

Preconditioning For Realistic Image Deblurring Problem

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Given a blurred image and the corresponding blurring operator, we try to restore the original unblurred image. Classically, many assumptions are made for fast image deblurring, such as periodic or neumann boundary conditions and spatially invariant blur. We do not make these assumptions. The boundary conditions we use are directly derived from the blurred images and we name it synthetic boundary conditions. We also do not assume spatial invariance of the blur. The resulting deblurred images are better than those under classical assumptions, but we lose the convenience of some fast well-established algorithms. In this talk, we describe our work to develop effective preconditioners for these very difficult, large scale imaging problems.

References

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Figure 1: LSQR results with reflexive and synthetic boundary conditions on diagonal motion blurred Barbara image.



Original Image



Diagonal motion blur (blur size: 11×11)



Reflexive boundary conditions
(PSNR: 27.0792, rel. error: 0.0928)



Synthetic boundary conditions
(PSNR: 28.9365, rel. error: 0.0750)

Figure 2: Improvement with regularized DCT preconditioning on synthetic boundary conditions.



Original image



Gaussian blur (blur size: 11×11 , std dev: 3)



Synthetic BC without preconditioning
100th iteration
(PSNR: 29.1433, rel. error: 0.0730)



Synthetic BC with preconditioning
25th iteration
(PSNR: 31.3906, rel. error: 0.0571)