Temperature Control of High-Performance Multi-Core Platforms Using Convex Optimization

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With technology advances, the number of cores integrated on a chip and their speed of operation is increasing. This, in turn is leading to a significant increase in chip temperature. Temperature gradients and hot-spots not only affect the performance of the system, but also lead to unreliable circuit operation and affect the life-time of the chip. Meeting the temperature constraints and reducing the hot-spots are critical for achieving reliable and efficient operation of complex multi-core systems. In this work, we present Pro-Temp, a convex optimization based method that pro-actively controls the temperature of the cores, while minimizing the power consumption and satisfying application performance constraints. The method guarantees that the temperature of the cores are below a user-defined threshold at all instances of operation, while also reducing the hot-spots. We perform experiments on several realistic multi-core benchmarks, which show that the proposed method guarantees that the cores never exceed the maximum temperature limit, while matching the application performance requirements. We compare this to traditional methods, where we find several temperature violations during the operation of the system.