FACULTY OF SCIENCE
UNIVERSITY OF COPENHAGEN

DEPARTMENT OF COMPUTER SCIENCE

Project outside course scope

Accelerating Ocean Modelling

Adressing performance bottlenecks of the ocean modelling framework Veros

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1 Introduction

Currently, many scientists use purely sequential software for ocean modelling, leading to long simulation times andinefficient use of modern hardware.The aim of this project is to tackle this problem by introducing highly parallel code that uses the potential of modern GPUs to accelerate the modelling process.

2 Tridiagonal Solver

One of the bottlenecks within veros is solving many tridiagonal systems....

Trivial Algorithm

Trivial Algorithm - Coalesced

In the trivial algorithm, successive iterations of the recurrent loop access neighboring data in memory. Since we assign one problem per thread, neighboring threads access data with the stride of the size of the dimension of the tridiagonal system. This means that the accesses are uncoalesced and we can improve the performance significantly by changing the underlying data layout. In this case the change is trivial - we just need to transpose the input matrix, which can be done efficiently using shared-memory tiling and tranpose the result back afterwards.

The benchmarks show clearly that the benefit of the transposition on the main kernel outweighs the cost of the transposition and thus increases the performance by a factor of XXXX.

Flat version

The flat version of the tridiagonal solver is based on.. [ABB+16]

Flat version in a single kernel

Precision

Futhark

Benchmarks

3 Turbulent kinetic energy

Components

Superbee scheme

4 Interfacing with Jax

Uses XLA Integrating CUDA code with Cython Needs modified compiler... blah

Bibliography

[ABB+16] ANDREETTA, Christian ; BÉGOT, Vivien ; BERTHOLD, Jost ; ELSMAN, Martin ; HENGLEIN, Fritz ; HENRIKSEN, Troels ; NORDFANG, Maj-Britt ; OANCEA, Cosmin E.: Finpar: A parallel financial benchmark. In: *ACM Transactions on Architecture and Code Optimization (TACO)* 13 (2016), Nr. 2, S. 1–27