Profile

Back to listing

Satish Kumar

Associate Professor

Heat Transfer, Combustion and Energy Systems

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Overview

Distinctions & Awards

Publications & Patents

Education

Ph.D., ME, Purdue University, 2007

M.S., ECE, Purdue University, 2007

M.S., ME, Louisiana State University, 2003

B.Tech., ME, Indian Institute of Technology, Guwahati, 2001

Research Areas and Descriptors

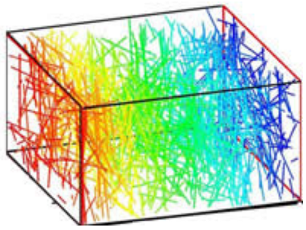
Heat Transfer and Fluid Mechanics: micro-nano heat transfer, electro-thermal transport, nanoscale materials and devices, computational fluid dynamics, bio-fluids, and electronics cooling.

Background

Dr. Kumar joined Georgia Tech in spring 2009 as an Assistant Professor. Prior, he worked at the Systems and Technology Group at IBM in Austin, Texas on thermal modeling and design of high-performance computing systems.

Research

Dr. Kumar research interests are in the development and validation of the first principles models for micro/nano scale electro-thermal transport and their applications in emerging devices, such as nanotube/ nanowire based devices, thermal management of electronic systems and heat/mass transfer analysis in bio-fluidic systems. His research efforts are focused on investigating transport induced by different carriers (electron, phonon, etc.) in emerging devices and different nanostructured materials using multiscale computational solvers. The research activities include the development of models to analyze and design nano-materials based architectures for efficient energy conversion and efficient micro-electronics cooling.



Temperature distribution in a 3-D nanotube network.

We have been developing an analytical and numerical framework which helps in understanding, controlling and designing nanowire and nanotube composites suitable for thin film transistors for various macro-electronic applications. This work is based on the physics of electron transport, thermal transport and heterogeneous percolation theory. The developed models are used to analyze the conductive properties of nanotube network and its composites and also for the analysis of coupled electrical and thermal performance of nanotube-network transistors. The nano-scale contact physics between nanotubes is explored using sub-continuum simulations. The contact thermal resistance and the energy transfer mechanisms at tube-tube interface are studied using molecular dynamics and wavelet theory. This work will benefit diverse applications such as flexible displays, transparent electrodes, energy storage devices, bio-chemical sensors or solar cells.

In the area of thermal management of electronic devices, we have been developing modeling techniques for analyzing novel thermal management devices such as ultrathin thermoelectric coolers integrated inside an electronic package. We have been studying on-chip power migration techniques and thermal interactions of multi-scale 3D interconnect structures with electronic packages. These studies are crucial not only for enhancing the efficiency, reliability and performance of advanced computing systems, but also for novel materials (CNT, graphene) based technologies where high power dissipation and heat removal can pose severe challenges.

The nature of our research is both applied and fundamental which involve various disciplines including thermal sciences, fluids sciences and semiconductor device physics. Students involved in this research work will also take courses in electrical engineering and physics department and perform computational/ experimental work, which will prepare them for a successful career in both academia and industry.

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