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Three-Dimensional Curved Wire Antenna Problems

Partial differential equations are often reformulated as surface integral equations, via, say, Green's theorem. Such a reformulation can be highly advantageous from a numerical point of view, since it makes the use of domain-termination techniques unnecessary and can be used in conjunction with high-order numerical integration schemes. In this talk I discuss our recent work on fast, high-order algorithms applied to the thin wire antenna problem. Based on the electric field integral equation, we develop a model applicable to three-dimensional curved wires. The algorithms we propose converge super-algebraically: faster than $\mathcal{O}(1/N^m)$ and $\mathcal{O}(1/M^m)$ for any positive integer m, where N and M are the numbers of unknowns and the number of integration points required for construction of the discretized integral operator, respectively. Previous methods are limited to low order convergence rates due to a tangent line approximation used to resolve the singularity of integral operator. We illustrate the effectiveness of our methods with applications to wires described by both closed and open curves; the latter case requires some special treatment of end-point singularities.

With Oscar Bruno, Caltech.