Baseline Performance Measurement of PPMAMRGodunov Explosion Example

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The target platform for this benchmark measurement is a machine named Seaborg located at NERSC. Seaborg is an IBM SP RS/6000 System and it currently consists of 6,080 processors. Each processor is a POWER3 chip with a clock speed of 375 MHz and peak performance of 1.5 Gflops. The Seaborg processors are clustered into 380 symmetric multiprocessor nodes (16 processors per node). Seaborg is a hybrid system in the sense that memory is distributed among nodes, but within a node memory is shared.

The Fortran compiler used for this was the AIX Fortran compiler `xlf` version 8.1.1.5 with the flags set to be `-O3 -qarch=auto -qmaxmem=99999 -qhot -qstrict`. The C++ compiler used was the AIX C++ compiler `xlC` version 6.0.0.7 with flags as `-O3 -qstrict -qarch=auto -qstaticinline`.

The input used for the runs is presented in Figure 1. Four different problems were used, each with increasing size and decreasing refinement threshold as shown in Table 1. For each of these problems, Table 2 shows the number of points or cells updated per AMR level. Finally, Table 3 and 4 show the parallel performance results of the Godunov PPM and Unsplit methods, including wall-clock run time, and memory usage.

Prob size	Refinement Threshold	Problem Name
16x16x16	0.1000	small
32x32x32	0.0500	large
64x64x64	0.0250	ex-large
128x128x128	0.0125	huge

Table 1: Different Sizes of Problems Used in Benchmark

Level	16x16x16	32x32x32	64x64x64	128x128x128
0	16384	131072	1048576	8388608
1	4194304	20316160	73105408	257818624
2	385974272	1295974400	5019926528	18760663040
totals	390184960	1316421632	5094080512	19026870272

Table 2: Number of Points Updated Per AMR Level for each Problem Size

```
godunov.whichproblem = 1
godunov.gamma = 1.4
godunov.shock_mach = 10.0
godunov.explosion_center = 0.6 0.6 0.6
godunov.explosion_size = 0.25
godunov.verbosity = 2
godunov.max_step = 4
godunov.max_time = 0.75
godunov.fixed_dt = -1.0
godunov.domain_length = 1.0
godunov.num_cells = 16 16 16
godunov.is_periodic = 0 0 0
godunov.max_level = 2
godunov.ref_ratio = 4 4 4
godunov.regrid_interval = 2 2 2
godunov.tag_buffer_size = 3
godunov.refine_thresh = 0.10
godunov.block_factor = 16
godunov.max_grid_size = 16
godunov.fill_ratio = 0.75
godunov.use_limiting = 1
godunov.use_char_limiting = 0
godunov.use_flattening = 1
godunov.fourth_order_slopes = 1
godunov.use_artificial_viscosity = 1
godunov.artificial_viscosity = 0.1
# turn off plot files
godunov.checkpoint_interval = -1
godunov.plot_interval = -1
godunov.cfl = 0.8
godunov.initial_cfl = 0.3
godunov.max_dt_growth = 1.1
godunov.dt_tolerance_factor = 1.1
```

Figure 1: Input file for PPM Godunov Explosion Runs

Prob size	Num Procs	Avg Memory MB	Min-Max Memory MB	AMR Run time (sec)
16x16x16	16	268	216-307	1249
32x32x32	32	429	345-501	2204
32x32x32	64	243	198-270	1157
32x32x32	128	147	118-167	590
32x32x32	256	101	76-117	308
64x64x64	128	412	345-468	2290
64x64x64	256	252	200-290	1249
64x64x64	512	172	131-199	602
64x64x64	1024	137	97-161	325
128x128x128	512	458	379-538	2278
128x128x128	1024	303	248-346	1225

Table 3: Seaborg Parallel Performance using PPM Godunov

Prob size	Num Procs	Avg Memory MB	Min-Max Memory MB	AMR Run time (sec)
16x16x16	16	268	215-297	868
32x32x32	32	434	359-493	1538
32x32x32	64	249	195-285	802
32x32x32	128	148	113-171	418
32x32x32	256	101	75-118	225
64x64x64	128	411	340-473	1566
64x64x64	256	249	197-291	820
64x64x64	512	168	128-199	438
64x64x64	1024	132	90-164	253
128x128x128	512	455	392-532	1702
128x128x128	1024	299	250-352	983

Table 4: Seaborg Parallel Performance using Godunov Unsplit