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FRONTIERS OF VERIFICATION, VALIDATION (V&V) AND UNCERTAINTY QUANTIFICATION

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ABSTRACT

Critical decisions based on numerical simulations require an assessment of how well the predictions obtained represent the reality-of-interest. Numerical methods, however, provide approximate solutions in computational continuum mechanics which unavoidably leads to errors in the computed results. These errors are associated with the numerical method (lack of mesh resolution, lack of iterative convergence, etc.); they also depend on underlying assumptions related to the form of the continuum models (incorrect constitutive law, incorrect dissipation behavior, etc.). Propagation of these errors and uncertainties employs concepts from Monte Carlo random sampling, polynomial chaos expansion, interval analysis, worst-case analysis, etc. Evaluation and quantification of these errors and uncertainties employs concepts from calculation or solution verification, sensitivity analysis, test-analysis correlation, etc.

These techniques are collectively referred to as the discipline of Verification and Validation (V&V). V&V provides a framework to establish confidence via the collection of evidence that the simulation code and its predictions exhibit correct sensitivities, are sufficiently accurate to study the reality-of-interest, and are sufficiently robust to numerical settings of the simulation.

This mini-symposium addresses recent theoretical advances and applications of V&V with an emphasis on four broad themes: 1) code verification and manufactured solutions, 2) solution verification and the quantification of numerical uncertainty, 3) V&V of constitutive models, and 4) V&V case studies. Applications discussed include continuum mechanics, structural dynamics, computational fluid dynamics, and the multiscale simulations of materials with emphasis on coupling techniques from first principles to continuum models. The mini-symposium brings together a set of leading international researchers to discuss evolving approaches used to evaluate, propagate and quantify sources of errors and uncertainties in the computational mechanics community.

Key words: Uncertainty Quantification, Code Verification, Model Validation, Computational Mechanics, Materials Modeling, Computational Fluid Dynamics.

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