

ADVANCED TOPICS IN NUMERICAL ANALYSIS: HIGH PERFORMANCE COMPUTING ASSIGNMENT 1

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1. MPI ring communication. I calculated the averaged communication time of transferring 2MB data and the estimated bandwidth. This was checked on both my local computer and the multiple machines (using crunchy1 & crunchy3). The results are:

- Single computer (fake):
averaged communication time = 0.0003s, estimated bandwidth = 3.24 GB/s;
- Multiple machines:
averaged communication time = 0.0088s. estimated bandwidth = 113MB/s.

2. Distributed memory parallel Jacobi smoother.

- Strong scaling of the Jacobi code: I ran the jacobi-mpi code with changing number of processors. The number of iterations is fixed as 10 and the problem scale is taken large enough as 360,000,000. Specifically I run the following
`mpirun -np p ./jacobi-mpi 360000000 10`
with changing $p = 3, 6, 12, 24, 36, 48$. The results are plotted in the following figure (and it is observed that the residual error keeps the same with changing p).
- The parallel version of Gauss-Seidel iteration becomes more difficult because it needs the updated values at previous grid points to calculate the value at present point. Thus the value at u_j cannot be calculated at each updating circle until u_{j-1} is achieved, making it essentially a serial algorithm.

