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Model order reduction for high dimensional parametric systems

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A successive sketch model based on adaptive sampling of points from a training data set is proposed in this work for model order reduction (MOR) of large scale multi parametric PDE systems. High fidelity solutions are generated for the selected sampled points belonging to the training set using classical finite element method (FEM). The goal of this work is to update the sketch model adaptively sampled on the selected parametric points such that when the reduced basis subspace is sufficiently enriched with the selected snapshots, it tends to converge towards the full order model (FOM). We present here the idea to construct the sketch model and propose a methodology to efficiently choose sample points from the parametric space using discrete empirical interpolation method (DEIM). The idea is based on heuristics where max norm error is evaluated between FOM and sketch model or the reduced order model(ROM) outputs on the computed sample points rather than searching for points which has maximum error over the entire parametric space. We demonstrate our work on a 9 dimensional parametric input space for an advection–diffusion problem on a 2D thermal block. We also validate our results on a validation parametric set and obtain an excellent convergence. The advantage of this approach is that it provides a black-box environment such that irrespective of the problem definition of the PDEsystem and the underlying discretization techniques used for solving the problem such as FEM or FVM, or for cases when posteriori estimators are unavailable, in such scenarios we should be able to find the optimal sampling points from the training set and generate appropriate snapshots.

Keywords: MOR, Sketch model, FOM, DEIM

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