***Department of Structural Engineering***
***University of California, San Diego***
***SE 290 Seminar***

Daniel C. Kammer
ATA Engineering, Inc.

**"Test-Based Uncertainty Quantification and Propagation Using Hurty/Craig-Bampton Substructure Representations"**

Wednesday, March 13, 2019
1:00 pm - 1:50 pm, Cognitive Science Building, Room 001

https://structures.ucsd.edu/seminars

## Abstract

This work presents a method for uncertainty propagation that is consistent with the "building-block approach" in which components of a system are tested and validated individually instead of an integrated vehicle test and validation being performed. The approach gives a unified methodology for representing and quantifying uncertainty in a Hurty/Craig-Bampton component based on component test results and propagating the uncertainty in component models into system-level predictions. Uncertainty in the Hurty/Craig-Bampton representations is quantified using a new hybrid parametric variation approach based on Soize's maximum entropy method. The proposed approach combines parametric and nonparametric uncertainty by treating the Hurty/Craig-Bampton fixed-interface eigenvalues as random variables and treating the corresponding mass and stiffness as random matrices. The proposed method offers several advantages over traditional approaches to uncertainty quantification in structural dynamics: the number of parametric random variables is relatively small compared to the usually large number of potential random finite element model parameters; therefore, time-consuming parametric sensitivity studies do not have to be performed. In addition, nonparametric model-form uncertainty is easily included using random matrix theory. The method requires the selection of dispersion values for the Hurty/Craig-Bampton fixed-interface eigenvalues and the corresponding mass and stiffness matrices. Test/analysis frequency error is used to identify the fixed-interface eigenvalue dispersions, and test self-orthogonality and test/analysis cross-orthogonality are used to identify the Hurty/Craig-Bampton mass and stiffness matrix dispersion values. The proposed uncertainty quantification methodology is applied to the Space Launch System liftoff configuration.

## Biography

Professor Kammer has broad expertise in dynamics, control, and identification of structural systems, including modal identification, test-analysis correlation, analytical model calibration, and analytical model validation. He developed the Effective Independence technique for systematically placing sensors, which is used throughout the analytical/experimental engineering community to select sensor locations for ground-based and on-orbit vibration testing. Professor Kammer has also developed several advanced techniques for generating accurate reduced-order models of structural systems. These test-analysis models are used in aerospace applications during test-analysis correlation to validate the accuracy of the analytical model. His modal TAM technique was instrumental in generating accurate TAMs for solid rocket motors during the Shuttle and small ICBM recovery programs. Professor Kammer has also performed extensive research in the area of component mode synthesis and substructure representations. He is currently combining this expertise with uncertainty propagation and quantification to develop methods for probabilistic test/analysis correlation and validation.