Improved Sparse Fourier Transforms for Sparse Spectral Methods

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We study the problem of quickly estimating the best possible k-term nonlinear Fourier approximating for a given function. Randomized sublinear-time Monte Carlo algorithms, which have a small probability of failing to output accurate answers for each input signal, exist for solving this problem. In this paper we present a deterministic approximation scheme with accompanying error guarantees and uniformly bounded sampling requirements. Furthermore, we present a simple technique for reducing the estimation of high-dimensional functions to a related one-dimensional problem. The end result is a robust deterministic Fourier nonlinear approximation method for general functions. Empirical evaluations of our methods demonstrate their efficiency compared to both existing Monte Carlo Fourier methods and standard fast Fourier transform algorithms. Applications of these new algorithms to sparse spectral methods will also be discussed.

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