Timing results for Lindgren and Triolith

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1 Code and test case

For all tests, the PENCIL CODE was used. It is publicly available on `http://pencil-code.googlecode.com/`, 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[1]. Power spectra are computed during the run, but our current parallelization of the Fourier transform requires that the meshpoint number is an integer multiple of the product of processor numbers in the y and z directions and the product of processor numbers in the x and y directions. In addition, the number of processors in one direction should not be so large that the number of mesh points per processor becomes comparable to or less than the number of ghost zones (which is 6).

2 Running the code

To run the code, get one of the sample run directories, e.g., `http://norlx51.nordita.org/~brandenb/pencil-code/timings/bforced/512_4x16x32`. The relevant file to be changed is `src/cparam.local`

```
ncpus=2048,nprocx=4,nprocy=16,nprocz=ncpus/(nprocx*nprocy)
nxgrid=512,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.

3 Triolith

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

Comments. Although on Triolith the number of processors per node is 16, resolutions with one or two powers of 3 (such as 576) still work well. Furthermore, the number of processors above which the scaling becomes poor increases quadratically with the number of mesh points. This implies that the RAM per processor increases linearly with the problem size per direction. However, this will not be a limitation, because even for 2304^3 meshes, the required RAM is still below 100 MB.

4 Lindgren

On Lindgren, we have performed weak scaling tests and compare with weak scaling results for Triolith. Triolith is about twice as fast as Lindgren.

[1]Run directories are available on `http://norlx51.nordita.org/~brandenb/pencil-code/timings/bforced/`

```
$Header: /var/cvs/brandenb/tex/pencil-code/performance/notes.tex,v 1.5 2021/10/31 02:55:14 brandenb Exp $
```

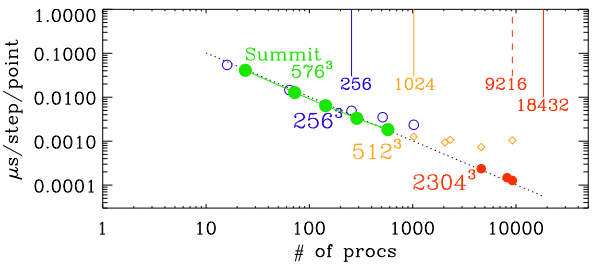

Figure 1: Strong scaling on Triolith.

Table 1: Triolith timings

proc	$\frac{\mu s}{\text{pt step}}$	resol.	layout
16	0.075	128^3	2x2x4
16	0.065	128^3	1x4x4
16	0.0544	256^3	1x4x4
64	0.0146	256^3	1x8x8
64	0.0164	256^3	2x4x8
256	0.0049	256^3	1x16x16
512	0.0035	256^3	2x16x16
1024	0.00236	256^3	2x16x32
1024	0.00127	512^3	2x16x32
1024	0.00129	512^3	4x16x16
2048	9.34×10^{-4}	512^3	4x16x32
2304	0.00107	576^3	4x18x32
4096	3.6×10^{-4}	1024^3	4x32x32
4096	3.8×10^{-4}	1024^3	8x16x32
4096	4.2×10^{-4}	1024^3	4x16x64
4608	7.38×10^{-4}	576^3	8x18x32
4608	2.66×10^{-4}	1152^3	4x32x36
4608	3.03×10^{-4}	1152^3	4x36x32
4608	3.12×10^{-4}	1152^3	4x18x64
4608	2.36×10^{-4}	2304^3	2x32x72
8192	1.475×10^{-4}	2048^3	4x32x64
9216	0.00104	576^3	16x18x32
9216	1.276×10^{-4}	2304^3	4x36x64
9216	1.30×10^{-4}	2304^3	4x32x72

Table 2: Lindgren timings

proc	$\frac{\mu s}{\text{pt step}}$	resol.	layout
1536	0.00171	$512^2\times384$	2x32x24
2048	0.00129	$512^2\times1024$	1x32x64
2048	0.00129	$1024^2\times2048$	1x32x64
4096	4.6×10^{-4}	2048^3	4x16x64
9216	2.36×10^{-4}	2304^3	4x48x48

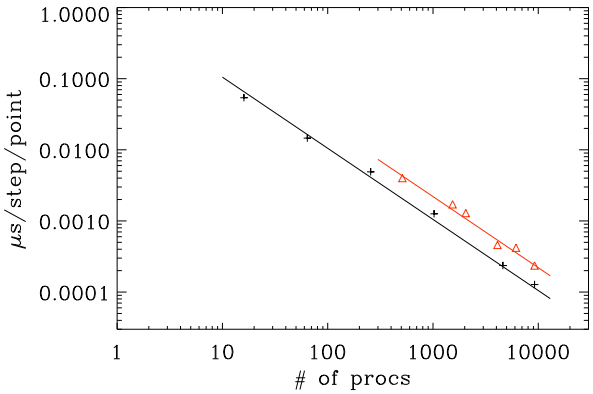

Figure 2: Comparison Triolith (black, plus signs) and Lindgren (red, triangles). Weak scaling.