

## PD713 Verification and Validation in Scientific Computing

### Day 1

- Introduction, Background, and Motivation
- Terminology and Fundamental Concepts
  - Brief history of terminology
  - Present definitions and interpretations
  - Alternate definitions used by related communities
  - Additional important terms
  - Who should conduct verification, validation, and uncertainty quantification?
- Code Verification
  - Software engineering
  - Criteria and definitions
  - Order of accuracy
  - Order of verification procedures
  - Traditional exact solutions
  - Method of manufactured solutions
  - Approximate solution methods
- Solution Verification
  - Round-off error
  - Iterative convergence
  - Iterative error estimation
  - Classification of discretization error estimators
  - Reliability of discretization error estimators
  - Discretization error and uncertainty estimation
  - Solution adaption procedures

### Day 2

- Validation Experiments
  - Validation fundamentals
  - Validation experiment hierarchy
  - Validation experiments vs. traditional experiments
  - Six characteristics of validation experiments
  - Detailed example of a wind tunnel validation experiment
- Model Accuracy Assessment
  - What are validation metrics?
  - Various approaches to validation metrics
  - Recommended characteristics for validation metrics
  - Confidence interval approach
  - Cumulative distribution functions approach

- Predictive Capability of Modeling and Simulation
  - Identify all sources of uncertainty
  - Characterize each source of uncertainty
  - Estimate solution error in system responses of interest
  - Estimate uncertainty in system responses of interest
  - Procedures for updating model parameters
  - Types of sensitivity analyses
  
- Final Topics
  - Planning and prioritization in modeling and simulation
  - Maturity assessment of modeling and simulation
  - Difficulties in implementing verification, validation, and uncertainty quantification (VVUQ)