Low-ranks in computational Fourier analysis

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Abstract

We address the construction of fast algorithms by exploiting local low ranks. While classical fast algorithms rely on structural properties of specific problems, more general problems would not allow for a fast algorithm in infinite precision but often do so when considered for finite accuracy. We discuss the idea of such schemes which uses low rank approximations under certain admissibility conditions and dedicated divide and conquer strategies. Examples are given for specific discretised integral operators including so-called hierarchical matrices for asymptotically smooth kernel functions and butterfly schemes for oscillatory kernels. In particular, this leads to a fast Fourier transform for sparse data with an application in photoacoustic tomography and to a fast evaluation scheme for polynomials in the unit disc.