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Optimal control of elliptic PDEs with joint chance state constraints

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We study optimal control of PDEs under uncertainty with the state variable subject to joint chance constraints. These constraints ensure that the random state variable meets pointwise bounds with high probability. For linear governing PDEs and elliptically distributed random parameters, we prove existence and uniqueness results for almost-everywhere state bounds. We prove variance reduction properties for the spherical-radial decomposition compared to the standard Monte Carlo estimator. We discuss different expansions of the uncertain variable in the governing equation. Numerical examples for linear and bilinear PDEs compare the performance of Monte Carlo and quasi-Monte Carlo sampling methods. We also study how the accuracy of the probabilities depends on the truncation of the random variable expansion, and numerically illustrate the variance reduction of the SRD. Finally, we discuss variants of the proposed algorithms for Gaussian process regression.

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Classification de Session: Chance-constrained programming

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