Uncertainty & Optimization: Friends or Foes?

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Abstract
Optimization is an engineering aspiration, uncertainties are an engineering reality. Focusing on the first leads to fragile, potentially unrealizable systems. Inclusion of uncertainties within an optimization exercise increases the computational complexity and cost while possibly obscuring the design target.

The talk will cover two orthogonal research efforts in which formal optimization and uncertainty quantification strategies are combined. The first part will focus on the use of optimization to derive fast algorithms for pseudo-spectral approximations such as those commonly used in stochastic collocation. Finding suitable points for multivariate polynomial interpolation is challenging and numerous research ideas are emerging ranging from linear programming to greedy procedures based on matrix decompositions.

The second part of the talk will focus on how uncertain outcomes can be incorporated in a formal optimization procedure. Specifically, a new metric for optimization under uncertainty formulations is derived to target the pdf of the system response, and to minimize the distance between the design-dependent response pdf and a given target over possible designs.

Examples of engineering applications will conclude the talk.