AMG

Summary Version

1.0

Purpose of Benchmark

Test single CPU performance and parallel scaling efficiency.

Characteristics of Benchmark

AMG is a parallel algebraic multigrid solver for linear systems arising from problems on unstructured grids. The driver provided for this benchmark builds linear systems for various 3D problems that are described in section D of the AMG2006.readme file. The code is written in ISO standard C.

The instruction mix is dominated by integer arithmetic and branches: 54% fixed point, 28% load/store, 15% branch, and 4% floating point. Branch prediction is challenging. There are very large demands on main memory bandwidth.

Parallelization is accomplished using MPI. The source code does have OpenMP directives from a performance study done years ago. Correct OpenMP operation has been confirmed on two small tests. The placement of the OpenMP directives does represent the current strategy for threading where it has been introduced, but a full exploitation of threading has yet to be done.

As the size of the problem being solved increases, MPI takes most of the time, and it can easily take 90% of the total time for large problems. Collective calls of various kinds consume more than 90% of the MPI time. The average non-collective MPI message size is between about 2–10 KB.

There are two methods for creating the matrix, its partitions, and communication arrays. The first uses a global partitioning with memory requirements depending on the number of processors. The second does not have this limitation and scales much better for large sizes, where large means >~10K processors. Only the second method will be used for Sequoia benchmarking.

See a much more detailed description of the code in the AMG2006.readme file.

Mechanics of Building Benchmark

Detailed instructions can be found in the AMG2006.readme file.

The benchmark has been compiled using icc, xlc, gcc, and PathC, and run on Xeon, POWER, Opteron, and Sparc CPU-based computers. Correct operation has been demonstrated on up to 125,000 processors on LLNL's BlueGene/L computer.

Mechanics of Running Benchmark

Detailed instructions can be found in the AMG2006.readme file within the benchmark code tar file. See the Sequoia AMG problem set document for specific problem configurations to be run.

Verification of Results

Detailed instructions can be found in the AMG2006.readme file.