

Particle Simulations with OpenACC: Speedup and Scaling

Status Update

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Tasks so far

Our tasks for this week were the following:

- Develop serial code.
- Investigate visualization tools.
- Investigate parallelization methods.

Serial code

The serial code is divided into the following three main sections:

- 1** Tracing particles (trails or no trails).
- 2** Drawing particles.
- 3** Updating particle details such as position and velocity.

For the moment, particle movement doesn't strictly abide to any well-established physics. For instance, particle collisions are not calculated yet.

Serial code

Demo...

Visualization tools

- For the time being, the simulation is done in two dimensions. This makes it relatively straightforward to paint the particles on the canvas.
- In three dimensions, we would need to add behaviour for the third dimension and would need to change the way in which particles are currently being drawn.
- To avoid building code for rendering in more than two dimensions, we could rely on visualization tools.

Visualization tools

An option for visualization is using *ParaView* [2].

- Used at the CSCS (Swiss National Supercomputing Centre) [1].
- Open source, used for visualizing two and three-dimensional data sets.
- Platforms supported range from single-processor workstations to multiple-processor distributed-memory supercomputers or workstation clusters.
- Many file formats supported.

Visualization tools

An example file format is the following:

<i>particle index</i>	<i>x-coordinate</i>	<i>y-coordinate</i>	<i>z-coordinate</i>
0	3.5	6.0	50.0
1	1.4	3.0	10.0
⋮	⋮	⋮	⋮
1000	5.5	10.5	20.2

Visualization tools

Using the file format [particle index, x-coordinate, y-coordinate], we need to create a file for each time step. In each file, we'll write the position of each particle in the given time step.

- positions_0.txt
- positions_1.txt
- positions_2.txt
- And so on...

Visualization tools

Demo...

Parallelization methods

Preliminary benchmarks made for matrix–matrix multiplication execution time, comparing performance of serial code vs code parallelized using *OpenACC*.

Parallelization methods

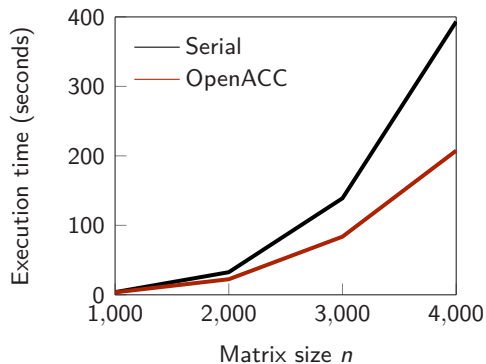


Figure: Matrix–matrix multiplication: execution time comparison.

Project plan

Show current project calendar...

References



CSCS. *ParaView*. URL: https://user.cscs.ch/scientific_computing/supported_applications/paraview/.



ParaView. *The ParaView Tutorial*. Nov. 2017. URL: https://www.paraview.org/Wiki/The_ParaView_Tutorial.

Questions

Thank you for your attention!
Any questions?