

Special Issue: Sandia V&V Challenge Problem



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It had become apparent to the participants in these challenge problems that there was a need to create a forum for the dissemination of verification and validation results for computational models. While the symposia provided a vehicle for this, a journal would be more effective and would appeal to people in a wider range of disciplines.

The mission statement "...The Journal disseminates original and applied research, illustrative examples, and high quality validation experiment data from leaders in the field of VVUQ of Computational Models" characterizes the original aims of the journal. Review articles and discussions were to be encouraged. Datasets from the experiments and models would be posted for use for validation of different models.

Of the three components of the journal title, Verification is probably the best understood and practiced, while Validation and Uncertainty Quantification are both less understood and practiced. In short, Validation addresses the question of the adequacy of a model to represent a real situation, and Uncertainty Quantification describes the variations observed or predicted.

Validation attempts to answer the question "Given a specific question, are the physics included in the model sufficient to answer the question?" We recognize that there may be conceptual differences between the experimentalist and the analyst. Certain features may not be describable equally in the model and in the experiment. For example, in medical experiments, we often see reference to a "clamped temperature" meaning that a portion of a domain is isothermal. To the modeler, this usually means prescribing an isothermal condition. For the experimentalist, this may be

an unobtainable condition. Like the "clamped" boundary, in general, there will be other aspects of the real situation, which are difficult to include in the computational model. Likewise, there may be intrinsic characteristics of the model that may not be achievable in an experiment.

Uncertainty Quantification is a recognition that different experiments will produce different results. Since models contain numerical and physical parameters, the analytical results will also have a distribution of values. Uncertainty Quantification attempts to quantify both of these distributions and to reveal their source and sensitivities.

Validation and Uncertainty Quantification are closely tied together. One cannot report their effects independently. The effects of different approaches to represent the "clamped temperature" condition can only be done statistically, that is, by quantifying the distribution of the results. In some situations, multiple experiments or computations can be done, and the statistics are reported from the classical point of view. For complex questions, often it is not possible to do more than a few comparisons and the Bayesian point of view must be employed, thus introducing the question of prior knowledge. In some cases, the models are used predictively, often based on parameters far from those used in the validation, introducing a whole new set of assumptions and levels of confidence.

Although the initial impetus for the journal was targeted toward applying VV&UQ to typical computational models (e.g., CFD, structural, and thermal), we need to recognize that in today's world almost every real situation will sooner or later be modeled and that the mathematics of these models may differ substantially from what we are currently used to. For example, the effectiveness of different inverse techniques is often based upon simulated experiments in which the deterministic model results are corrupted with noise. Testing of these mathematical algorithms with real experimental results is relatively rare. One of the aims of the journal is to post data sets of the experimental and model calculations. While we expect that most papers will be based upon current mathematical models, we encourage contributions that describe the uncertainty associated with the experiments that others may use to validate future or not yet anticipated models.

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