PECOS

Predictive Engineering and Computational Sciences

UQ Tools

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ICES

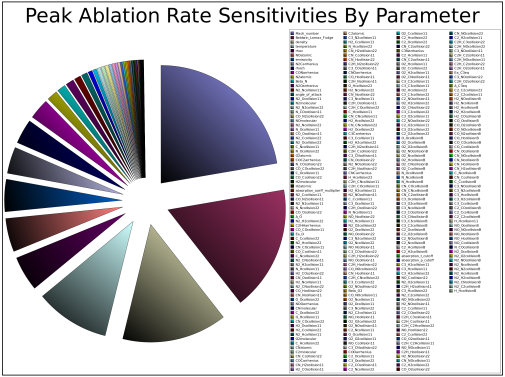
ASC

Tools and Processes Enabling UQ

- Forward propagation of prior information (sensitivity analysis)
- Bayesian calibration and software for sampling
- Bayesian optimal experimental design

Sensitivity Analysis

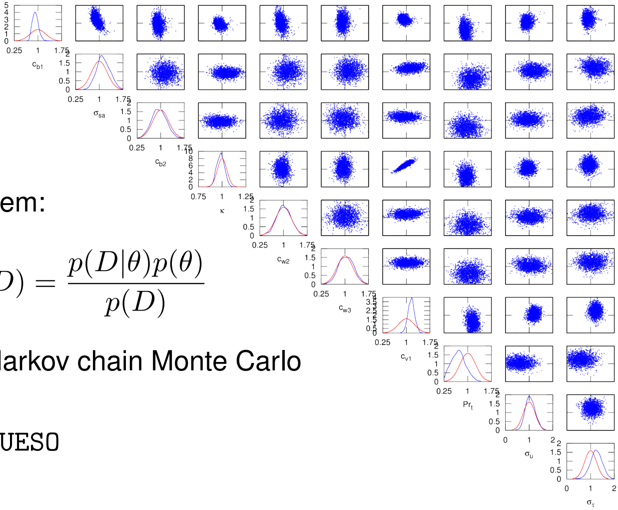
- Begin UQ process with sensitivity study in Year 1 FSS
- Identify key parameters/models for further investigation
- Conducted analogous exercise in PSAAP 1 with ~ 300 parameters



- Result: < 30 parameters account for 95%+ uncertainty
- > 150 parameters negligible to within numerical error

Submodel Calibration Example: Turbulence Model

Jointly calibrate model parameters via Bayesian update



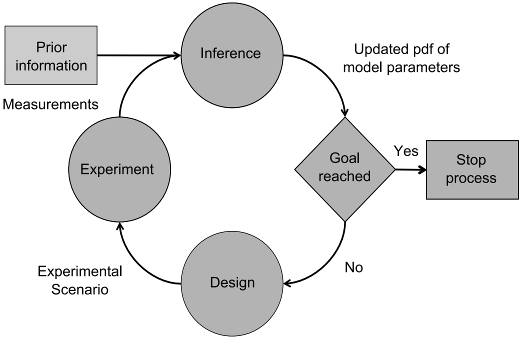
Bayes' theorem:

$$p(\theta|D) = \frac{p(D|\theta)p(\theta)}{p(D)}$$

Sampling: Markov chain Monte Carlo

- Using QUESO

Bayesian Experimental Design for Calibration



- Uncertainty encoded in PDF measured by information entropy
- Identify designs which maximally posterior parameter uncertainty

- Experimentalist defines optimization domain
- Computational scientist chooses best experiment to inform model
- Iterate until desired uncertainty reached