An Application of the Randomized Singular Value Decomposition (SVD) to Polynomial and Radial Basis Function (RBF) Approximations

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Abstract

Matrix decompositions have widespread application in scientific computing and numerical analysis. The Singular Value Decomposition (SVD) is of particular interest, due to its applicability in solving rank-deficient and ill-conditioned linear systems, and in solving linear least squares problems. Traditional algorithms for computing the SVD are computationally expensive, sometimes prohibiting their use in numerical approximation. We propose to apply a modern randomized technique for computing the SVD to deterministic approximation problems. Our target approximation problems involve linear approximation with approximants comprised of radial basis functions (RBFs) and polynomials; the matrices arising from such approximants can be rank-deficient or ill-conditioned. Our goal is to explore the interplay of parameters from both the approximants and the randomized SVD algorithm with an eye toward improving cost-accuracy profiles.