Timing results for Dardel

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1 Code and test case

For all tests, the Pencil Code Pencil Code Collaboration (2021) was used. It is publicly available on `http://github.com/pencil-code`, where also detailed documentation is available. The code uses explicit sixth order finite differences. The time step is third-order. In this sample, we run isothermal magnetohydrodynamics in a periodic domain.

Table 1: Dardel timings

proc	$\frac{\mu s}{\text{pt step}}$	resol.	layout	comp.
128	6.346E-03	256^3	4x4x8	Cray
256	3.215E-03	256^3	4x8x8	Cray
512	1.857E-03	256^3	8x8x8	Cray
1024	1.505E-03	256^3	8x8x16	Cray
2048	1.884E-03	256^3	8x16x16	Cray
512	1.571E-03	512^3	8x8x8	Cray
1024	1.102E-03	512^3	8x8x16b	Cray
2048	5.508E-04	512^3	8x16x16	Cray
4096	7.461E-04	512^3	16x16x16	Cray
512	1.568E-03	512^3	8x8x8	gnu
1024	9.260E-04	512^3	8x8x16	gnu
2048	5.550E-04	512^3	8x16x16	gnu
4096	7.702E-04	512^3	16x16x16	gnu
4096	2.093E-04	1024^3	16x16x16	Cray
8192	1.215E-04	1024^3	16x16x32	Cray
16384	8.536E-05	1024^3	16x32x32	Cray
4096	2.754E-04	1024^3	16x16x16	gnu
8192	1.194E-04	1024^3	16x16x32	gnu
16384	6.046E-05	1024^3	16x32x32	gnu
32768	3.953E-05	1024^3	32x32x32	gnu
2048	3.416E-04	2048^3	8x16x16	gnu
4096	1.859E-04	2048^3	8x16x32	gnu
4096	1.674E-04	2048^3	16x16x16	gnu
8192	9.271E-05	2048^3	16x16x32	gnu
16384	6.853E-05	2048^3	16x32x32	gnu
32768	2.909E-05	2048^3	32x32x32	gnu
8192	8.588E-05	4096^3	16x16x32	gnu
16384	4.368E-05	4096^3	16x32x32	gnu
32768	3.153E-05	4096^3	32x32x32	gnu

2 Running the code

To run the code, get one of the sample run directories, e.g., `https://github.com/pencil-code/pencil-code/tree/master/doc/timings/N4096_32x32x32`. The relevant file to be changed is `src/cparam.local`

```
ncpus=32768,nprocx=32,nprocy=32,nprocz=ncpus/(nprocx*nprocy)
nxgrid=4096,nygrid=nxgrid,nzgrid=nxgrid
```

In particular, the values of ncpus, nprocx, nprocy, and nxgrid. Once they are chosen, say make, and submit start_run.csh.

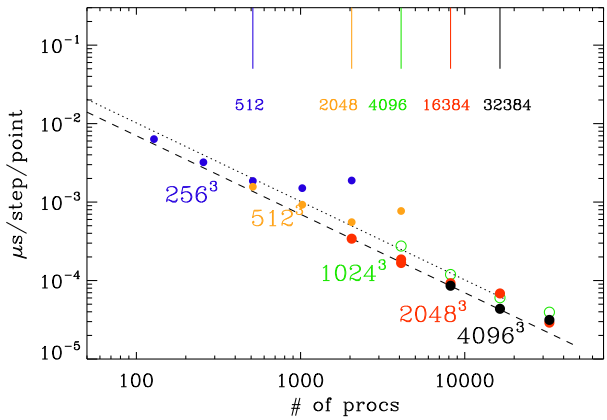

Figure 1: Strong scaling on Dardel. The dotted and dashed lines corresponds to 1.02μs/proc/step/point and 0.70μs/proc/step/point, respectively.

3 Dardel results

On Dardel, strong scaling tests have been performed for five mesh sizes. The time per time step and mesh point is given for different processor numbers and layouts. Generally, it is advantageous to minimize the processor surface area, and to keep the number of processors in the x direction small.

Performancewise, Cray with O2 optimization is equivalent to gnu with O3. While gnu-O3 is able to handle memory or whatever compiler problems much better, it is otherwise not better than Cray-O2, and often some 10–20% slows, but this is within the measurement accuracy.

References

Pencil Code Collaboration: 2021, "The Pencil Code, a modular MPI code for partial differential equations and particles: multipurpose and multiuser-maintained," *J. Open Source Software* **6**, 2807

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