Adaptive low-rank tensor approximation for high dimensional operator equations

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Problems in high spatial dimensions are typically subject to the "curse of dimensionality" which roughly means that the computational work, needed to approximate a given function within a desired target accuracy, increases exponentially in the spatial dimension. A possible remedy is to seek problem dependent dictionaries with respect to which the function possesses sparse approximations. Employing linear combinations of particularly adapted rank-one tensors falls into this category. In this talk we highlight some recent developments centering on the adaptive solution of high dimensional operator equations in terms of stable tensor expansions. Some new concepts related to tensor contractions, tensor recompression, coarsening, and rescaling operators are outlined. Some essential issues are addressed that arise in the convergence and complexity analysis but have been largely ignored when working in a fully discrete setting. In particular, when dealing with high-dimensional diffusion problems, a central obstruction is related to the spectral properties of the underlying operator which is an isomorphism only when acting between spaces that are not endowed with tensor product norms. The theoretical results are illustrated by numerical experiments.

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