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Data-driven parameter and model order reduction for industrial optimisation problems

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In this contribution we present data-driven reduced order models with a focus on reduction in parameter space to fight the curse of dimensionality in design optimization. We show two extensions of the Active Subspaces (AS) technique: a kernel version exploiting an intermediate mapping to a higher dimensional space, and a local approach in which a clustering induced by a global active subspace is used for regression and classification tasks [1]. We also integrate parameter space reduction methods within a multi-fidelity nonlinear autoregressive scheme to improve the approximation accuracy of high-dimensional functions [2], using only high-fidelity data. We also show how to integrate AS into the genetic algorithm to enhance the convergence during the optimization of high-dimensional quantities of interest [3]. These methods, together with non-intrusive reduced order models based on proper orthogonal decomposition, are applied to a diverse range of engineering problems such as structural optimization of cruise ships [4], shape optimization of a combatant hull, and the prediction of hydroacoustic noise [5].

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