Analysis and Computations of Optimal Control Problems for Stochastic Partial Differential Equations

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In this talk, we consider mathematically and computationally optimal control problems for stochastic elliptic partial differential equations. The control objective is to minimize the expectation of a cost functional, and the control is of the deterministic, boundary value type. The main analytical tool is the Karhunen-Loeve (K-L) expansion. Mathematically, we prove the existence of an optimal solution; we establish the validity of the Lagrange multiplier rule and obtain a stochastic optimality system of equations; we represent the input data in their K-L expansions and deduce the deterministic optimality system of equations. Computationally, we approximate the optimality system through the discretizations of the probability space and the spatial space by the finite element method; we also derive error estimates in terms of both types of discretizations. Some numerical experiments are given.