

Publication

Algorithmic performance studies on graphics processing units

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We report on our experience with integrating and using graphics processing units (GPUs) as fast parallel floating-point co-processors to accelerate two fundamental computational scientific kernels on the GPU: sparse direct factorization and nonlinear interior-point optimization. Since a full re-implementation of these complex kernels is typically not feasible, we identify the matrix-matrix multiplication as a first natural entry-point for a minimally invasive integration of GPUs. We investigate the performance on the NVIDIA GeForce 8800 multicore chip initially architected for intensive gaming applications. We exploit the architectural features of the GeForce 8800 GPU to design an efficient GPU-parallel sparse matrix solver. A prototype approach to leverage the bandwidth and computing power of GPUs for these matrix kernel operation is demonstrated resulting in an overall performance of over 110 GFlops/s on the desktop for large matrices and over 38 GFlops/s for sparse matrices arising in real applications. We use our GPU algorithm for PDE-constrained optimization problems and demonstrate that the commodity GPU is a useful co-processor for scientific applications. (c) 2008 Elsevier Inc. All rights reserved.

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