OpenCL for JTC

0.1

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Contents

Chapter 1

Main Page

This is the OpenCL version of JTC extra stuff

1.1 Introduction

The rapid development of parallel hardware in the last decade requires a constant evaluation of the parallel algoritms used in large scale scientific applications . Iterative kernels are essential components of iterative solvers which are the preferred technique in a variety of large scale problems. Jacobi iteration for the second order discretisation of the Laplacian $3D$ operator:

$$u_{i,j,k}^{(new)} = \frac{1}{6}(u_{i-1,j,k}^{(old)} + u_{i+1,j,k}^{(old)} + u_{i,j-1,k}^{(old)} + u_{i,j+1,k}^{(old)} + u_{i,j,k-1}^{(old)} + u_{i,j,k+1}^{(old)}) \ , \tag{1.1}$$

is the one of the simplest, yet not trivial, example of iterative kernel. In its simple form it contains the features relevant to the performance for a large class of iterators: i) stranded memory access and ii) low number of floating point operations per memory reference.

1.2 Results

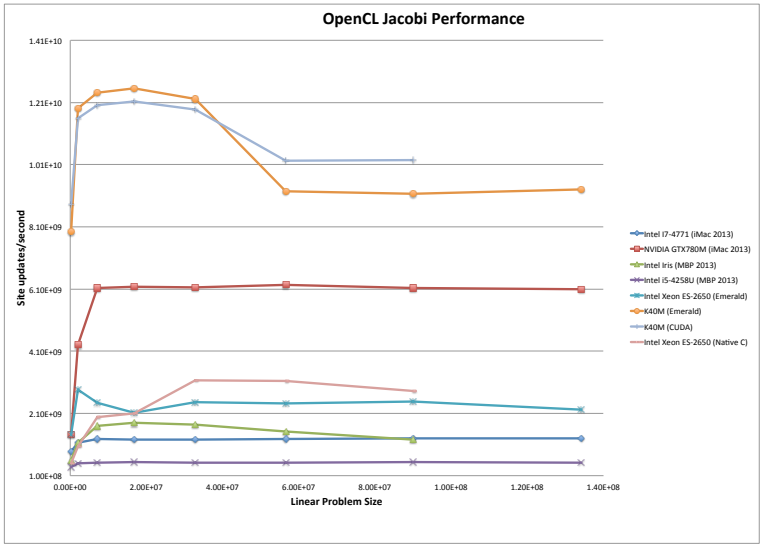

Figure 1.1: My application

Chapter 2

Todo List

File jacobi_opencl.h

Include header files to grab typename Real

File jacobi_relaxation_ocl.cl

include the header to grab the typedef of Real

Global OpenCL_Jacobi (int Nx, int Ny, int Nx, Real *unknown)

modify prototype to pass in opencl struct

Global OpenCL_Jacobi_Iteration (int maxIters, int convergenceIters)

Fix this memory transfer

Chapter 3

Data Structure Index

3.1 Data Structures

Here are the data structures with brief descriptions:

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

Chapter 5

Data Structure Documentation

5.1 OpenCLInstance Struct Reference

`#include <jacobi_opencl.h>`

Data Fields

- cl_device_id device_id
- cl_context context
- cl_command_queue commands
- cl_program program
- cl_kernel jacobi_ocl
- cl_mem d_u1
- cl_mem d_u2
- unsigned int xDim
- unsigned int yDim
- unsigned int zDim

5.1.1 Detailed Description

OpenCLInstance - A struct containing the device ide, context, command queue, program, kernel and problem size for OpenCL

Definition at line 37 of file jacobi_opencl.h.

5.1.2 Field Documentation

5.1.2.1 cl_command_queue OpenCLInstance::commands

Compute command queue

Definition at line 40 of file jacobi_opencl.h.

5.1.2.2 cl_context OpenCLInstance::context

Compute context

Definition at line 39 of file jacobi_opencl.h.

5.1.2.3 cl_mem OpenCLInstance::d_u1

Device memory used for the input unknown 1 vector

Definition at line 44 of file jacobi_opencl.h.

5.1.2.4 cl_mem OpenCLInstance::d_u2

Device memory used for the input unknown 2 vector

Definition at line 45 of file jacobi_opencl.h.

5.1.2.5 cl_device_id OpenCLInstance::device_id

Compute device id

Definition at line 38 of file jacobi_opencl.h.

5.1.2.6 cl_kernel OpenCLInstance::jacobi_ocl

Compute kernel

Definition at line 42 of file jacobi_opencl.h.

5.1.2.7 cl_program OpenCLInstance::program

Compute program

Definition at line 41 of file jacobi_opencl.h.

5.1.2.8 unsigned int OpenCLInstance::xDim

Definition at line 47 of file jacobi_opencl.h.

5.1.2.9 unsigned int OpenCLInstance::yDim

Definition at line 47 of file jacobi_opencl.h.

5.1.2.10 unsigned int OpenCLInstance::zDim

Grid dimensions

Definition at line 47 of file jacobi_opencl.h.

The documentation for this struct was generated from the following file:

- jacobi_opencl.h

Chapter 6

File Documentation

6.1 jacobi_opencl.c File Reference

```
#include "jacobi_opencl.h"
#include "../jacobi_c.h"
#include <CL/cl.h>
```

Macros

- #define DEVICE CL_DEVICE_TYPE_DEFAULT

Functions

- int output_device_info (cl_device_id)
- char * err_code (cl_int)
- void OpenCL_Jacobi (int Nx, int Ny, int Nx, Real *unknown)
- void OpenCL_Jacobi_Iteration (int maxIters, int convergenceIters)

6.1.1 Detailed Description

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Definition in file jacobi_opencl.c.

6.1.2 Macro Definition Documentation

6.1.2.1 #define DEVICE CL_DEVICE_TYPE_DEFAULT

Definition at line 21 of file jacobi_opencl.c.

6.1.3 Function Documentation

6.1.3.1 char* err_code (cl_int)

6.1.3.2 void OpenCL_Jacobi (int *Nx*, int *Ny*, int *Nx*, Real * *unknown*)

Todo modify prototype to pass in opencl struct

Definition at line 31 of file jacobi_opencl.c.

6.1.3.3 void OpenCL_Jacobi_Iteration (int *maxIters*, int *convergenceIters*)

OpenCL_Jacobi_Iteration –

Parameters

maxIters	- The maximum number of iterations to perform
convegenceIters	- the number of iteration between convergence checks

Todo Fix this memory transfer

Definition at line 152 of file jacobi_opencl.c.

6.1.3.4 int output_device_info (cl_device_id)

6.2 jacobi_opencl.h File Reference

```
#include "../"
```

Data Structures

- struct OpenCLInstance

Functions

- void OpenCL_Jacobi (int Nx, int Ny, int Nx, Real *unknown)
- void OpenCL_Jacobi_Iteration (int maxIters, int convergenceIters)

6.2.1 Detailed Description

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Todo Include header files to grab typename Real

Definition in file jacobi_opencl.h.

6.2.2 Function Documentation

6.2.2.1 void OpenCL_Jacobi (int *Nx*, int *Ny*, int *Nx*, Real * *unknown*)

OpenCLJacobi – Initialise the OpenCL runtime and perform memcopies

Parameters

Nx	- The x size of the domain.
Ny	- The y size of the domain.
Nz	- The z size of the domain.
unknown	- The initial conditions

Todo modify prototype to pass in opencl struct

Definition at line 31 of file jacobi_opencl.c.

6.2.2.2 void OpenCL_Jacobi_Iteration (int *maxIters,* int *convergenceIters*)

OpenCL_Jacobi_Iteration –

Parameters

maxIters	- The maximum number of iterations to perform
convegenceIters	- the number of iteration between convergence checks

Todo Fix this memory transfer

Definition at line 152 of file jacobi_opencl.c.

6.3 jacobi_relaxation_ocl.cl File Reference

```
#include "../jacobi_c.h"
```

Functions

- __kernel void jacobi_relaxation_ocl (const int Nx, const int Ny, const int Nz, global const Real *restrict d_u1, global Real *restrict d_u2)

6.3.1 Detailed Description

This file contains the single and double precision kernel calls

Todo include the header to grab the typedef of Real

Definition in file jacobi_relaxation_ocl.cl.

6.3.2 Function Documentation

6.3.2.1 __kernel void jacobi_relaxation_ocl (const int *Nx,* const int *Ny,* const int *Nz,* global const Real *restrict *d_u1,* global Real *restrict *d_u2*)

jacobi_relaxation_ocl –

Parameters

Nx	- The x size of the domain
Ny	- The y size of the domain
Nz	- The z size of the domain
d_u1	- The input array
d_u2	- The output array

Definition at line 14 of file jacobi_relaxation_ocl.cl.