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Adaptive Basis Functions Suitable for a Well-Conditioned Formulation to the Inverse Electromagnetic Scattering Problem under the BIM

The work presented shows that through an adaptive set of basis functions, the MoM solution to the linearized scalar inverse electromagnetic scattering problem is capable of alleviating the ill-conditioning of the resulting matrix equation. The selected basis functions, whole-domain and harmonic, provide a perfectly conditioned system of equations under the first-order Born approximation when appropriately selected field frequencies are chosen.

By analogy, we iteratively solve the full nonlinear problem using the Born Iterative Method (BIM) by introducing variability in the basis function expansion through a single phase parameter. By selecting the parameter value that minimizes the condition number of the discrete matrix operator, we demonstrate that it is possible to maintain a well-conditioned, linearized inverse problem, at each iteration of the BIM. The benefit of this approach is that it removes the requirement for Tikhonov regularization (or equivalent regularization schemes) usually needed to obtain physically meaningful solutions to the discrete system at each iteration.