Guest Editorial: Special Issue on Self-Aware Systems on Chip

Nikil Dutt, Axel Jantsch

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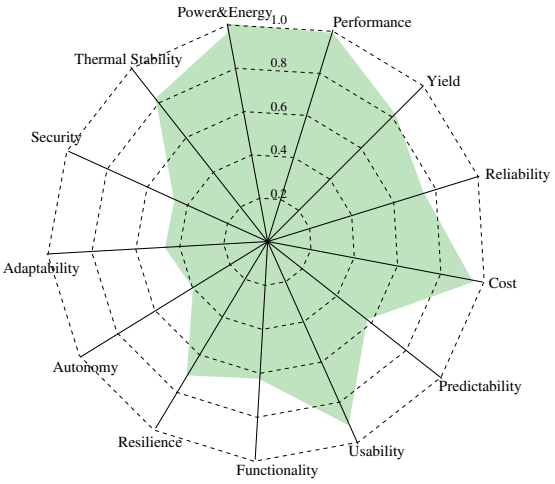
Complex SoCs require sophisticated, dynamic management of resources because there are so many competing and equally important objectives to be pursued. This is the second in a series of two special issues on Self-Aware Systems on Chip. The figure below illustrates the high expectations on current systems where the shaded area represents a typical system today, that prioritizes some objectives at the expense of others. However, the dynamic requirements of complex SoCs may require a varying and shape-shifting footprint of coverage in the SoC radar chart, reflecting not only the multi-objective nature of the design space, but also the need to adaptively prioritize different objectives during SoC execution, highlighting the need for self-awareness.

In the first special issue on self-aware SoCs several techniques to handle functional faults, power on FPGAs, process-voltage-temperature (PVT) variations, and critical path delays have been presented. In all cases it became apparent that the concurrent consideration of multiple objectives requires a comprehensive model of the system's state and its objectives. This point is further demonstrated in this special issue where functional faults, QoS, varying workloads, temperature, PVT variations and reliability are subject of dynamic decision making. As these examples illustrate, when three or more goals are balanced at the same time, it becomes beneficial to collect an abundance of data, analyze it carefully and make decisions based on a detailed and nuanced understanding of the current state.



The SoC Radar.

Although the methods, described in these two special issues, are fairly sophisticated, none handles a majority of the issues shown in the SoC radar. To give justice to all of them will require further progress in the direction of true self-awareness.

This special issue commences with “Self-Test and Diagnosis for Self-Aware Systems”, a survey of the state of the art of self-testing and self-monitoring techniques by Michael A. Kochte and Hans-Joachim Wunderlich. Self-testing has a long tradition and is a mature field, and the authors show that many of its techniques facilitate the self-awareness of a system. It is followed by an article by A. Kostrzewa, S. Tobuschat and R. Ernst on “Self-Aware Network-On-Chip Control in Real-Time Systems”, which proposes an NoC management that combines flexible adaptation with QoS guarantees for demanding applications like autonomous driving.

The third article deals with thermal management in high performance computing platforms. “Self-Aware Thermal Management for High Performance Computing Processors” by A. Bartolini, R. Diversi, D. Cesarini and F. Beneventi uses a run-time optimization strategy based on sophisticated analysis of noisy sensor data and dynamic learning to handle the peculiarities of thermal heterogeneity of the platform and variable application work loads.

Finally, “Run-Time Adaptive Power-Aware Reliability Management for Many-Cores” by M. Salehi, A. Ejlali and M. Shafique balances performance, power and reliability in the face of PVT variability by deploying both hardware and software hardening modes.

The articles in these two special issues on Self-aware SoCs illustrate the complexities of dynamic resource management in today’s SoCs, unveil the shortcomings of the state of the art and point to the topics that require further research and innovations. We hope you find these articles interesting, educating and inspiring.