PURDUE UNIVERSITY

Department of Mathematics

Center for Computational & Applied Mathematics

Distinguished Lecture Series

Prof. Jan S Hesthaven

Jan S Hesthaven is a Professor of Mathematics and Chair of Computational Mathematics and Simulation Science, École polytechnique fédérale de Lausanne (EPFL) in Lausanne, Switzerland.

After receiving his PhD in 1995 from the Technical University of Denmark, Professor Hesthaven joined Brown University where he became Professor of Applied Mathematics in 2005. In 2013 he joined EPFL as Chair of Computational Mathematics and Simulation Science. His research interests focused on the development, analysis, and application of high-order accurate methods for the solution of complex time-dependent problems, often requiring high-performance computing. A particular focus of his research has been on the development of computational methods for problems of linear and non-linear wave problems and the development of reduced basis methods.

He has received several awards for both his research and his teaching, and has published 4 monographs and more than 125 research papers. He is on the editorial board of 8 journals and serves as Editor-in-Chief of SIAM J. Scientific Computing.

Reduced order modeling for parametrized PDEs

Monday, Sept. 11, 2017 **|** 4:30 PM **|** LWSN 1142

The development of reduced order models for complex applications, offering the promise for rapid and accurate evaluation of the output of complex models under parameterized variation, remains a very active research area. Applications are found in problems which require many evaluations, sampled over a potentially large parameter space, such as in optimization, control, uncertainty quantification and applications where near real-time response is needed.

However, many challenges remain to secure the flexibility, robustness, and efficiency needed for general large scale applications. In this talk, we discuss recent developments of reduced basis methods that enables the formulation of rigorous error estimates to certify the results obtained with the reduced model. The efficiency and accuracy of this shall be demonstrated by a number of 2D and 3D examples.

We subsequently discuss the extension of such ideas to time-dependent problems and problems with substantial nonlinear behavior. For nonlinear time-dependent problems we pay particular attention to reduced models for Hamiltonian problems but shall also consider more general problems. For general nonlinear problems such as the Navier-Stokes equations, a direct development of a reduced model is complex. To overcome this we discuss the use of machine learning, combining reduced basis methods and neural networks. This opens the doors for the development of fast reduced models for very general parameterized nonlinear problems, yet many questions remains open.

Throughout the talk we illustrate the different ideas with examples and also point out some of the many remaining open problems, in particular the application and understanding of reduced basis methods for general nonlinear problems.

A reception with refreshments will follow immediately after the lecture outside of LWSN 1142