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Uncertainty Quantification in Simulation of Microsystems: Opportunities and New Directions

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Abstract: In recent years, there has been increasing interest in predicting the performance of micro/nanosystems from fundamental physical principles. However, fabrication processes produce large variability in device dimensions, material properties and surface conditions, among others. Furthermore, physical models for device behavior are approximate and span a wide range of length and time scales. When complex microsystems consisting of interconnected components and models are simulated, the cumulative effect of these uncertainties is manifested in the final predictions. In order to believe these predictions and to base decisions on them, it is deeply important to quantify uncertainty in microsystem simulations. In this talk, I describe recent computational work being undertaken in the PRISM center on the quantification of uncertainty in complex heterogeneous microsystems through the use of Bayes networks. PRISM focuses on understanding the long-term behavior of MEMS using large-scale simulation. The work involves multiscale, multiphysics simulations of radio-frequency capacitive MEMS switches, accounting for fluid-structure-electrostatics interactions at micron scales, metal-dielectric contact, and failure mechanisms such as dielectric charging. Though the specific examples are from the MEMS community, the broader ideas in the talk are applicable to simulations of general complex systems.

Biography: Jayathi Murthy is Ernest Cockrell Jr. Department Chair and Professor of Mechanical Engineering at the University of Texas at Austin and Director of PRISM: NNSA Center for Prediction of Reliability, Integrity and Survivability of Microsystems. She received her Ph.D degree from the University of Minnesota. During her employment at Fluent Inc., a leading vendor of CFD software, she developed the unstructured solution-adaptive finite volume methods underlying their flagship software Fluent, and the electronics cooling software package ICEPAK. More recently, her research has addressed sub-micron thermal transport, multiscale multiphysics simulations of MEMS and NEMS and uncertainty quantification in these systems. In 2012, she was named a distinguished alumna of IIT Kanpur. Prof. Murthy serves on the editorial boards of *Numerical Heat Transfer* and *International Journal of Thermal Sciences* and is an editor of the 2nd edition of the *Handbook of Numerical Heat Transfer.*