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AN ADAPTIVE BASIS-ENRICHING TECHNIQUE FOR POD-GREEDY ALGORITHM

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In a recent work [1], an adaptive algorithm for adjusting the reduced basis from proper orthogonal decomposition (POD) and the basis from DEIM (discrete empirical interpolation method) for nonlinear non-parametric systems is derived. In this work, we extend the adaptive scheme to nonlinear parametric systems. The aim is to adaptively adjust the reduced basis (RB) derived by the POD-Greedy algorithm and the (D)EIM basis for interpolating the nonlinear function. A standard approach of reducing the nonlinear parametric system is using the POD-Greedy algorithm plus (D)EIM. At each iteration of the algorithm, the reduced basis is enriched by adding the first k dominant POD modes of the snapshot matrix for that iteration. Usually, k is taken as 1, and the (D)EIM interpolation is determined a priori and based on experience. Using an efficient error estimator from [2] as a guide for the RB error and the interpolation error, we are able to adaptively choose an appropriate value for k as well as a suitable number of DEIM basis corresponding to the current RB. The key of the adaptivity is the fact that the error estimator allows for separation of the error contributions from the RB and DEIM approximations. We test our algorithm on a parametric viscous Burgers' Equation and show that, upon convergence, the adaptive method needs fewer iterations than the standard approach.

We also propose a modified primal-dual based error estimator. Here, instead of reducing the dual system using the reduced basis method as the standard choice, we use a frequency-domain PMOR method [3] to obtain the reduced dual system. We demonstrate that the modified error estimator shows an improved effectivity for the considered example in the POD-Greedy algorithm.

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