OOKAMI PROJECT APPLICATION

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Project Title: FFT-based Fast Stencil Computations

Usage:

- Testbed

Principal Investigator: Rezaul Chowdhury

- University/Company/Institute: Stony Brook University
- Mailing address including country:

  Department of Computer Science
  239 New Computer Science Building
  Stony Brook University
  Stony Brook, NY 11794-2424
  USA

- Phone number: 631-632-8959
- Email: rezaul@cs.stonybrook.edu

Names & Email of initial project users:

- Rezaul Chowdhury (rezaul@cs.stonybrook.edu)
- Aaron Gregory (aaron.f.gregory@stonybrook.edu)
- Yimin Zhu (yimzhu@cs.stonybrook.edu)
- Zafar Ahmad (zafahmad@cs.stonybrook.edu)
- Reilly Browne (reilly.browne@stonybrook.edu)

Usage Description:

A stencil is a pattern used to compute the value of a cell in a spatial grid at some time step from the values of nearby cells at previous time steps. A stencil computation applies a given stencil to the cells in a spatial grid for some set number of timesteps. Stencil computations are widely used for simulating the change of state of physical systems over time.

All currently available stencil algorithms that can accept arbitrary linear stencils perform $\Theta(NT)$ work, where N is the number of cells in the spatial grid and T is the number of timesteps. Very recently we have designed $o(NT)$-work algorithms for linear stencils, based on fast Fourier transforms [1]. Implementations of these algorithms outperform existing fastest stencil implementations on Intel KNL (Knights Landing) and Skylake processors.

The goal of the current project is to explore how the key features of Ookami, such as SVE and HBM, can be used to further improve the performance of our stencil algorithms. We also plan to benchmark GPU implementations of our algorithms on the Ookami GPU node.

Computational Resources:

- Total node hours per year: 10,000
- Size (nodes) and duration (hours) for a typical batch job: 1-64 nodes, 1 hour
- Disk space (home, project, scratch): 40GB, 2TB, 2TB

Personnel Resources:

None required.

Required software:

C/C++, OpenMP, MPI, CUDA, Python, FFT libraries.

If your research is supported by US federal agencies:

- Agency: NSF
- Grant number(s): CNS-1553510

References

[1] Z. Ahmad, R. Chowdhury, R. Das, P. Ganapathi, A. Gregory, and Y. Zhu. Fast stencil computations using Fast Fourier Transforms. In *Proc. 33rd ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)*, 2021.