A Parallel FDTD with MPI Library and Serial Parallel FDTD Algorithms

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In this course we will present two algorithms, namely the parallel FDTD method (PFDTD) using the MPI (Message Passing Interface) library and the new algorithm serial parallel FDTD (SPFDTD) [1] - [4]. Those algorithms are used for simulating large and very large electromagnetic problems.

An overview of parallel architectures will be provided. We will present how to parallelize an FDTD code with PML absorbing boundary condition by dividing the computational domain into N processors. The parallel processing techniques required for the PFDTD with the MPI instructions will be presented such as:
MPI_ISEND and MPI_IRECV which are used to exchange the field data at the interface between two adjacent subdomains,
MPI_BARRIER for synchronization of all processors after each process,
MPI_ALLREDUCE for result collection from all processors.

Next, we will present a new serial-parallel FDTD approach to solve large electromagnetic problems that is difficult to handle via a direct application of the PFDTD algorithm because of the large size. This technique is based on dividing the original problem into relatively small sub-regions, and evaluating the solution that are localized in each of these sub-regions using parallel processing. The excitation of the sub-regions can either be direct sources, as for instance in the aggressor array, or be derived from the fields propagating into domain–from adjacent regions through the interfaces. Of course, the advantage of using the serial-parallel approach is that it can handle very large problems, well beyond the scope of the direct methods.
Several examples of scattering and antenna problems with dividing the computational domain into subdomains will be illustrated.

References

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