HYBRID UNCERTAINTY QUANTIFICATION TECHNIQUES FOR REACTIVE TRANSPORT APPLICATIONS

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This work presents a novel hybrid intrusive/non-intrusive approach for building multi-physics simulators embedded with uncertainty quantification (UQ) capabilities. This hybrid approach offers the flexibility over pure intrusive or non-intrusive approach by incorporating a “mix-and-match” philosophy whereby each individual physics module may be equipped with the best UQ method (intrusive or non-intrusive) available to it, and by seamlessly “gluing” these modules together to facilitate forward and inverse uncertainty propagation through the multi-physics model. We demonstrate its viability by formulating, implementing, and analyzing our hybrid UQ method on a two-dimensional nonlinear multi-species reactive flow-transport model, discretized by the finite-element method. The hydraulic conductivity field is represented by the Karhunen-Loeve expansion. The hydraulic head, specific flux, flow concentration and reaction rates are expressed by the polynomial chaos expansion.