An Introduction to Computational Methods for Image Restoration

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Abstract

The restoration of images that have been contaminated by blur and noise is an active area of research in computational mathematics. This talk reviews several methods for this purpose. The deblurring and denoising requires the approximate solution of a linear system of equations, with a large matrix. The matrix models the blurring. For gray-scale images each pixel typically contributes one row and one column to the matrix. Color images give rise to larger systems of equations. The matrices are very ill-conditioned and may be numerically singular. Common solution methods are based on Arnoldi and Lanczos methods for reducing the large linear system of equations to a small one. The solution of the linear systems of equations requires regularization to alleviate difficulties due to ill-conditioning. Regularization replaces the given linear system of equations by a system with a less ill-conditioned matrix. Both linear and non-linear regularization methods are described. The latter give rise to large non-linear systems of equations. This talk discusses iterative methods for gray-scale and color images as well as several regularization methods. Available software will be described.