NUS National University of Singapore | Department of Mechanical Engineering
Faculty of Engineering

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Department Seminar

Topic: **Surrogate Model Reduction for Linear Systems Based on Frequency-Domain Modal Analysis**

Speaker: **Dr. John T. Kim**
Associate Professor, Department of Mechanical Engineering
National University of Singapore

Date: **17 October 2014, Friday**

Time: **11.00am to 12.00pm**

Venue: **EA-06-02** *(map of NUS can be found at http://map.nus.edu.sg/)*

Abstract

In this presentation, a novel model reduction methodology for linear systems with parameter variations is presented based on a frequency-domain formulation and use of the Proper Orthogonal Decomposition (POD). For an efficient treatment of parameter variations, the system matrices are divided into a nominal and an incremental part. It will be shown that the dynamics governing the perturbed part is modally equivalent to a new system where the incremental matrices are isolated into the forcing term and no longer appear in the homogeneous part of the equation. Thus, it becomes possible to interpret and analyze the effects and impact of the parameter variations in the context of conventional forced response problem in which the system is driven by the incremental matrices. To account for the continuous changes in the parameters, the Single-Composite-Input (SCI) is invoked with a finite number of predetermined incremental matrices acting as simultaneous inputs. The Frequency-Domain Karhunen-Loeve (FDKL) procedure is used to calculate a rich set of basis modes accounting for the variations. The new procedure is applied to an example structural dynamics-like problem and shown to produce extremely accurate Reduced-Order Surrogate Model (ROSM) for a wide range of parameter variations.

About the Speaker

John T. Kim worked at the Boeing Company, Seattle, for sixteen and half years. Prior to this, he was a research associate at Georgia Tech. His areas of specialty are structural dynamics, fluid-structure-control interaction (a.k.a., aeroservoelasticity), system identification and reduced-order modeling of large-scaled dynamic systems, unsteady aerodynamics, and composite structures. At Boeing, he developed innovative computational and experimental tools to enhance accurate and rapid estimation of dynamic loads, flutter and control laws, all of which are essential in design and analysis of modern aircraft structures. In 2003 he was awarded the Best Paper Award at the 5th BTEC (Boeing Technological Conference) for his work on reduced-order aerodynamic and aeroelastic modeling. Since 2005 he has taught the AIAA short course, "Computational Methods in Aeroelasticity" at AIAA Structural Dynamics and Materials Conf., Boeing Ed Wells, National Aerospace Laboratory in Bangalore, India, and NASA Langley. He is an Associate Fellow of American Institute of Aeronautics and Astronautics. In 2013 he joined National University of Singapore in the Department of Mechanical Engineering. He earned his Ph.D. from Massachusetts Institute of Technology in Aeronautics and Astronautics.

Admission is free. All are welcome to attend.