Uncertainty Quantification of Multiphysics Systems Through Nonlinear Elimination and Measure Transformation

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Uncertainty quantification of multiphysics systems represents numerous mathematical and computational challenges. Indeed, uncertainties that arise in each physics in a fully coupled system must be captured throughout the whole system, the so-called curse of dimensionality. We present techniques for mitigating the curse of dimensionality in network-coupled multiphysics systems by using the structure of the network to transform uncertainty representations as they pass between components. When incorporated into a Newton-based nonlinear elimination solution scheme, these techniques allow efficient and robust uncertainty quantification of network systems. Examples relevant to the simulation of nuclear power plants will be discussed.

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