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System Level Multi-Core Thermal Management for Work-Stealing Based Parallel Programs

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ABSTRACT

In recent years, temperature and power consumption of multi-core processors have become major challenges for designers and users. As processor's temperature rises, cooling costs and power consumption increases and affects processor life time. According to our studies, no thermal management approach has been proposed at the operating system being aware of work-stealing scheduler in parallel programs. In this paper, a dynamic thermal management algorithm has been proposed at the operating system level that manages the processor temperature according to a threshold for work-stealing based parallel programs. Hence, we propose temperature and performance models to predict the future temperature and estimate the amount of program performance changes. Using proposed models, the proposed algorithm determines the appropriate number of active cores and processor frequency such that temperature does not violate the threshold and the performance degradation minimizes. Experiments show that the proposed algorithm has up to 28% higher performance than neighbor-aware algorithm and, unlike this algorithm, never violates the specified temperature threshold.

Keywords: Parallel Execution, Multi-core, Work-stealing, Operating System, Scheduler, Thermal Management.