Symbol approach (for structured matrices) in multigrid with applications in imaging

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We consider the deblurring problem of noisy and blurred images in the case of space invariant point spread functions. The use of appropriate boundary conditions leads to linear systems with structured coefficient matrices related to space invariant operators like Toeplitz, circulants, trigonometric matrix algebras etc. We propose to combine the an algebraic multigrid (which is typical for structured matrices) with the low-pass filtering properties of the classical geometrical multigrid used in a PDEs context or with the Tikhonov regularization. In the first case, using an appropriate smoother, we obtain an iterative regularizing method, while in the second case we obtain an op- timal technique which seems to be robust with respect to the regularization parameter.

In the talk we first review the theoretical ground given by the convergence theory in the case of structured matrices and then we present the adaptation in the case of image restoration problems. More in detail, we will emphasize (both in the theoretical study and in the applications) the role of the generating function in two directions: A) in order to minimize the storage requirements and the complexity of every single iteration, and B) in order to obtain an optimal method, that is an iterative technique whose convergence rate is independent of the size of the involved matrices and depending on some analytical features of the symbol.

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