11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

PARAMETRIZED-BACKGROUND DATA-WEAK FORMULATION FOR STATE AND MODEL BIAS ESTIMATION

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Key words: *data assimilation, parametrized PDEs, reduced basis, design of experiment.*

We present an integrated variational framework which combines a best-knowledge mathematical model (parametrized partial differential equation) and data (M experimental observations) to yield estimates for state and parametric and nonparametric model biases. We first abstract the estimation problem as a variational problem in the presence of unlimited observations. We then consider an approximate solution of the variational problem based on experimentally-realizable limited observations. We provide an associated a priori theory which identifies distinct contributions to reduction in the state error with the number of observations. The theory in addition identifies the optimal test and trial space; in the context of our variational data assimilation, the former is associated with the optimal sensor placement and the latter is informed by the best-knowledge parametric manifold. We develop an efficient offline-online computational strategy in the reduced basis setting in which we invoke real data in real-time. We finally apply the method to real data associated with a (three-dimensional) acoustic resonator to assess the effectiveness of the proposed method.