Exploiting Sparsity in Bayesian Inverse Problems of Parametric Operator Equations

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Abstract: In this talk, we will discuss a parametric deterministic formulation of Bayesian inverse problems with distributed parameter uncertainty from infinite dimensional, separable Banach spaces, with uniform prior probability measure on the uncertain parameter. The underlying forward problems are parametric, deterministic operator equations, and computational Bayesian inversion is to evaluate expectations of quantities of interest under the Bayesian posterior, conditional on given noisy observational data. For forward problems belonging to a certain sparsity class, we quantify analytic regularity of the Bayesian posterior and prove that the parametric, deterministic density of the Bayesian posterior belongs to the same sparsity class. These results suggest in particular dimension-independent convergence rates for data-adaptive Smolyak integration algorithms. The proposed approach is applicable for instance for definite or indefinite elliptic and for parabolic evolution problems, with scalar or tensorial unknowns and also with uncertainty in domains, and to highdimensional initial value problems with uncertain coefficients.

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