Compressive sensing approximation of high-dimensional parametric operator equations

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Compressive sensing enables accurate recovery of approximately sparse vectors from incomplete information. We apply this principle to the numerical solution of parametric operator equations where the parameter domain is high-dimensional. In fact, one can show that the solution of certain parametric operator equations (parametric PDEs) is analytic in the parameters which can be exploited to show convergence rates for nonlinear (sparse) approximation. Building on this fact, we show that methods from compressive sensing can be used to compute approximations from samples (snapshots) of the parametric operator equation for randomly chosen parameters, which in turn can be computed by standard techniques including Petrov-Galerkin methods. We provide theoretical approximation rates for this scheme.