FFT benchmark

SGI-IZO

March 27, 2009

Abstract

In this article we report the results of some benchmarks about FFT libraries made in the machines of the SGI-IZO. Among the installed FFT libraries intel MKL and FFTW3 are the best ones.

Contents

1 FFT libraries **2**

2 How to link **2**

3 Architectures **2**

4 Benchmarks **4**

A Other benchmarks **6**

1 FFT libraries

Fast Fourier Transforms are an intensive task performed by various scientific computing programs. The correct choice of the used library can improve the performance of the program without any effort.

Currently in the machines of the SGI-IZO we have installed the Intel's MKL-Math Kernel Libraries, gnu's gsl-Gnu Scientific Libraries as well as open source FFTW2 and FFTW3 (FFT on the West) libraries.

More information about installed software in `www.ehu.es/sgi`.

2 How to link

Here you cna find how to link the **Intel** and **FFTW3** libraries, which are the most efficient ones.

- **Linking a Fortran Program to use the Intel FFT Libraries**, (FFTW3 wrappers)

  `-lfftw3xf_intel -lmkl_intel_lp64 -lmkl_sequential -lmkl_core -lpthread`

- **Linking a C Program with to use the Intel FFT Libraries**, (FFTW3 wrappers)

  `-lfftw3xc_intel -lmkl_intel_lp64 -lmkl_sequential -lmkl_core -lpthread`

- **Linking a C Program with the FFTW3 Library**

  `-lfftw3`

3 Architectures

We have made the benchmarks in the following machines.

IT-New

: The newest nodes of Arina with dual core Itanium2 processors at 1.6 GHz and 18 MB of L3 cache.

IT-Old

: The oldest nodes of Arina with Itanium2 processors at 1.3 GHz and 3 MB of L3 cache.

C2D

: The newest nodes of Péndulo, PCs with Intel Core2duo processors at 2.1 GHz and 2 MB of L2 cache.

PIV

: The oldest nodes of Péndulo, PCs with Intel Pentium IV processors at 2.4 GHz and 512 KB of L2 cache.

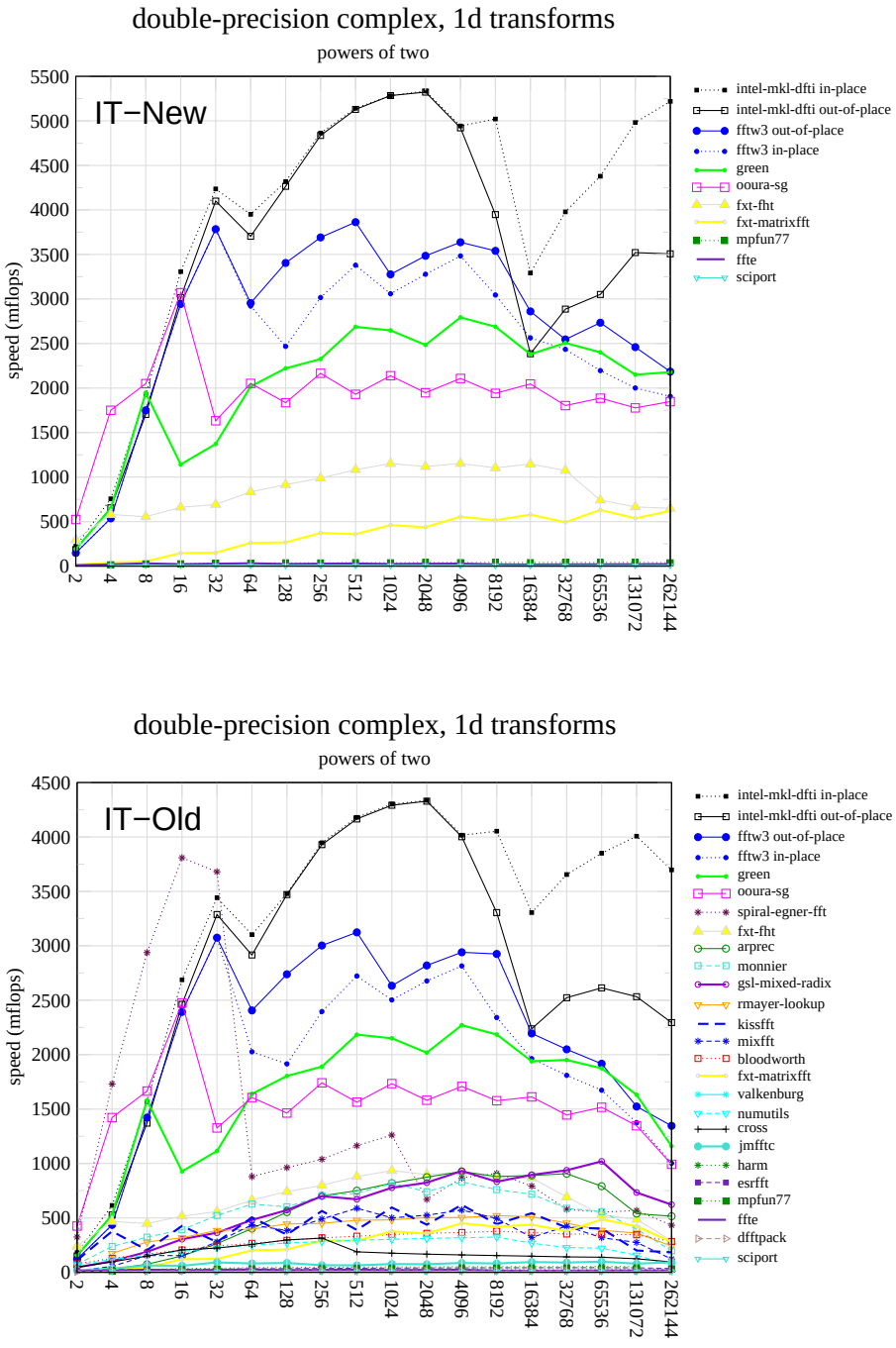


Figure 1: Benchmark on Itanium nodes of Arina.

4 Benchmarks

In Fig. 1 we show the results of one of the benchmarks for the Itanium nodes. First, we see that the best libraries are intel MKL ones followed by FFTW3, while others have a lower performance. In this particular benchmark the difference between MKL and FFTW3 is the biggest one, but in other benchmarks are quite similar. Nevertheless, intel MKL is usually slightly better. In the appendix A we show the results for all the benchmarks in the IT-New nodes.

On the other hand we see how much the new Itanium2 processors nodes have improved over the old ones.

In Fig. 2 we show the results of one of the benchmarks for the nodes of Péndulo. The best one is the MKL library. The Pentium Core2Duo processor performance is similar to IT-New ones. The most remarkable difference between Core2duo processor an Itanium2 being the large FFTs operations, where probably, the large cache of the Itanium2 processor makes its performance better.

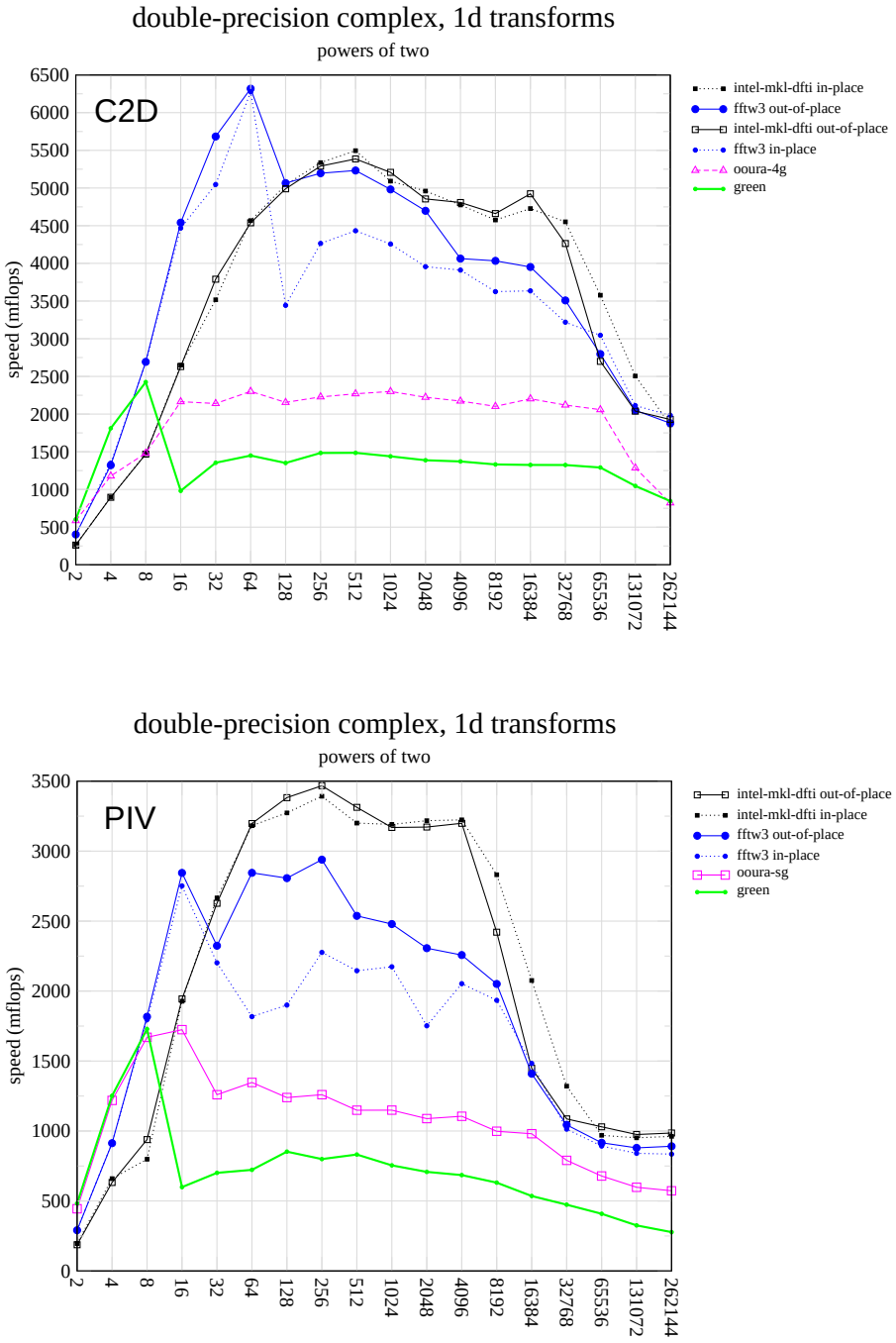
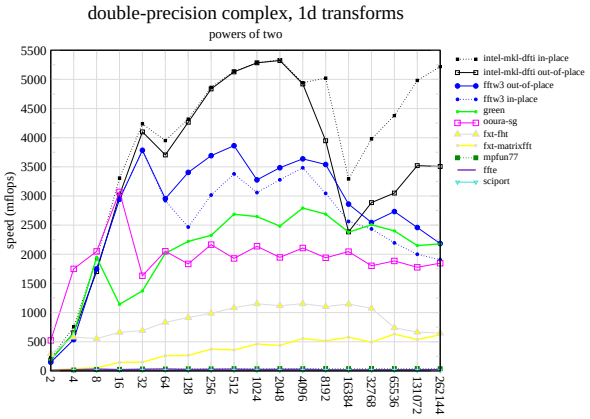
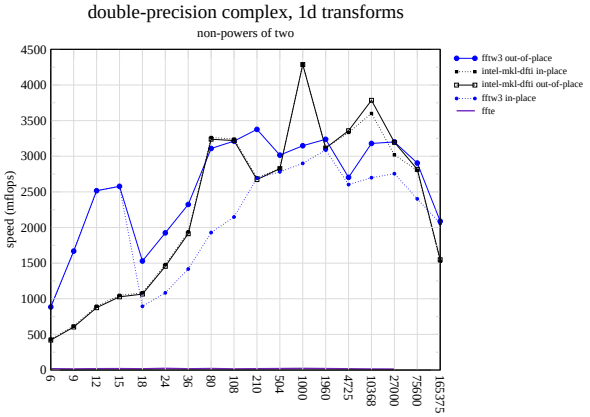


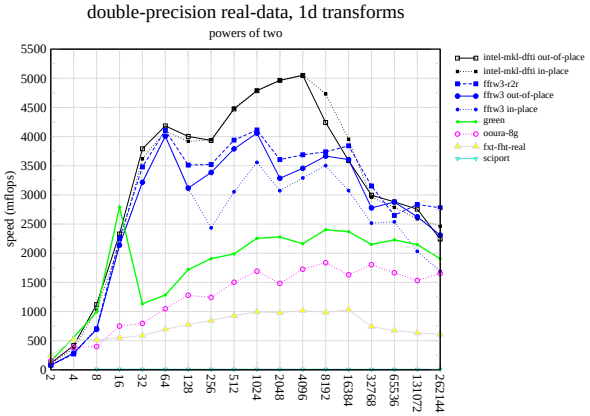
Figure 2: Benchmark on PC nodes of Péndulo.

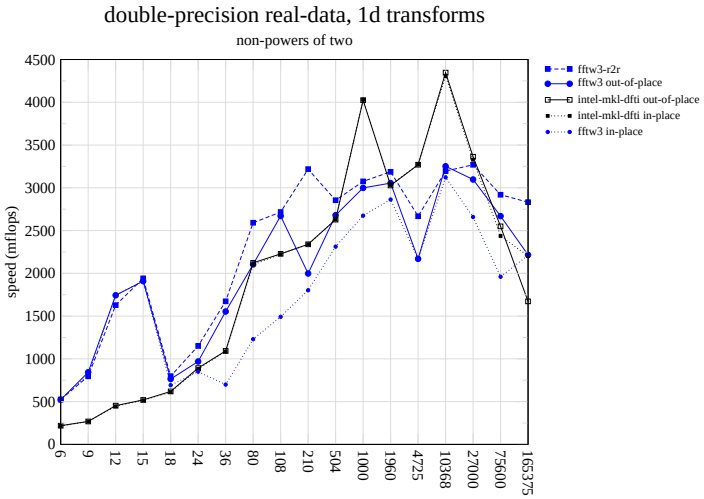
A Other benchmarks

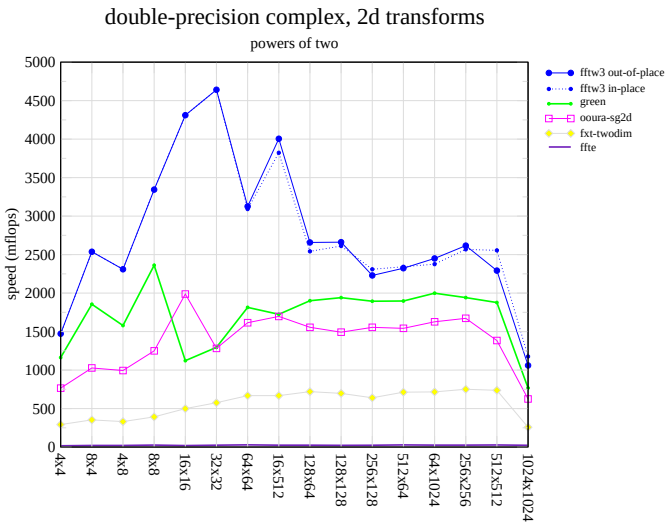
In this appendix we show all figures which the benchmarks made in the IT-New nodes.

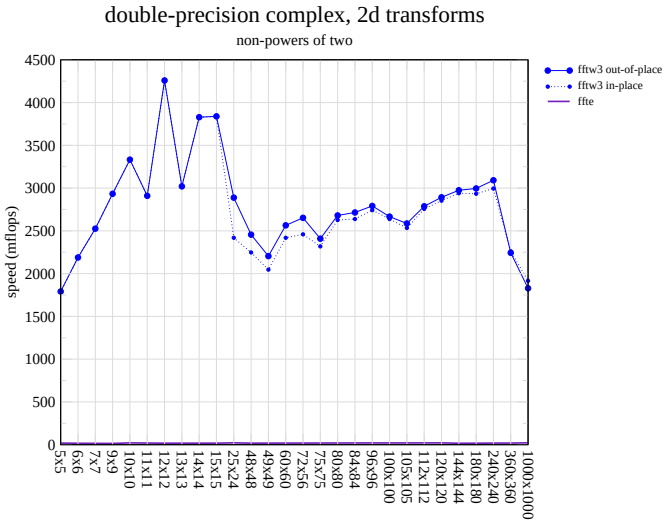


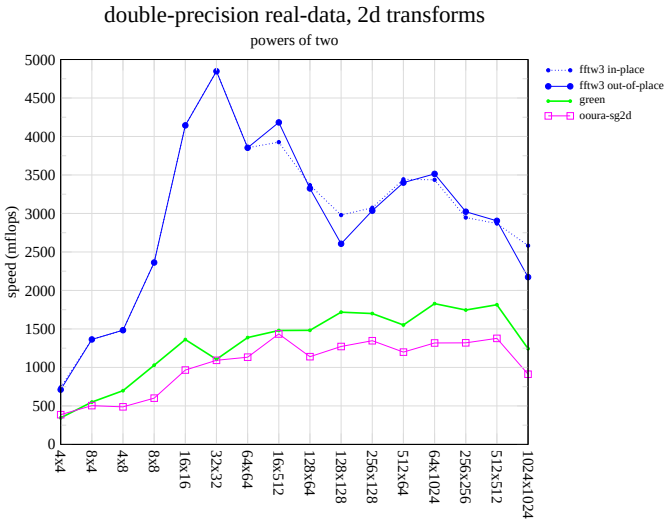


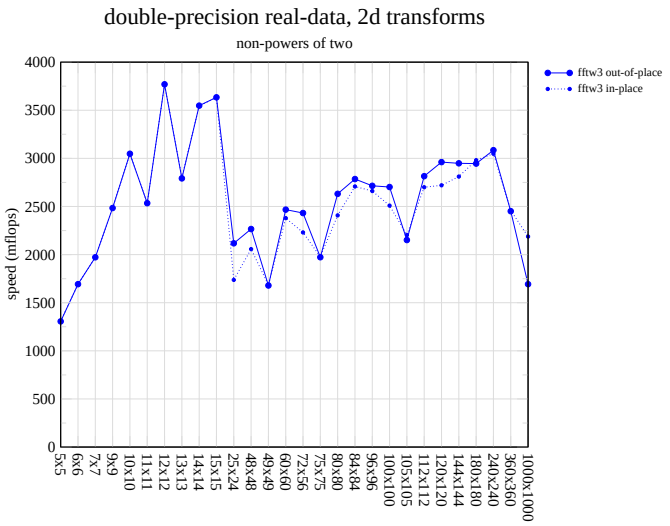


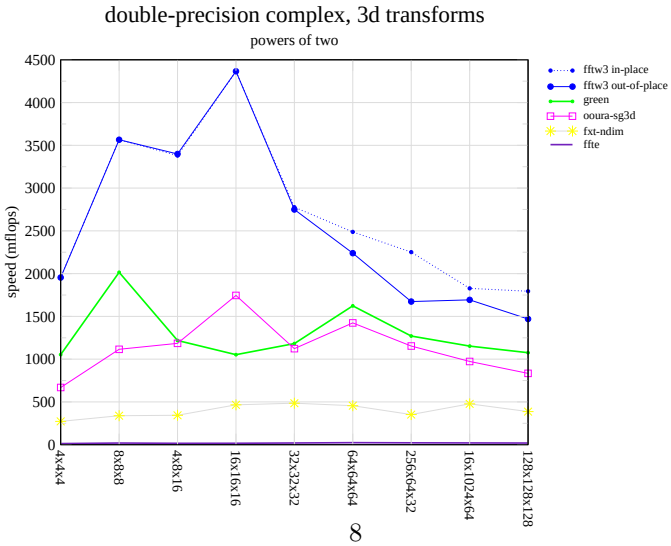

double-precision real-data, 1d transforms
non-powers of two
speed (mflops)
fftw3-r2r
fftw3 out-of-place
intel-mkl-dfti out-of-place
intel-mkl-dfti in-place
fftw3 in-place
0
500
1000
1500
2000
2500
3000
3500
4000
4500
6
9
12
15
18
24
36
80
108
210
504
1000
1960
4725
10368
27000
75600
165375

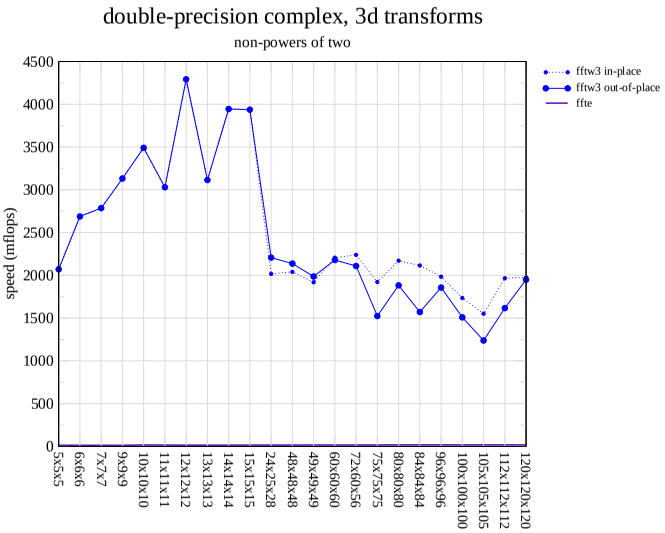

double-precision complex, 2d transforms
powers of two
speed (mflops)
fftw3 out-of-place
fftw3 in-place
green
ooura-sg2d
fxt-twodim
ffte
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
4x4
8x4
4x8
8x8
16x16
32x32
64x64
16x512
128x64
128x128
256x128
512x64
64x1024
256x256
512x512
1024x1024

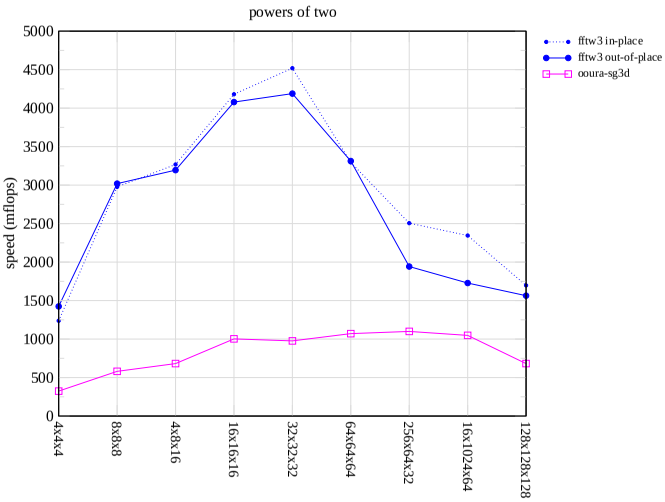

double-precision complex, 2d transforms
non-powers of two
speed (mflops)
fftw3 out-of-place
fftw3 in-place
ffte
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5x5
6x6
7x7
9x9
10x10
11x11
12x12
13x13
14x14
15x15
25x24
48x48
49x49
60x60
72x56
75x75
80x80
84x84
96x96
100x100
105x105
112x112
120x120
144x144
180x180
240x240
360x360
1000x1000

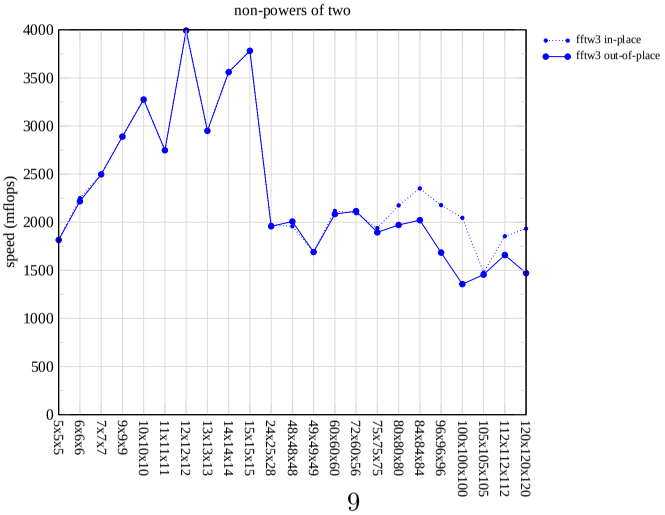

double-precision real-data, 2d transforms
powers of two
speed (mflops)
fftw3 in-place
fftw3 out-of-place
green
ooura-sg2d
4x4
8x4
4x8
8x8
16x16
32x32
64x64
16x512
128x64
128x128
256x128
512x64
64x1024
256x256
512x512
1024x1024


double-precision real-data, 2d transforms
non-powers of two
speed (mflops)
fftw3 out-of-place
fftw3 in-place
5x5
6x6
7x7
9x9
10x10
11x11
12x12
13x13
14x14
15x15
25x24
48x48
49x49
60x60
72x56
75x75
80x80
84x84
96x96
100x100
105x105
112x112
120x120
144x144
180x180
240x240
360x360
1000x1000


double-precision complex, 3d transforms
powers of two
speed (mflops)
fftw3 in-place
fftw3 out-of-place
green
ooura-sg3d
fxt-ndim
fftw
4x4x4
8x8x8
4x8x16
16x16x16
32x32x32
64x64x64
256x64x32
16x1024x64
128x128x128


double-precision complex, 3d transforms
non-powers of two
speed (mflops)
fftw3 in-place
fftw3 out-of-place
fffe
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5x5x5
6x6x6
7x7x7
9x9x9
10x10x10
11x11x11
12x12x12
13x13x13
14x14x14
15x15x15
24x25x28
48x48x48
49x49x49
60x60x60
72x60x56
75x75x75
80x80x80
84x84x84
96x96x96
100x100x100
105x105x105
112x112x112
120x120x120


double-precision real-data, 3d transforms
powers of two
speed (mflops)
fftw3 in-place
fftw3 out-of-place
ooura-sg3d
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
4x4x4
8x8x8
4x8x16
16x16x16
32x32x32
64x64x64
256x64x32
16x1024x64
128x128x128


double-precision real-data, 3d transforms
non-powers of two
speed (mflops)
fftw3 in-place
fftw3 out-of-place
0
500
1000
1500
2000
2500
3000
3500
4000
5x5x5
6x6x6
7x7x7
9x9x9
10x10x10
11x11x11
12x12x12
13x13x13
14x14x14
15x15x15
24x25x28
48x48x48
49x49x49
60x60x60
72x60x56
75x75x75
80x80x80
84x84x84
96x96x96
100x100x100
105x105x105
112x112x112
120x120x120