FEEDER Foundations for Engineering Education for Distributed Energy Resources

Spring 2018 Seminar Series

Optimization, uncertainty quantification, and services of engineering assets

FRIDAY APRIL 20, 2018

2:00 PM – HEC 356

Abstract

The design, manufacturing, and service of machines for transportation, power generation, and oil and gas industries present innumerous opportunities for multidisciplinary optimization and uncertainty quantification. Engineers and analysts are constantly challenged to balance performance, reliability, and cost, while industry is addressing growing demands, tight regulations, and the need for rational use of resources. This seminar will present successful applications of multidisciplinary optimization and uncertainty quantification during design and illustrate opportunities in post design. The discussions will be centered on how the use of state-of-the art computational methods allow the fusion of heterogeneous sources of data with engineering models. First, a surrogate-based framework is presented as an enabler for engineering design optimization. In addition to minimizing the number of high-fidelity simulations, the surrogate-based framework has shown to be (a) capable of handling highly non-linear design spaces, (b) able to scale with parallel computing, and (c) robust to incomplete or failed simulations. Second, a statistical approach for characterizing prediction uncertainty of high-fidelity models is presented. The Bayesian formulation of the Gaussian process is used to fuse information from limited amount of simulations and experimental data. The framework has been successfully used to quantify uncertainty due to (a) model parameters, (b) number of simulations and experiments, and (c) discrepancy between the simulation code and the actual physical system. Finally, the multidisciplinary nature of post-design is illustrated through examples in asset performance management (lifing of gas turbine components) and operations optimization (power system model identification). Other post-design opportunities include but are not limited to (a) minimization of unplanned downtime, (b) maximization of productivity trends, and (c) cost avoidance in regulatory compliance.

Dr. Felipe A. C. Viana

University of Central Florida

Biography

The vast majority of Dr. Viana's work has been applied to new designs and improvement of fielded products with focus on aircraft propulsion, power generation, and oil and gas systems. Over the years, his research has generated more than 60 peer reviewed publications (see citations here), as well as 4 published and another 2 filled patents. He also serves as Review Editor for the Structural and Multidisciplinary Optimization Journal and as reviewer in top journals and conferences (AIAA Journal, Journal of Mechanical Design, and Engineering Optimization, among others). Before joining UCF, Dr. Viana was a Sr. Scientist at GE Renewable Energy, where he led the development of state-of-the art computational methods for improving wind energy asset performance and reliability. Prior to moving to that role at GE, he spent five years at GE Global Research, where he lead and conducted research on design and optimization under uncertainty, probabilistic analysis of engineering systems, and services engineering. Dr. Viana has a PhD in Aerospace Engineering from the University of Florida and a PhD in Mechanical Engineering from the Universidade Federal de Uberlandia. Throughout his graduate studies, he focused on developing methods for multidisciplinary optimization and inverse problems. Applications include the optimization of passive vibration control mechanism using piezoelectric resonant shunted circuits (collaboration with EMBRACO) and identification of landing gear model parameters (collaboration with EMBRAER).