"Uncertainty Quantification and Model Validation in Mechanical System Behavior Prediction"

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Abstract: This talk will present recent methods to address several challenges in model-based performance prediction of engineering systems. Model-based simulation becomes attractive for systems that are too large and complex for full-scale testing. However, model-based simulation involves many approximations and assumptions, and thus confidence in the simulation result is an important issue. Sources of uncertainty are both aleatory and epistemic, stemming from natural variability, information uncertainty, and modeling errors. Recent research on methods for model validation, model calibration, and prediction uncertainty quantification will be discussed. The presentation will also include methods for quantifying various types of errors and uncertainties, including model form uncertainty; methods for assessing confidence in extrapolation to usage conditions different from laboratory conditions; and methods for test design/planning to meet validation and prediction uncertainty requirements. These techniques will be illustrated with a variety of mechanics problems, including multi-level, multi-disciplinary systems, and materials damage modeling.

Bio: Professor Sankaran Mahadevan has more than twenty years of research and teaching experience in reliability analysis, design optimization, uncertainty quantification, and model verification and validation. His research has been funded by NSF, NASA, FAA, DOE, DOT, NRC, U.S. Army Research Office, U.S. Air Force, U.S. Army Corps of Engineers, GM, Chrysler, Union Pacific, American Railroad Association, and Sandia, Idaho, Los Alamos and Oak Ridge national laboratories. His research contributions are documented in more than 110 journal articles and numerous other publications. He has also published two textbooks on reliability methods. Professor Mahadevan directs an NSF-funded IGERT multidisciplinary doctoral program in Reliability and Risk Engineering and Management at Vanderbilt University, consisting of 30 professors from all engineering departments and the business school, and supported by many industry and government sources. Professor Mahadevan obtained his B.S. from Indian Institute of Technology, Kanpur, M.S. from Rensselaer Polytechnic Institute, and Ph.D. from Georgia Tech.