An Efficient Parallel SAT Solver Exploiting Multi-Core Environments

Aries Design Automation, LLC

Technical Abstract

The hundreds of stream cores in the latest graphics processors (GPUs), and the possibility to execute non-graphics computations on them, open unprecedented levels of parallelism at a very low cost. In the last 6 years, GPUs had an increasing performance advantage of an order of magnitude relative to x86 CPUs. Furthermore, this performance advantage will continue to increase in the next 20 years because of the scalability of the chip manufacturing processes. The goal of this project is to efficiently exploit the GPU parallelism in order to accelerate the execution of a Boolean Satisfiability (SAT) solver. SAT has a wide range of applications, including formal verification and testing of software and hardware, scheduling and planning, cryptanalysis, and detection of security vulnerabilities and malicious intent in software. We bring a tremendous expertise in SAT solving, formal verification, and solving of Constraint Satisfaction Problems (CSPs) by efficient translation to SAT. In our previous work (done on the expenses of our company) we achieved 2 orders of magnitude speedup in solving Boolean formulas from formal verification of complex pipelined microprocessors, 4 orders of magnitude speedup in SAT-based solving of CSPs, and 8 orders of magnitude speedup in SAT-based routing of optical networks.

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Efficient Integration, Validation and Troubleshooting in Multimodal Distributed Diagnostic Schemes

Qualtech Systems, Inc.

Technical Abstract

In general, development and validation of diagnostic models for complex safety critical systems are time and cost intensive jobs. The proposed Phase-II effort will automate some vital processes essential in developing integrated diagnostic schemes and cost-effective revalidation of the integrated models. The automated processes, resulting from this effort will be incorporated as tools in TEAMS Design and Analytic Platform. For reducing the burden of testing diagnostic models, capability for automatically generating test cases, regression test suites along with the options for their playback will be developed under this effort. Additionally, an option for efficient diagnostics and troubleshooting in multi-mode systems will be introduced in TEAMS via this SBIR effort. To ensure the readiness of the TEAMS tools and options developed through this effort, those will be verified and validated with one or more NASA's ground support systems that are associated with the ARES or Constellation Program Ground Support. Collectively, these achievements will significantly reduce the time and cost in developing and better utilizing large scale fault diagnostic systems using TEAMS.

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