On PDE-constrained optimization under uncertainty: an approximation scheme and solution strategies

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Abstract

In recent years there has been an increasing interest in optimization problems constrained by random Partial Differential Equations (PDEs), since the latter are effective mathematical tools to take into account intrinsic randomness or partial knowledge of the system under study.

After an introduction to the topic, we will discuss a new approximation framework tailored to overcome the curse of dimensionality, i.e. to be effective when the random PDE depends on a very large (possibly even countable) number of random parameters. This new approach, which relies on the combination technique framework, is based on mixed difference of spatial approximations and quadrature formulae for the stochastic variables. It then requires the solution of several optimization problems (which are much cheaper compared to a direct fine approximation of the original one). To solve such problems, we then discuss iterative solvers and preconditioners tailored for the linear optimality systems that typically arise in PDE-constrained optimization under uncertainty.

The talk is based on a joint work with Fabio Nobile (EPFL).