Technical University of Denmark

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Final Report

A GPU-accelerated Navier-Stokes Solver using OpenCL

Special Course at GPUlab, Scientific Computing Section, DTU
Supervisor: Allan P. Engsig-Karup Ph.D.

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DTU Informatics
Department of Informatics and Mathematical Modelling

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1
Introduction

The goal of this report is to document the work done for individual special course "A GPU-accelerated Navier-Stokes Solver using OpenCL". The project took place in GPUlab of Scientific Computing Section of Department of Informatics and Mathematical Modeling (DTU Informatics) at Technical University of Denmark. The project work for this special course took place between late March until early August 2012 and was supervised by Allan P. Engsig-Karup Ph.D. The course was worth 5 ECTS points.

The practical goal of this project was to design and implement a scientific computing application for execution on GPUs. The implemented application was then verified and validated using standard benchmarks.

The performance of implemented PDE solver was analyzed.

Apply optimization techniques for improving performance of PDE solver on GPUs.

Understand how to write a parallel program using OpenCL for heterogenous computing on many-core architectures.

Apply basic principles for numerical approximation/discretization.

Section 2 is

Section 3 is

Section 4 is

Section 5 is

2 Survey of GPU programming

AMD APP

http://developer.amd.com/sdks/AMDAPPSDK/Pages/default.aspx

http://stackoverflow.com/questions/1126989/what-future-does-the-gpu-have-in-computing

OpenCL Studio

http://www.youtube.com/user/OpenCLStudio

2.1 CUDA/OpenCL

2.2 Previous research

What applications use OpenCL GPU-acceleration OpenCL in Photoshop CS6 WinZip 16.5

2.3 Other Technologies

C++ AMP (C++ Accelerated Massive Parallelism)

OpenACC

2.4 Architectures

NVIDIA

AMD

3 Navier-Stokes

3.1 Description of Navier-Stokes

Reynolds number < 1000

3.2 Implementation

3.2.1 Sequential

3.2.2 Parelleized on GPU

4
Performance Analysis

4.1 Computed results

5
Validation

6 Conclusions

References