Trends in Next Generation HPC Architectures and Their Impact on Computational Methods for Nuclear Reactor Analysis (And Beyond)

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Abstract

Next-generation HPC platforms in many cases will force application developers to re-formulate fundamental algorithmic and implementation approaches that were adopted over the previous generation. Overall levels of concurrency, the relative cost of FLOP/s compared to data movement, available memory per floating point unit, depth and complexity of the memory hierarchy, awareness of power costs, and overall resilience characteristics are a few broad areas where exascale-type machines will depart significantly from current practice. While constrained to some degree by the technology, in designing future HPC systems there is still considerable latitude both in a relatively broad range of design tradeoffs and the programming models that are used to optimally express them. At the same time, regardless of specific design choices, most applications will need to evolve considerably to make efficient use of these systems, including developing new algorithmic implementations, formulations, and potentially even new mathematical descriptions of the target physical problem. In this talk I discuss in depth several concrete examples of this "push" and "pull" of co-design drawn from five years of experience leading the CESAR Co-Design Center, relevant to both methods in nuclear reactor analysis and beyond.

References

1. Andrew Siegel. Trends in Next Generation HPC Architectures and Their Impact on Computational Methods for Nuclear Reactor Analysis (and beyond). S. Ashby et al. The opportunities and challenges of exascale computing. Summary Report of the Advanced Scientific Computing Advisory Committee (ASCAC) Subcommittee, Fall 2010. .