

Invited Talk

Computational Science using Graphics Processing Units: An Overview and Case Study

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SINTEF / NITH

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Lille Auditorium, floor 2,

HIB (data blokk), Thormøhlensgate 55



Abstract:

The use of video processors and graphics processing units (GPUs) for non-graphics applications has a long history. Around ten years ago, researchers started to demonstrate that the GPU could outperform the CPU for matrix, stencil, and other operations. Today, an increasing number of the fastest supercomputers on the Top500 list employ GPUs, and GPUs have become a mainstream architecture.

This talk covers two topics. In the first part of the talk, we will give an overview of GPU computing, and current research topics at the department of Applied Mathematics at SINTEF ICT, Oslo. In the second part of the talk, we present the efficient solution to time-dependent problems using numerical schemes with compact stencils. In computational science, the aim is often to produce results as fast as possible within a given error tolerance, or conversely to produce as accurate as possible results given a fixed time budget. Implicit and unstructured methods typically have a very high "algorithmic performance", as they provide simple means for using large time-steps and local refinement. However, these methods are typically only able to utilize a small fraction of the peak performance of CPUs, and even worse on accelerators such as the GPU. Thus, for many problems, this means that explicit methods with structured grids can be highly competitive, as one may obtain close-to peak performance. Starting with the physical problem, we go through the numerical scheme, its mapping onto the GPU, checking for physical correctness, and finally optimization to achieve peak performance.

