Model Validation and Uncertainty Quantification:

Recent Advances and Opportunities for Aerospace Applications

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Abstract

The presentation discusses recent advances in model validation and uncertainty quantification in single-physics and multi-physics numerical simulations, and their implications to aerospace engineering applications. Bayesian approaches towards information fusion and the integration of results from different uncertainty quantification activities are discussed. The information available (models, test data, and expert opinion) is often heterogeneous and at different levels of fidelity. A Bayesian network appears useful for multi-fidelity information fusion across multiple physics and multiple levels of the test hierarchy. The results of calibration, verification, and validation with respect to each individual model can be aggregated and propagated through the Bayesian network in order to quantify the overall prediction uncertainty. The relevance of test data to the prediction quantity of interest can also be quantitatively included in the framework. Based on the uncertainty aggregation, an inverse problem formulation for test selection and design is developed. Example problems from aerospace engineering are used to illustrate recent advances and discuss opportunities for future work.