College of Engineering
Department of
Mechanical & Industrial Engineering

The Sidney E. Fuchs Seminar Series

3:30-4:20pm, Friday, October 25, 2013
Frank H. Walk Design Presentation Room

Predictability and Uncertainty in Large-Scale Simulations

by George Em Karniadakis*

The Charles Pitts Robinson and John Palmer Barstow Professor of Applied Mathematics, Brown University; also at MIT & PNNL

In many simulations in fluid and solid mechanics but also in molecular simulations there are many sources of uncertainty, e.g. associated with boundary conditions, material properties or equations of state and constitutive laws. These uncertainties may contribute to large errors in the simulation, typically much larger than the spatio-temporal discretization errors, leading to erroneous dynamics or performance predictions.
In this talk, we will present several such examples from fluid mechanics but also across various disciplines and subsequently we will discuss different probabilistic and deterministic numerical approaches to quantify the effect of such uncertainties. Such stochastic simulations also serve for a better validation with the experiments but also through sensitivity analysis they can steer the experimental effort to a more effective sets of measurements. .

* George Karniadakis received his S.M. (1984) and Ph.D. (1987) from Massachusetts Institute of Technology. He was appointed Lecturer in the Department of Mechanical Engineering at MIT in 1987 and subsequently he joined the Center for Turbulence Research at Stanford / Nasa Ames. He joined Princeton University as Assistant Professor in the Department of Mechanical and Aerospace Engineering and as Associate Faculty in the Program of Applied and Computational Mathematics. He was a Visiting Professor at Caltech (1993) in the Aeronautics Department. He joined Brown University as Associate Professor of Applied Mathematics in the Center for Fluid Mechanics on January 1, 1994. He became a full professor on July 1, 1996. He has been a Visiting Professor and Senior Lecturer of Ocean/Mechanical Engineering at MIT since September 1, 2000. He was Visiting Professor at Peking University (Fall 2007). He is a Fellow of the Society for Industrial and Applied Mathematics (SIAM, 2010-), Fellow of the American Physical Society (APS, 2004-), Fellow of the American Society of Mechanical Engineers (ASME, 2003-) and Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA, 2006-). He received the CFD award (2007) and the J Tinsley Oden Medal (2013) by the US Association in Computational Mechanics. His h-index is 60 and he has been cited more than 17,500 times (see google scholar citations).
Karniadakis is the lead PI of an OSD/AFOSR MURI on Uncertainty Quantification and Director of a new DOE Center of Mathematics for Mesoscale Modeling of Materials (CM4).

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