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EDITORIAL

# Special issue on high density data centers

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The power consumption and heat load of computing, storage and networking hardware have drastically increased over the last few years. It is expected that combined data center products and services will grow rapidly over the next few years, demanding more hardware, power and cooling resources to match the high demand on the compute services. An intelligent approach will resolve the cooling capacity required by the increasing heat load of the data center. But a closer look at the data center design, power architecture and hardware assets is needed to address the challenges that data centers will face in light of the increased load and service demands on both hardware and software requirements. This special issue is intended to raise awareness of some of the challenges facing data centers of the future and focuses on various elements that are being investigated by researchers and applications that are being developed in these areas.

There was great response to the call for papers but due to the limited space and time only five papers were accepted and selected for this special issue. These papers are authored by an outstanding roster of experts in their respective fields, and tackle various data centers issues from different angles, requirements and interests. Their topics include compute and system power, cooling, RFID and data center design. In the final analysis, they are all concerned with the end products and services that make up a complete data center entity. Thus in a sense, the data center research track requires a multidisciplinary research approach to truly represent the multidisciplinary environment that exists within the data center.

The increasing high density of data centers is motivated in part by increased compaction at the hardware level. Blade servers are great examples of such compaction, and represent one of the fastest growing enterprise server markets. Leigh et al., in

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their paper on "Designing a general-purpose infrastructure for configurable system architectures," discuss the challenges with designing blade servers to enable them to be the key building blocks for future data centers. They discuss the design of blade servers for high performance, power efficiency, availability and manageability, along with illustrative examples of how blade servers can be used for specific parallel and distributed applications in the data center.

High density data centers contain extremely large numbers of servers and other movable assets. Accurate and timely knowledge about asset location is of paramount importance, but is difficult to achieve in a cost effective way. Brignone et al. in their paper, "Real time asset tracking in the data center," describe an asset tracking system which automatically detects and identifies assets with a resolution equal to the asset size.

Li et al. in their paper, "Optimizing thermal design of data center cabinets with a new multi-objective genetic algorithm," explore the multi-objective optimization of data center cabinets. A reduced order model of the cabinet is constructed for design optimization, using the proper orthogonal decomposition technique. A new computationally efficient multi-objective genetic algorithm (MOGA) technique, using 50% fewer simulation calls compared to conventional MOGA, is developed for optimal design.

Rambo and Joshi in their paper, "Modeling of data center airflow and heat transfer: state of the art and future trends," present an assessment of the current state of the art of data center air-flow and heat transfer simulations. Future trends in compact modeling are presented, with a focus on integrating rack level models with facility level simulations. The role of compact multi-scale simulations in real time control for optimal operation is identified.

Finally, Beitelmal and Patel in their paper, "Thermo-fluids provisioning of a high performance high density data center," present a transient computational fluid dynamic (CFD) model to show the effects of cooling resources failure on the data center environment and how fast the systems inlet temperature climbs up to the maximum threshold value set by the system manufacturer. This paper shows the value of and encourages future research on workload migration where application failure and potential disaster could be averted.

I am grateful for the support of various reviewers who ensured the high quality of this special issue and I would like to thank Professor Elmagarmid for overseeing the review process of the paper I co-authored with Chandrakant Patel. My hope is that this collection of papers can help shed some light and generate fruitful discussion on the data center's complicated environment and the challenges facing it.