Fast Algorithms for the Removal of Non-Uniform Motion Blurs

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Images used for medical and scientific purposes are rarely perfect. Imperfections in the imaging system and environmental effects may result in serious degradations in the recorded image. For example, movement of the heart during cardiac imaging produces motion blurs.

Computational methods can be used to remove the blur, provided that the magnitude and direction of the motion is known. If the motion can be described by a single direction with uniform speed, then the deblurring process is equivalent to solving an ill-conditioned linear system where the coefficient matrix is block Toeplitz with Toeplitz blocks. A much more difficult situation arises when objects are moving in different directions at different speeds. In this case the structure of the coefficient matrix is substantially more complicated, and development of efficient algorithms is much more difficult. In this talk we consider images that are degraded by non-uniform motion blurs, describe the structure of the coefficient matrix, and show how this structure can be exploited to efficiently implement iterative image deblurring methods.