Members

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Optimizing Hydrodynamic Simulations of Quantum Fluids

CSCI 4576/5576 Project Checkpoint, Fall 2014

**Introduction**

Here we will talk briefly summarizing the progress we have made.

**Progress**

We have succeeded in implementing the following things:

1. **Single-Core Optimization:** runs faster! Here is a plot of the speedup and efficiency for the benchmark cases!
2. **OpenMP:** We have succeeded (?) in developing an OpenMP version of the 2D code that runs faster. Here is a plot of the speedup and efficiency for the benchmark cases!
3. **MPI:** We have thought about domain decomposition and Aniq will talk about that.
4. **Data Handling:** We have implemented HDF5.
5. **Profiling:** We have done some profiling on the original code, the optimized serial code, and the OpenMP code and here are some figures!

**Problem Size**

The physical case for the 2D benchmark is a lattice size of 1001 by 1001 with a standard deviation of 200 and 1000 time steps. The physical case for the 3D benchmark will be a lattice size of 251 by 251 by 251 with a standard deviation of 50 and 500 time steps. We have run the following accuracy and performance tests of weak scaling for the 2D case:

|  |  |  |  |
| --- | --- | --- | --- |
| Nx | Ny | Standard Deviation | Number of Time steps |
| 251 | 251 | 50 | 250 |
| 501 | 501 | 100 | 250 |
| 1001 | 1001 | 200 | 250 |

The accuracy and performance tests for the 3D case will be

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nx | Ny | Nz | Standard Deviation | Number of Time steps |
| 125 | 125 | 125 | 25 | 250 |
| 251 | 251 | 251 | 50 | 250 |
| 501 | 501 | 501 | 100 | 250 |

**References**

1. Shiyi, Chen and Gary D. Doolen. “Lattice Boltzmann method for fluid flows.” *Annual Review of Fluid Mechanics*. 1998, 30.
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3. Latt, Jonas. “Hydrodynamic Limit of the Lattice Boltzmann Equations.” *Thesis, University of Geneva*. 2007.
4. Succi, Sauro. “The Lattice Boltzmann Equation for Fluid Dynamics and Beyond.” *Oxford University Press .* 2001.