Linear and Nonlinear Methods for Model Reduction

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We consider model reduction methods for the approximation of multivariate analytic functions in the case where the functions depend on infinitely many variables but present a certain anisotropy.

The usual approach to model reduction is to construct a low dimensional linear space and define the approximation as some projection into the latter. However, it's well-known that nonlinear methods, such as adaptive or best n- term approximations, provide improved efficiency. Alternatively, we consider a collection of linear spaces (aka a library) used to approximate locally the target function. All the linear spaces in the library are of dimension considerably smaller than the dimension required for a single space to achieve the same accuracy. While exhibiting a marginal improvement in the approximation of the multivariate functions, it circumvents the inherent exponentially increasing complexity in constructing reduced spaces as their dimension increases.

We first introduce various anisotropic model classes based on Taylor expansions and study their approximation by finite dimensional polynomial spaces described by lower sets. Then, in the framework of parametric PDEs, we present a possible strategy that can be used to build a library and provide an analysis of its performance.