**A Nearest-Neighbor-Based Thermal Sensor Allocation and Temperature Reconstruction Method for 3-D NoC-Based Multicore Systems**

Based on the analysis of the previous approaches, we find that the current thermal-sensing NoC-based multicore system design has two design challenges:

1. The flexible allocation of number-limited sensors that can adapt to different applications
2. The accuracy of full-chip temperature reconstruction that requires acceptable computing latency and hardware cost.

In this article, we allocate the number-limited thermal sensors based on the spatial thermal correlation of the cores, and the relative position of the cores will not change as the chip works under different applications. Besides, we use an artificial neural network (ANN) to estimate the temperature of nonsensor-allocated nodes.

The contributions of this article are summarized as follows:

1. We propose the nearest-neighbor-based thermal sensor allocation method. Previous work [20] has proven that the temperature correlation of different cores in the multicore system is mainly related to their distance. Based on the spatial correlation, we propose the nearest-neighbor-based initialization algorithm to make thermal sensors surround every nonsensor-allocated core. We then use the genetic algorithm (GA) to optimize the initial sensor allocation to adjust the number of obtained sensors.
2. We propose the ANN-based full-chip temperature reconstruction method. We can get the accurate temperature of these sensor-allocated nodes from the allocated thermal sensors. Due to the temperature correlation, these nodes also contain temperature information of other nonsensor-allocated nodes around them. We can express the hidden temperature information explicitly with ANN to estimate the full-chip temperature precisely.

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* The proposed method allocates thermal sensors based on spatial correlations, which remain consistent regardless of application workloads, enhancing flexibility in temperature reconstruction.
* We can conclude that the correlation of two nodes is mainly dependent on the distance between them, and the farther their distance is, the less correlation they have. In other words, the correlation defined by (1) will not change when the chip works under different workloads.
* A mathematical model is introduced to optimize sensor placement, ensuring that each nonsensor-allocated node has nearby sensors to improve temperature estimation accuracy.
* We propose a nearest-neighbor-based thermal sensor allocation method. Our method aims to allocate thermal sensors around the nodes without sensors. Because of their close distance,their temperature information has a high correlation. Therefore, nonsensor-allocated nodes’ temperature can be estimated by the sensor-allocated nodes around them.
* Although the sensor allocation obtained by the initialization algorithm (NEAREST-NEIGHBOR) can meet the constraints, the number of sensors cannot be adjusted according to the constraints of the hardware cost. Therefore, we use GA to explore the optimal sensor-allocated locations for different sensor numbers.