

**Scalability & Adaptivity: Achieving Conflicting Goals in a  
Heterogeneous Computing Era**

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Faculty Host– Baskar Ganapathysubramanian

**April 9, 2019 at 11:00 am in 2004 Black**

**Abstract**

Partial differential equations (PDEs) are pervasive in engineering and science, and their numerical solutions are of paramount importance in understanding complex, natural, engineered, and societal systems. For large-scale PDE systems, adaptivity is essential to keep the memory footprint small, especially on modern architectures. At the same time scalability of our computational algorithms and codes is essential in order to be able to solve large problems. These two goals are however difficult to achieve on modern heterogeneous architectures. Adaptivity in particular leads to unstructured memory access leading to poor distributed-memory scalability. In this talk, I will present Dendro, a large-scale adaptive mesh refinement framework that achieves high levels of spatial adaptivity without sacrificing scalability or efficiency. Additionally, by using a flexible symbolic interface in conjunction with automatic code generators for C++ with MPI, OpenMP, Vectorization and CUDA, we are able to make application codes extensible and highly portable as well. I will present examples from computational relativity, seismic wave propagation, and computational fluid dynamics to demonstrate the strengths of the framework.

**Biography**

Hari Sundar is an Assistant Professor in the School of Computing at the University of Utah. His research focuses on the development of computationally optimal parallel, high-performance algorithms, that are efficient and scalable on state-of-the-art architectures. It is driven by applications in biosciences, geophysics, and computational relativity. His research has resulted in the development of state-of-the-art distributed algorithms for adaptive mesh refinement, geometric multigrid, fast Gauss transform and sorting. He received his Ph.D. from the University of Pennsylvania and was a PostDoc at the Institute for Computational Engineering & Sciences at the University of Texas at Austin.

***This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.***

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