

## Parallelizing the Hybrid Pseudo-Spectral Time Domain/Finite Difference Time Domain Algorithms for the Large-Scale Electromagnetic Simulations Using Message Passing Interface Library

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**Abstract :** Due to its coarse grid, the Pseudo-Spectral Time Domain (PSTD) method has advantages against the Finite Difference Time Domain (FDTD) method in terms of memory requirement and operation time. However, since the efficiency of parallelization is much lower than that of FDTD, PSTD is not a useful method for a large-scale electromagnetic simulation in a parallel platform. In this paper, we propose the parallelization technique of the hybrid PSTD-FDTD (HPF) method which simultaneously possesses the efficient parallelizability of FDTD and the quick speed and low memory requirement of PSTD. Parallelization cost of the HPF method is exactly the same as the parallel FDTD, but still, it occupies much less memory space and has faster operation speed than the parallel FDTD. Experiments in distributed memory systems have shown that the parallel HPF method saves up to 96% of the operation time and reduces 84% of the memory requirement. Also, by combining the OpenMP library to the MPI library, we further reduced the operation time of the parallel HPF method by 50%.

**Keywords :** FDTD, hybrid, MPI, OpenMP, PSTD, parallelization

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