach, the Galerkin system of the new formulation is *intrinsically well-conditioned*.

Numerical tests confirm the excellent mesh-size independent conditioning of the Galerkin matrices of our second-kind approach and the resulting fast convergence of iterative solvers like GMRES. Furthermore, we obtain competitive accuracy of the new second-kind results in comparison to the first-kind computations.

Keywords: Electromagnetic scattering, second-kind boundary integral equations, Galerkin boundary element methods.

Mathematics Subject Classifications (2010): 65N12, 65N38, 65R20.

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