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DATA-ENHANCED MULTI-MODEL UNCERTAINTY QUANTIFICATION AND EXPERIMENTAL DESIGN OF COMPLEX COMPUTATIONAL SYSTEMS

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MINISYMPOSIUM

High-fidelity computational mechanics applications are notoriously expensive which limits the number of simulations of these models that can be used for many-query tasks, e.g. uncertainty quantification (UQ). Consequently, multi-level and multi-fidelity modeling have been developed to reduce the computational burden associated with evaluating high-fidelity statistics and/or the construction of surrogates. Multi-fidelity methods increase accuracy for a fixed computational cost by optimally allocating computational resources to multiple models/data sources of varying cost and accuracy. Typically, a limited number of high-fidelity simulations are used to maintain predictive accuracy while larger numbers of lower-fidelity simulations are used to allow greater explorations of model uncertainties; this can reduce errors in estimates of uncertainty by orders of magnitude for a fixed budget.

This minisymposium will present advancements in multi-model algorithms for surrogate construction and UQ. Topics of interest include the development and/or deployment of advanced multi-fidelity tools, including inference and estimation, uncertainty propagation, experimental design, and data-driven learning. Examples of research questions of high interest include: (1) how to identify an effective multi-fidelity model ensemble?; (2) how can model ensembles be adaptively tuned or pruned to improve the multi-fidelity estimation?; (3) how can structure be identified and exploited to improve multi-fidelity analysis, e.g., by resorting to latent/shared variables?; (4) what are relationships between multi-fidelity modeling, multi-task learning, and transfer learning, and how can they be exploited?; (5) how can multifidelity UQ tools be embedded in design, optimization, and control problems?; and (6) how can multi-fidelity tools be leveraged in challenging computational scenarios like unsteady, nonlinear, and/or chaotic regimes? Moreover, talks can also focus on pragmatic strategies for overcoming problem specific challenges that arise during deployment of multi-fidelity methods to realistic mechanics models, e.g. strategies that account for the computational cost of constructing pilot samples datasets which guide the optimal allocation of resources.

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