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Towards automatically adaptive solvers for Maxwell's equations in three dimensions

The numerical simulation of Maxwell's equations plays a critical role in chip and antenna design, radar cross section determination, biomedical imaging, wireless communications, and the development of new meta-materials and better waveguides to name a few. In order to enable design by simulation for problems arising in these applications, automatically adaptive solvers which resolve the complexity of the geometry and the input data play a critical role. In two dimensions, this has been made possible through the development of high-order integral equation based solvers which rely on well-conditioned integral representations, efficient quadrature formulas, and coupling to fast multipole methods. However, much is still to desired of these solvers in three dimensions (both in terms of their efficiency and accuracy), particularly in the context of enabling automatic adaptivity in complex geometries. In this talk, I will present an efficient high-order solver for solving Maxwell's equations in complex three dimensional geometries with focus on the efficient quadrature methods for computing singular integrals.