# Parallel Time Domain Solvers for Electrically Large Transient Scattering Problems

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Abstract:

Marching on in time (MOT)-based integral equation solvers represent an increasingly appealing avenue for analyzing transient electromagnetic interactions with large and complex structures. MOT integral equation solvers for analyzing electromagnetic scattering from perfect electrically conducting objects are obtained by enforcing electric field boundary conditions and implicitly time advance electric surface current densities by iteratively solving sparse systems of equations at all time steps. Contrary to finite difference and element competitors, these solvers apply to nonlinear and multi-scale structures comprising geometrically intricate and deep sub-wavelength features residing atop electrically large platforms.

Moreover, they are high-order accurate, stable in the low- and high-frequency limits, and applicable to conducting and penetrable structures represented by highly irregular meshes.

This presentation reviews some recent advances in the parallel implementations of time domain integral equation solvers, specifically those that leverage multilevel plane-wave time-domain algorithm (PWTD) on modern manycore computer architectures including graphics processing units (GPUs) and distributed memory supercomputers. The GPU-based implementation achieves at least one order of magnitude speedups compared to serial implementations while the distributed parallel implementation are highly scalable to thousands of compute-nodes. A distributed parallel PWTD kernel has been adopted to solve time domain surface/volume integral equations (TDSIE/TDVIE) for analyzing transient scattering from large and complex-shaped perfectly electrically conducting (PEC)/dielectric objects involving ten million/tens of millions of spatial unknowns.