Adaptive Execution of Particle Advection Workloads

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I. Abstract

Particle Advection is a fundamental flow visualiation calculation with widely varying workloads. Determining the optimal architecture to run these workloads on is a critical consideration. In this study, we investigate the important tradeoffs that must be factored in when deciding how to best schedule the Particle Advection workloads on appropriate resources. Given this insight, our main contribution is a new algorithm which adapts execution using the GPU to run relevant parts of the problem and then switch the targeted device according to how the workload evolves. This algorithm is motivated by the observation that CPUs are sometimes able to better perform part of the overall computation since (1) this practice avoid latency times to the GPU and (2) CPUs operate at a faster rate when the workload can't take advantage of the threads on a GPU. We evaluate our algorithm by running workloads that vary over data set, number of particles, number of steps taken, and number of GPU nodes. We then compare our algorithm to traditional GPU-only and CPU-only approaches. Our findings show X, Y, and Z. The results of this study will help inform the Scientific Visualiaiton community about those architectures that give optimal performance at certain stages of the simulation run.

II. Intro

Particles. They Advect.

III. Related Work

We read lots of related work that built the basis for our study.

IV. Experiments

To study the effect of adaptively selecting the target device during the Particle Advection execution, we conducted various experiments over a range of carefully tuned parameters. Our experiments varied over 4 main factors:

- **Data Set**: Here we had several different simulation codes that were used to thoroughly test our algorithm. Our simulations included:
  - Fusion
  - Double Gyre
  - Fish Tank
- **Number of Particles**: Include a range of particles.
- **Number of Steps Taken**: Include a range of steps.
- **Number of GPU Nodes**: Include various nodes.

The experiments were run on a big supercomputer. The experiments were within a super cool framework.

V. Results

We had a bunch of cool results.

Perhaps eventually put a diagram here.

We can make lots of analysis.

VI. Conclusion

We studied the affects of adaptive device selection during a vtk-m Particle Advection run. We have shown that by analyzing the current workload and selecting an appropriate device, we get better performance over the traditional single-device alternatives. Our findings suggest that adaptively selecting an appropriate device can also lead to better energy efficiency, in addition to enhanced performance. We hope to get this paper published and solve world hunger while we're at it.

VII. Future Work

We have lots of future work ideas. They're superb.

VIII. Acknowledgements

We have lots of people to acknowledge. Whoop whoop.