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Parallel computing technologies 2016

Victor Malyshkin[1]

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This special issue is devoted to parallel computing technologies, whose state defines now the applicability of supercomputers in science and industries.

In the paper by R. S. Campos, B. M. Rocha, M. Lobosco, R. W. dos Santos "Multilevel parallelism scheme in a genetic algorithm applied to cardiac models with mass-spring systems" an adaptive parallel genetic algorithm is proposed, which is able to automatically choose which loops should be run in parallel and balancing the workload. Similar algorithms are used for the implementation of distributed system functions. Without such algorithms, the development of parallel system software would be impossible.

The papers by D. Akhmed-Zaki, D. Lebedev, V. Perepelkin "Implementation of a three dimensional Three-Phase Fluid Flow ("Oil-Water-Gas") numerical model in LuNA Fragmented Programming System", I. Menshov, P. Pavlukhin "Highly scalable implementation of an implicit matrix-free solver for gas dynamics on GPU-accelerated clusters", A. Borisenko, M. Haidl, S. Gorlatch "A GPU parallelization of Branch-and-Bound for multiproduct batch plants optimization", Ren Chen, S. G. Singapura, V. K. Prasanna "Optimal dynamic data layouts for 2D FFT on 3D memory integrated FPGA", K. Rojek, R. Wyrzykowski. "Performance modeling of 3D MPDATA simulations on GPU cluster", A. Tangherloni, M. S. Nobile, P. Cazzaniga. D. Besozzi, G. Mauri "Gillespie's stochastic simulation algorithm on MIC coprocessors" demonstrate the methods and parallel applications of numerical algorithms, their implementation on supercomputers of different architectures.

✉ Victor Malyshkin
malysh@ssd.sscc.ru

[1] Supercomputer Software Department, Institute of Computational Mathematics and Mathematical Geophysics (ICM&MG), Russian Academy of Sciences, Pr. Lavrenriev 6, 630090 Novosibirsk, Academgorodok, Russia

The papers by O. Bandman “Parallelization efficiency versus stochasticity in simulation reaction-diffusion by cellular automata” and L. C. de S. M. Ozelima, A. L. B. Cavalcante and J. M. Baetensc “On the iota-delta function: a link between cellular automata and partial differential equations for modeling advection—dispersion from a constant source” deal with the development and application of cellular automata.

Problems of parallel system programming are considered in the papers by Kh. Hasanov, A. Lastovetsky “Hierarchical redesign of classic MPI reduction algorithms”, V. Malyshkin, V. Perepelkin, G. Schukin “Scalable distributed data allocation in LuNA fragmented programming system”.

Progressively, the parallel system software should be increasingly intelligent. For instance, a compiler should be able to recognize/to understand the sense of a certain situation in a parallel program and automatically to generate the necessary system decisions. A behavior of an application parallel program should also be situation dependent. The current resources allocation, the load of communicating system should be dynamically taken into account when generating a look ahead control decision. Without similar system algorithms, the technology and system of high-level parallel programming, for instance, the system of automatic parallel programs construction, cannot be created. The latter paper suggests the description of such an algorithm and a brief description of the fragmented programming system LuNA that automatically generates the application parallel programs for the numerical modeling.