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Validation and Uncertainty Quantification in CASL Nuclear Reactor Modelling

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The Consortium for Advanced Simulation of LWRs (CASL) seeks to provide credible, science-based modelling and simulation capabilities to address phenomena limiting the operation and safety performance of Light Water Reactors [1]. A key component of achieving this goal is the ability to quantify sensitivities of quantities of interest to uncertainties inherent in models, model parameters and solution algorithms. Specific challenges within CASL include: a broad range of coupled applications codes ranging from legacy codes to new codes undergoing active development, uncertainties that arise from how data is transferred among these codes, the interplay of solution algorithms employed by each application as well as the overall coupling algorithm, and the tendency toward intractable problem sizes even within a high-performance parallel computing environment. The Validation and Uncertainty Quantification (VUQ) focus area within CASL has made progress addressing these challenges, and the approach taken will be presented in this talk along with results for a key CASL challenge problem.

Specifically, an overview of the CASL software environment will be presented with emphasis on how the DAKOTA optimization package has been incorporated [2]. Next, results for a CASL challenge problem representing coupled neutronics and thermal hydraulics over a complete fuel assembly will be presented and include sensitivity, calibration and uncertainty quantification studies using reactivity as the figure of merit. Some discussion on practical issues and their resolution will be included. Finally, challenges to realizing a generally extensible VUQ capability will be addressed along with ongoing work to address these.

REFERENCES

[1] CASL website: http://www.casl.gov
[2] DAKOTA website: http://dakota.sandia.gov