

Runtime Wear-Based Task Mapping for Embedded Chip Multiprocessors



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As transistors continue to become smaller, they become exponentially susceptible to permanent wearout faults. Without mitigation, these types of faults will render systems useless within unacceptably short time periods. Our work presents the design for a runtime task mapping subsystem which mitigates these faults using a wear-based heuristic.

Figure 1 depicts the type of system we consider in our work. Systems are composed of applications and an underlying operating system, all of which are executed on an NoC. The components that make up the NoC contain wear and temperature sensors that provide the information which our task mapping methods use to make decisions. We compare our wear-based heuristic to power- and temperature-based heuristics used within the same system framework. Using a wide range of synthetic and real-world benchmarks, we show that our wear-based heuristic is able to improve total system lifetime by an average of between 5.3% and 7.6% over temperature-based heuristics depending on the benchmark. In the best case, MTTF is improved by 16.7%. Additionally, we show that our wear-based heuristic can be used to drastically improve the time to the first component failure (TTFF) of a system. TTFF is a metric that is of interest to designers who wish to avoid the design and verification difficulties of systems which are expected to recover after a component failure. Our wear-based heuristic improves TTFF by an average of between 10.3% and 18.2% over temperature-based heuristics depending on the benchmark. In one benchmark, TTFF was improved by 32.9%. Our observations lead us to conclude that runtime, wear-based task mapping must be incorporated into systems for which lifetime is a primary design goal. In the future, we plan to augment our runtime wear-based task mapping with machine learning techniques to further improve system lifetime.

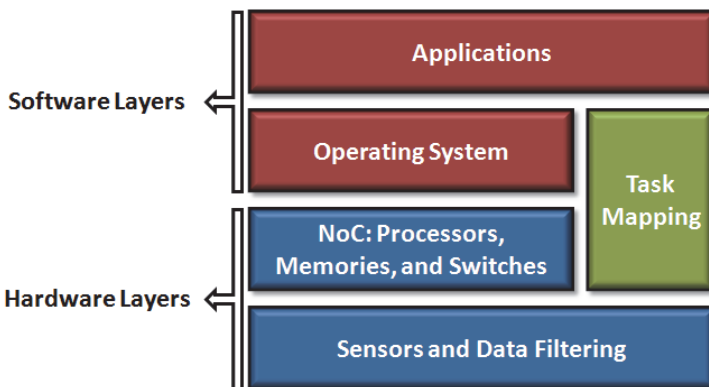


Fig. 1: Overview of embedded chip multiprocessor with runtime wear-based task mapping