



Press release

Doctoral defence at DIKU on super computers by Jesper Larsson Träff

On October 2, 2009 at 2 pm DIKU (the Department of Computer Science at the University of Copenhagen), Universitetsparken 1, DK-2100 Copenhagen Ø, Small Auditorium, hosts a doctoral defence entitled:

Aspects of the efficient Implementation of the Message Passing Interface (MPI)

The dissertation has been submitted for defence of the Dr. Scient degree at the Faculty of Science at the University of Copenhagen by

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Opponents:

Professor Brian Vinter, Department of Computer Science at the University of Copenhagen and
Professor Jaswinder Pal Singh, Princeton University

Main results

A long series of software-engineering and algorithmic contributions to the efficient implementation the Message Passing Interface (MPI) standard, highlighting potential and problems of a standardized interface for the convenient and efficient utilization of current and next-generation super-computer systems.

Specific contributions include: round-optimal broadcast algorithms, best-known reduction and prefix-sums algorithms, realization of process reordering by communication graph partitioning, as well as efficient, vectorized handling of structured, non-consecutive datalayouts.

A brief summary of the dissertation:

Industrial research and (product) development in the High-Performance Computing area is a constrained and incremental process, that can both contribute to and benefit significantly from interaction and open exchange of ideas with the scientific community. In contrast to the practices of academic research, product responsibility mandates a higher degree of software robustness, completeness and correctness, whereas the focus on specific hardware or product lines may constrain results or preclude exploration of otherwise natural alternatives.

This dissertation reflects such industrial research and development over almost a decade concerning an implementation of the Message Passing Interface (MPI), a universally accepted standard for programming large, distributed memory parallel machines, for the SX-series of vector supercomputers built by the Japanese company NEC. NEC also delivered the Earth Simulator with the corresponding MPI implementation (as described here) that in 2002 contributed decisively to a revitalization of the High-Performance Computing field.

The dissertation gives a critical overview of MPI, of design decisions and circumstances leading to the message passing standard, and summarizes discussions of the MPI standard in the community up to the point in late 2007 where the MPI Forum started to reconvene with the aim of alleviating known deficiencies of MPI and proposing functionalities for better support of emerging, large-scale supercomputers.

The scientific contribution of the dissertation consists of a number of conference and journal publications that were at their time influential in the MPI developers' community. These are concerned with central elements of the MPI standard, like collective operations in need of carefully designed and implemented communication algorithms, one-sided communication that is crucial for the efficiency of certain applications on e.g. the Earth Simulator, handling of structured, non-consecutive data, process remapping by virtual process topologies, and also deals critically with the design of the interface, performance and correctness issues.

Some of the issues and techniques have relevance far beyond MPI to the design and efficient implementation of new, better interfaces for High-Performance Computing interfaces and systems.

Further information

The dissertation is available at the publisher, Shaker, Aachen, www.shaker.de.

Furthermore, it is available at the homepage of the doctorand, www.traff-industries.de,

Further details, including a brief summary can be found on www.traff-industries.de/pages/disputats.html.

The MPI standard is described on www.mpi-forum.org.

The Earth Simulator is described on www.jamstec.go.jp/esc/.

The homepage of NEC Corporation which produces the SX-supercomputer is www.nec.com.

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