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Comparison of a Pragmatic and Versatile “Real Space” Model Validation Framework against Several Other Validation Frameworks

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Abstract

This presentation will outline a practical and versatile “Real Space” approach to model validation ([1] – [4]) and then compare it against other selected approaches such as the ASME V&V20 framework [5] and the Oberkampf & Roy framework [6]. The comparison will be in terms of the how the issues of model accuracy and adequacy are framed and assessed, including the versatility and workability (complexity and cost) of the UQ techniques used to handle various sources of random and systematic uncertainties (correlated and uncorrelated, interval and probabilistic) in the experiments and models/simulations.

The Real-Space approach does not employ “Transform Space” discrepancy measures and acceptance criteria to assess model accuracy and adequacy. A large variety of mathematical transforms such as the subtraction transform in [5] and the “area” validation metric in [6] can be used to characterize discrepancy between experiment and simulation results. The transform measures in the literature can be relatively sophisticated and involved, with varying transparency and interpretability of the physical and decision-making significance of the numerical values yielded by the discrepancy measures. The transforms can also put constraints on what forms and types of uncertainty can be addressed. Furthermore, workable criteria to assess adequacy of model/experiment agreement in terms of transform measures are still elusive, whereas a simple criterion can be applied in Real Space that assesses the relative risk and adequacy of a model.

The Real-Space validation methodology reflects a pragmatism and versatility evolved from working a broad variety of industrial-scale problems involving complex physics and constitutive models, steady-state and time-varying nonlinear behavior and boundary conditions, and various categories of uncertainty in experiments and models in the areas of heat transfer, structural mechanics, irradiated electronics, and combustion in fluids and solids.


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