A Special Section on Multicore Parallel CAD: Algorithm Design and Programming

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High-performance parallel computer architecture and systems have improved at a phenomenal rate. Meanwhile, VLSI Computer-Aided Design (CAD) software for multibillion-transistor IC design has become increasingly complex and requires prohibitively high computational resources. Recent studies have shown that numerous CAD problems with their high computational complexity can greatly benefit from the increasing parallel computation capabilities. However, parallel programming imposes big challenges for CAD applications. A full exploration of the computational power of emerging general-purpose and domain-specific multicore/many-core processor systems calls for fundamental research and engineering practice across every stage of parallel CAD design, from algorithm exploration, programming models, design-time and runtime environment, to CAD applications, such as verification, optimization, and simulation.

Included in this journal special section is some recent progress on parallel CAD research, including algorithm foundations, programming models, and parallel architectural-specific optimization. Specifically, we have selected nine articles among all the submissions. They can be categorized into four groups based on the problems they solve and the parallel architectures they employ. Problems they attack include design optimization and simulation/analysis; employed architectures are either general multicore processors or Graphics Processing Units (GPUs).

The first article, "Efficient and Deterministic Parallel Placement for FPGAs", is on design optimization on general multicore processors. The second and the third

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articles, “Design and Implementation of a Throughput Optimized GPU Floorplanning Algorithm” and “GPU-Based Parallelization for Fast Circuit Optimization”, are on design optimization on GPU platforms. The next four articles, “Multithreaded Simulation for Synchronous Dataflow Graphs”, “Accelerating UNISIM-Based Cycle-Level Microarchitectural Simulations on Multicore Platforms”, “A New Algorithm for VHDL Parallel Simulation”, and “Locality-Driven Parallel Static Analysis for Power Delivery Networks”, deal with simulation and analysis on multicore processors. Finally, the last two articles, “Massively Parallel Logic Simulation with GPUs” and “Gate-Level Simulation with GPU Computing”, discuss how to speed up simulation on GPU platforms.