Abstract: Tau3P, a parallel effort to the Omega3P project in the DOE Grand Challenge [1], is a new 3D parallel time-domain solver for simulating LARGE RF structures with an accuracy beyond what existing codes can provide. It is based on the modified Yee algorithm formulated on an unstructured grid, and uses hexahedral and pentahedral cells to obtain a more realistic geometry description. Mesh generation is performed by SIMAIL/CUBIT while the distribution of mesh data onto multi-processors is handled by the DistMesh class library as in Omega3P with the partitioning done by ParMETIS. Since the execution of Tau3P is predominantly matrix-vector operations during time advancement, the program can be readily implemented on distributed memory machines using MPI or on shared memory systems running threads. We will present results from the SGI/CRAY T3E at NERSC and from a 4-node Xeon server. The simulations include S-parameter calculations for the NLC power input coupler and an RF choke for pulse heating experiments. Parallel performance issues of the code on distributed versus shared memory architectures will be discussed.

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Coupler Fields at Matched Frequency

- Amplitude: coupler field ~15% higher than structure cell field
- Phase: 60° in coupler cell, 120° in structure cell

Signals in Input/Output Ports

- Input Port Reflections
- Output Port Transmissions

Parallel Efficiency

Tau3P parallelization is predominantly on the matrix-vector operations during time advancement. Due to the mixture of orthogonal and non-orthogonal elements on the mesh, the matrix bandwidth (# of non-zeros in a row) varies so that straightforward partitioning on distributed or shared memory machines would result in significant load imbalance.

Load Balancing

RF choke example on SGI/CRAY-T3E at NERSC - load imbalance for this mesh approaches 3 to 1 as # of processors increases

An improved partitioning scheme is in progress