

independent_particle benchmark

October 10-11, 2017

Working with version from the eigen branch:

```
commit 16be0738707de5b7abb6d9574a20e952996d28f1
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Date: Tue Oct 10 17:31:04 2017 -0500
```

loosen boost requirement

tev

installed environment modules in ~/opt/modules. Added to bashrc:

```
. ~/opt/modules/init/profile.sh
. ~/work/projects/justspack/share/spack/setup-env.sh
```

In order to work with minigia, I do

```
spack load gcc
spack load cmake
```

Various compilers:

gcc 4.4 (system):

```
ltev>cd build-tev-gcc44
ltev>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math
ltev>./independent_particle
orig best time = 0.005406
optimized best time = 0.003673
optimized speedup = 1.47182
GSVector::implementation = 1
vectorized best time = 0.00191
vectorized speedup = 1.92304
omp simd best time = 0.003671
omp simd speedup = 1.00054
```

gcc 4.8 (/usr/local):

```
ltev>cd build-tev-gcc48/
ltev>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math
ltev>prefixadd /usr/local/gcc-4.8.2
ltev>ldpathadd /usr/local/gcc-4.8.2/lib64
ltev>./independent_particle
orig best time = 0.00536215
optimized best time = 0.00358196
optimized speedup = 1.49699
GSVector::implementation = 1
vectorized best time = 0.00191678
vectorized speedup = 1.86874
omp simd best time = 0.00358083
omp simd speedup = 1.00032
```

gcc 5.1 (/usr/local):

```
ltev>cd build-tev-gcc51
ltev>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math
ltev>ldpathadd /usr/local/gcc-5.1.0/lib64
ltev>prefixadd /usr/local/gcc-5.1.0
ltev>./independent_particle
orig best time = 0.00536193
optimized best time = 0.0038617
optimized speedup = 1.38849
GSVector::implementation = 1
vectorized best time = 0.00208626
vectorized speedup = 1.85101
omp simd best time = 0.00198575
omp simd speedup = 1.94471
```

gcc 7.2 (spack):

```
ltev>cd build-tev-gcc72
ltev>spack load gcc
ltev>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math
ltev>./independent_particle
orig best time = 0.00462292
optimized best time = 0.00358175
optimized speedup = 1.29069
GSVector::implementation = 1
```

```
vectorized best time = 0.00203214
vectorized speedup = 1.76255
omp simd best time = 0.00180544
omp simd speedup = 1.98386
```

knl

get to knl with

```
qsub -q knl -l nodes=1:knl -A mi -I
```

need (for intel)

```
ldpathadd ~/extra/lib
. /opt/intel/compilers_and_libraries/linux/bin/compilervars.sh intel64
. /opt/intel/compilers_and_libraries/linux/mpi/intel64/bin/mpivars.sh intel64
MODULEPATH=/home/amundson/work/projects/justspack/share/spack/modules/linux-
scientificfermi6-x86_64:/home/amundson/opt/modules/modulefiles
spack load gcc
spack load cmake
```

(additional for gcc 7.2)

```
spack load openmpi
```

gcc 7.2:

```
lkn1>cd build-knl
lkn1>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math -march=knl
lkn1>./independent_particle
orig best time = 0.0126429
optimized best time = 0.0101326
optimized speedup = 1.24775
GSVector::implementation = 1
vectorized best time = 0.00441139
vectorized speedup = 2.29692
omp simd best time = 0.00120199
```

icc 2017:

```
lkn1>cd build-knl-icca/
lkn1>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-xMIC-AVX512
```

```
lkn11>./independent_particle
orig best time = 0.00854646
optimized best time = 0.00718185
optimized speedup = 1.19001
GSVector::implementation = 1
vectorized best time = 0.0052826
vectorized speedup = 1.35953
omp simd best time = 0.000882793
omp simd speedup = 8.13537
```

panal7

added to bashrc:

```
. /home/amundson/work/projects/justspack/share/spack/setup-env.sh
```

to use intel compiler:

```
. /opt/intel/bin/compilervars.sh intel64
```

gcc 4.8 (system):

```
lpanal7>cd build-gcc48
lpanal7>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math
lpanal7>./independent_particle
orig best time = 0.00425929
optimized best time = 0.00290606
optimized speedup = 1.46566
GSVector::implementation = 1
vectorized best time = 0.00146869
vectorized speedup = 1.97867
omp simd best time = 0.00290487
omp simd speedup = 1.00041
```

gcc 7.2:

```
lpanal7>cd build-gcc72
lpanal7>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math
lpanal7>./independent_particle
orig best time = 0.00358477
optimized best time = 0.0029044
optimized speedup = 1.23425
GSVector::implementation = 1
```

```
vectorized best time = 0.00142039
vectorized speedup = 2.0448
omp simd best time = 0.00142964
omp simd speedup = 2.03157
```

intel 2017:

```
lpanal7>cd build-intel/
lpanal7>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-axAVX,SSE4.2,SSE2
lpanal7>./independent_particle
orig best time = 0.00424219
optimized best time = 0.00288041
optimized speedup = 1.47277
GSVector::implementation = 1
vectorized best time = 0.00145798
vectorized speedup = 1.97561
omp simd best time = 0.00142179
omp simd speedup = 2.0259
```

zlorfik

gcc 4.8 (system):

```
lzlorfik>./independent_particle
orig best time = 0.00355568
optimized best time = 0.00242013
optimized speedup = 1.46921
GSVector::implementation = 1
vectorized best time = 0.00121264
vectorized speedup = 1.99576
omp simd best time = 0.00243985
omp simd speedup = 0.99192
```

gcc 7.2: (note use of AVX, native architecture)

```
lzlorfik>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-march=native -ffast-math -DGSV_AVX
lzlorfik>./independent_particle
orig best time = 0.00299124
optimized best time = 0.00241769
optimized speedup = 1.23723
GSVector::implementation = 2
```

```
vectorized best time = 0.00117436
vectorized speedup = 2.05872
omp simd best time = 0.00117715
omp simd speedup = 2.05384
```

intel 2017:

This binary was copied from panal7, along with several shared libraries. I used

```
prefixadd `pwd`
```

before running independent_particle

```
lzlorfik>cd copied-intel
lzlorfik>./independent_particle
orig best time = 0.0035414
optimized best time = 0.00240271
optimized speedup = 1.47392
GSVector::implementation = 1
vectorized best time = 0.00120261
vectorized speedup = 1.9979
omp simd best time = 0.0011753
omp simd speedup = 2.04434
```

pgi 17.4:

Get pgi compilers on zlorfik by using

```
prefixadd /opt/pgi/linux86-64/17.4
```

vectorclass uses intrinsics not available in pgi, so I had to remove the GSVector implementation. See the pgi branch of minigia.

pgi only implements OpenMP 3, so pragma simd just generated a warning.

```
lzlorfik>cd build-pgi
lzlorfik>./independent_particle
orig best time = 0.00479701
optimized best time = 0.00118916
optimized speedup = 4.03394
omp simd best time = 0.00117477
omp simd speedup = 1.01225
```

My Mac

Everything (cmake, gcc, non-native clang) is from Homebrew.

gcc-7.2:

```
lmac>cd build-gcc72
lmac>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math -DGSV_AVX -march=native
lmac>./independent_particle
orig best time = 0.001802
optimized best time = 0.001441
optimized speedup = 1.25052
GSVector::implementation = 2
vectorized best time = 0.000781
vectorized speedup = 1.84507
omp simd best time = 0.000781
omp simd speedup = 1.84507
```

apple clang:

```
lmac>cd build-appleclang
lmac>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math -DGSV_AVX -march=native
lmac>./independent_particle
orig best time = 0.00180926
optimized best time = 0.0014459
optimized speedup = 1.25131
GSVector::implementation = 2
vectorized best time = 0.000782871
vectorized speedup = 1.84692
```

clang-5.0:

```
lmac>cd build-clang5
lmac>grep DEFINES CMakeCache.txt
DEFINES:UNINITIALIZED=-ffast-math -DGSV_AVX -march=native
lmac>./independent_particle
orig best time = 0.00181236
optimized best time = 0.00144507
optimized speedup = 1.25417
GSVector::implementation = 2
vectorized best time = 0.000782885
vectorized speedup = 1.84582
omp simd best time = 0.000783298
omp simd speedup = 1.84485
```

Appendix

```
lmac>type prefixadd
prefixadd is a function
prefixadd ()
{
    pathadd $1/bin;
    ldpathadd $1/lib
}
lmac>type ldpathadd
ldpathadd is a function
ldpathadd ()
{
    if [ -z "$1" ]; then
        export LD_LIBRARY_PATH=`pwd`:LD_LIBRARY_PATH;
    else
        export LD_LIBRARY_PATH=$1:LD_LIBRARY_PATH;
    fi
}
lmac>type pathadd
pathadd is a function
pathadd ()
{
    if [ -z "$1" ]; then
        export PATH=`pwd`:PATH;
    else
        export PATH=$1:PATH;
    fi
}
```