Chombo/Proto Poisson example

Abstract

Given a charge distribution ρ, and a field ϕ the spatial Helmoltz equation is given by

$$(\alpha I + \beta \nabla)\phi = \rho. \tag{1}$$

where α and β are constants. The Chombo Proto example solves the spatial Helmholtz equation in two or three dimensions using geometric multigrid with standard V-cycles.

We present the performance for a single level calculation on a single node of a Cori Haswell node. The boundary conditions are periodic and the charge distribution has compact support of $r = 0.2$. Further parameters are as follows.

- Identity coefficient, $\alpha = 1$.
- Laplacian coefficient, $\beta = -0.1$.
- Number of smoothings per relaxation, $n_s = 4$.
- Grid dimensions $= 512^3$.
- Domain size $L_x = L_y = L_z = 1$.

All calculations are done with a varying number of threads, keeping the number of computational units constant. If N_t is the number of OpenMP threads and N_m is the number of MPI processes, for all calculations, $N_t N_m = 32$. Floating point rates are calculated as a post-processing step.

N_t	N_m	T_{vcycle}	F_{resid}
1	32	1.223	78.1 GFlop
2	16	2.450	39.0 GFlop
4	8	2.480	30.6 GFlop
8	4	2.334	18.4 GFlop
16	2	2.695	10.5 GFlop
32	1	2.361	6.5 MFlop

Table 1: AMRPoisson performance.

N_t	N_m	T_{vcycle}	F_{resid}
1	32	3.89	20.1 GFlop
2	16	6.53	12.7 GFlop
4	8	6.47	12.6 GFlop
8	4	6.27	12.6 GFlop
16	2	6.00	12.6 GFlop
32	1	5.85	12.7 GFlop

Table 2: 7 point stencil proto performance. Same stencil as AMRPoisson

N_t	N_m	T_{vcycle}	
1	32	12.4	22.9 GFlop
2	16	20.7	14.7 GFlop
4	8	20.7	14.4 GFlop
8	4	19.7	14.7 GFlop
16	2	18.8	14.9 GFlop
32	1	18.6	14.9 GFlop

Table 3: 27 point stencil proto performance.