Frontiers of Scientific Computing Lecture Series

Multiscale Modeling of the Human Arterial Tree on the Teragrid

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Abstract:
In this talk I will present an overview of activities in large-scale simulations of blood flow in the arterial tree, including the intracranial vasculature. The macrovascular network (MaN, consisting of all large arteries) is modeled using 3D high-order spectral element methods, the mesovascular network (MeN, consiting of all arterioles) is resolved using 1D discontinuous Galerkin methods whereas the microvascular network (MiN, consisting of the capillary beds) is modeled using dissipative particle dynamics methods. Examples of large-scale simulations will be presented from the rheology of red blood cells in capillaries and arterioles to the complex flow circulation patterns in the circle of Willis.

Speaker's Bio:
Professor Karniadakis received his B.Sc. from NTU, Athens, Greece in 1982, his M.S. from MIT, in 1984 and his Ph.D. from MIT in 1987. He was an Assistant Professor at Princeton from 1988-1993, a Visiting Professor at Caltech in the Spring quarter of 1993, an Associate Professor at Brown University from 1994 to 1996 and became a full Professor at Brown University in 1996. He has been a Visiting Professor/Senior Lecturer of Mechanical Engineering at the Massachusetts Institute of Technology since 2000. Professor Karniadakis has worked on multiresolution methods for over 20 year. He developed the first algorithms for microfluidics (late 1980s), and published the first book on this field. He pioneered parallel computing in 3D turbulence simulations in the mid-eighties. He organized several International Conferences including several Microfluidics Symposia (July 2002; January 2001); the first Symposium on Wavelets & Turbulence (1991), and the first conference on Discontinuous Galerkin Methods (1999). He developed and maintained the code NEKTAR (freeware) used in Universities, national labs, and industry. His work has appeared on the covers of many scientific journals (e.g., Physics Today, Scientific Computing & Automation, Parity (Japanese), Physical Review Letters, Science and in Aerospace 2001. Half of his advisees hold tenure-track position in diverse fields (Applied Math, Microfluidics, Computer Science, Bioengineering, and Combustion). Professor Karniadakis has authored three books and more than 200 research papers. He has received research support from the Office of Naval Research, the National Science Foundation, the Air Force Office of Scientific Research and the US-Israel Binational Science Foundation. He is a Fellow of the American Society of Mechanical Engineers, A Fellow of the American Physical Society and an AIAA Associate Fellow. In 2007 Professor Karniadakis was awarded the 2007 Computational Fluid Dynamics Award presented by the US Association of Computational Mechanics.

This lecture has a reception.

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