Course Description

We offer a one week Ph.D. summer school on Scientific GPU Computing May 23-27, 2011. The school is hosted by GPULAB (http://gpulab.imm.dtu.dk) at DTU Informatics.

Due to thermal restrictions further performance gains of microprocessors do no longer mainly depend on clock frequency increases but parallelization of the processor into multiple cores. Soon there will be tens of cores in each CPU with hundreds to follow. Graphics Processing Units (GPUs) already contain hundreds of scalar processing cores and thus enable us to explore this realm of massively parallel computing today.

The high number of parallel cores poses a great challenge for software design that must expose massive parallelism to benefit from the new hardware. The main purpose of this course is to teach practical algorithm design for such parallel hardware.

Focus will be on both CUDA and OpenCL programming using C, GPU architecture, parallelization of linear algebra algorithms, and how this can be leverage into advanced applications in scientific computing.

Course objective

This summer school is about utilizing massively parallel graphics processors (GPUs) for general purpose desktop scientific computing.

Course Homepage

http://gpulab.imm.dtu.dk/PhDschool2011/

Course organizers

Assistant Professor Allan P. Engsig-Karup
PostDoc Hans Henrik Sørensen
Assistant Professor Jeppe R. Frisvad
DTU Informatics
Technical University of Denmark.

Course lecturer

Associate Professor in Applied Math Tim Warburton
Department of Computational and Applied Math
Rice University, Texas, USA.

This course is offered as part of the activities of the DTU Informatics Graduate School (ITMAN) and of the DCAMM International Graduate Research School, see www.dcamm.dk.

Participants

The course is intended for Ph.D. students and M.Sc. students with a fundamental knowledge of numerical analysis and linear algebra and must be able to program Matlab. They are expected to read the first five chapters of the book before participating in the course.

Work Load

Approximately 35 scheduled hours (lectures, discussions and computer exercises) during the course and approximately 40 hours for the completion of an assignment problem after the duration of the course. Also, to prepare for the course it is required that participants read the first few chapters of the course literature.

Course Contents

Topics related to parallel programming in C using CUDA or OpenCL and scientific computing will be covered in the course. Useful programming tools for scripting, profiling, debugging and available software libraries for parallel sparse/dense numerical linear algebra operations on GPUs will be introduced. Some case studies relating to PDE solvers and highlights of experiences with the use of advanced numerical methods for large-scale scientific computing using multiple GPUs for complex PDE solvers will be given. Every day during the course there will be hands-on exercises in problem solving using massively parallel graphics processors (GPUs).

See the course homepage for more details.

Course Literature

The following textbook is recommended for background reading. David B. Kirk, Wen-mei W. Whu. Programming Massively Parallel Processors: A hands-on approach. Morgan Kaufmann, 2010.

Language

All lectures will be given in English.

Evaluation and Diplomas

To pass the course, active participation and the satisfactory completion of an assignment problem after the duration of the course are required. ETCS points: 5.

Registration

Ask for a registration form from the DCAMM-course secretariat, attn.: Kari Haugland, Department of Mathematics, Technical University of Denmark, Building 303S, DK-2800 Lyngby, Denmark.
Tel.: (+45) 45253031, Fax: (+45) 45881399, E-mail: dcamm@mat.dtu.dk.

Registration Fee

There is no registration fee for students enrolled at universities and public research institutions. For researchers employed at universities and public research institutions the registration fee is €500. For all other participants the registration fee is €1500. Payment information will be given upon signing up for the course.

Deadline

The submitted request for registration must be received by the course secretariat no later than **May 1st, 2011.** Information on enrollment will be posted within a week after this date.
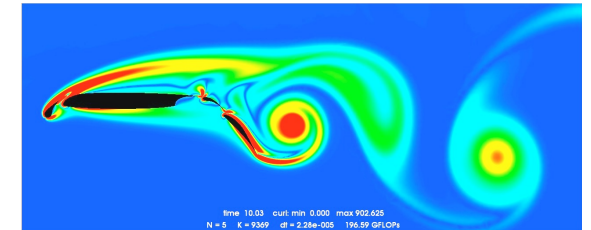
Lunch

ITMAN is sponsoring a daily lunch for participants that are enrolled at universities and public research institutions.

Housing

There are a limited amount of rooms available on the premises of the Technical University of Denmark (DTU). These will be offered free of charge to students and otherwise at a cost of €25 per night. Accommodation in hostels/hotels can also be arranged by the participants themselves, see e.g. the Wonderful Copenhagen website at www.woco.dk and course webpage.

Scholarships

For PhD students enrolled at non-Danish universities and research institutions outside the EU, we can offer a limited number of scholarships in order to facilitate participation, covering lodging (see above) and extra living costs with a per diem amount of €25. Travel expenses will not be covered. Your CV and a short letter of recommendation from your PhD supervisor should be sent in together with the registration form.

Internet Resources

For facts on the Technical University of Denmark and visitors' information: See http://www.dtu.dk. Information about teaching and research at DTU Informatics can be found at http://www.imm.dtu.dk, and for DCAMM at http://www.dcamm.dk.

About ITMAN

The DTU Informatics Graduate School ITMAN (IT MAN) administers the PhD program at DTU Informatics. ITMAN promotes cross-disciplinary research, matching information technology and mathematical modelling with other disciplines, often in collaboration with external collaborators: Other research institutions and private companies.

ITMAN is based on the idea of optimizing the relationship man - knowledge - IT as a key to growth for Danish companies in the global innovation and productivity competition. If one is to understand the role of IT, it is essential to view IT as more than "computers and software": IT is always a factor in the intricate net of machine, man and market.

ITMAN aims to strengthen research education through a series of initiatives: Specialized PhD courses and summer schools, quality assurance of supervision, PhD processes and procedures, research environment, implementation of a mentor program, help with IPR, social activities, etc.

About DCAMM

The Danish Center for Applied Mathematics and Mechanics, DCAMM is an informal framework for internationally oriented scientific collaboration between staff members at a number of departments at the Technical University of Denmark (DTU) and Aalborg University (AAU). The departments cooperating within DCAMM are:

- DTU Informatics
- DTU Mathematics
- DTU Mechanical Engineering
- Dept. of Civil Engineering, AAU
- Dept. of Mechanical Engineering, AAU

DCAMM is an informal construction. The day to day activities are coordinated by the secretary of the Center, while the formal governing body of DCAMM is the Scientific Council.

The DCAMM International Graduate Research School functions within the standard framework of the Ph.D.-education at the Technical University of Denmark (DTU) and at Aalborg University (AAU). Ph.D.-students associated to the School are full members of DCAMM through their departments and are enrolled in relevant Ph.D. programmes at DTU and AAU.

The School's role is to provide for an interdisciplinary framework for education of young researchers in an international research environment, and the activities are supported by Danish Agency for Research, Technology and Innovation (FI).

Ph.D.summer school / Advanced school

Scientific GPU Computing

Organized by:

The Technical University of Denmark
DTU Informatics
Section for Scientific Computing
&
The Danish Center for Applied Mathematics and Mechanics

At DTU Informatics, Kgs. Lyngby, Denmark

May 23 - May 27, 2011