



Institute Lecture

Thermal Management of Microsystems from Chips to Data Centers

Yogendra Joshi

G.W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology
Atlanta, GA 30332

Thursday, 24th March, 2011; Time: 4:00 PM, Venue: L-9, New Lecture Hall Complex

Abstract

Thermal management of microsystems involves at least ten decades of length scales. This talk will focus on the two ends of this multi-scale challenge. An increasing fraction of the thermal Dissipation in future microprocessor chips is projected to be in the wiring or interconnects. With continuing feature size reductions below the current ~50 nm, the copper electrical resistivity increases and thermal conductivity decreases due to carrier scattering, exacerbating the thermal challenges. Studies on pool boiling from nano-structured surfaces for thermal enhancement will be presented. Three-dimensionally stacked architectures provide potentially high device and interconnect performance for future microprocessors. However, stacking of high power chips with non-uniform power maps poses significant heat removal challenges, which will be discussed. In the second half of the talk, I will focus on the energy efficient thermal management of data centers. In 2006, data centers in the United States consumed about 61 billion kWh, or 1.5 % of total U.S. electricity consumption. Efforts for energy usage reduction for cooling using alternate equipment layouts for improved air-delivery, and real-time control of computing loads for best utilization of cooling resources will be discussed. The role of reduced order modeling approaches, for rapid predictions of air flows and temperatures, and experimental characterization using particle image velocimetry will be outlined.

About the speaker

Yogendra Joshi is Professor and John M. McKenney and Warren D. Shiver Distinguished Chair at the G.W. Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. His research interests are in multi-scale thermal management. He received a Bachelor of Technology degree in Mechanical Engineering from the Indian Institute of Technology in Kanpur in 1979, Master of Science in Mechanical Engineering from the State University of New York, Buffalo in 1981, and a Doctor of Philosophy in Mechanical Engineering and Applied Mechanics, from the University of Pennsylvania in 1984. He is the author or co-author of over 250 archival journal and conference publications, and is an elected Fellow of the ASME and the American Association for the Advancement of Science. He has served as Associate Editor for the ASME J. of Electronics Packaging (two terms) and the ASME J. Heat Transfer, and is currently an Associate Editor for the IEEE Transactions in Components and Packaging Technologies. He was a co-recipient of ASME Curriculum Innovation Award (1999), Inventor Recognition Award from the Semiconductor Research Corporation (2001), the ASME Electronic and Photonic Packaging Division Outstanding Contribution Award in Thermal Management (2006), ASME J. of Electronics Packaging Best Paper of the Year Award (2008), IBM Faculty Award (2008), IEEE Semitherm Significant Contributor Award (2009), and IIT Kanpur Distinguished Alumnus Award (2011).

All interested are welcome.

A. K. Chaturvedi
Dean of Research and Development
IIT Kanpur