THE NORWEGIAN UNIVERSITY
OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF ENGINEERING DESIGN
AND MATERIALS

MASTER THESIS SPRING 2014
FOR
STUD.TECHN. TEODOR ANDRE ELSTAD AND SIMEN HAUGERUD GRANLUND

UTILIZING GENERAL-PURPOSE COMPUTING ON GRAPHIC PROCESSING UNITS (GPGPU) FOR ENGINEERING ALGORITHM SPEED UP
Utnytte beregningskraft i grafiske prosessorer (GPGPU) til å øke beregningshastighet for ingeniøralgoritmer.

Most software tools for KBE development is today based around special purpose Modeling frameworks like the AML KBE language developed by TechnoSoft Inc. While this approach has been very successful there are continuously requirements for extending the capabilities both regarding new functionality and computational performance.

TechnoSoft would like to have certain algorithms sped up, by utilizing general-purpose computing on graphics processing units (GPGPU). The goal of the master thesis will be to implement a small library of GPGPU-enhanced algorithms that could be used in TechnoSoft applications.

The technology to be investigated is NVIDIA http://www.nvidia.com/page/technologies.html including the CUDA architechure and OpenCL.

Towards the end of the work with the master assignment, when algorithms for grid smoothing for CFD analysis are developed, the candidates will study if these algorithms are well suited for speed up by graphic processor implementation.

The assignment includes:

1. A study of advantages offered by using GPGPU. How to best utilize the high capacity for parallel processing? What kind of problems can be sped up?
2. An evaluation of suitable GPGPU tools. Should development be based on OpenCL or CUDA?
3. An evaluation of GPGPU libraries like ViennaCL and cuBLAS.
4. Select engineering algorithms for test applications, in cooperation with the advisers, that are well suited and relevant for speed up by implementation on the graphic processor.

5. Extensive performance testing of different implementations on different problem sizes and hardware. Are we getting good speed up on real life problems and hardware, or is the overhead associated with parallel computing hampering performance?

Three weeks after start of the thesis work, an A3 sheet illustrating the work is to be handed in. A template for this presentation is available on the IPM's web site under the menu "Masteroppgave" (http://www.ntnu.no/ipm/masteroppgave). This sheet should be updated one week before the Master's thesis is submitted.

Performing a risk assessment of the planned work is obligatory. Known main activities must be risk assessed before they start, and the form must be handed in within 3 weeks of receiving the problem text. The form must be signed by your supervisor. All projects are to be assessed, even theoretical and virtual. Risk assessment is a running activity, and must be carried out before starting any activity that might lead to injury to humans or damage to materials/equipment or the external environment. Copies of signed risk assessments should also be included as an appendix of the finished project report.

The thesis should include the signed problem text, and be written as a research report with summary both in English and Norwegian, conclusion, literature references, table of contents, etc. During preparation of the text, the candidate should make efforts to create a well arranged and well written report. To ease the evaluation of the thesis, it is important to cross-reference text, tables and figures. For evaluation of the work a thorough discussion of results is appreciated.

The thesis shall be submitted electronically via DAIM, NTNU's system for Digital Archiving and Submission of Master's thesis.

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