A Comparison and Compilation of Spatial Image Priors for Image Deconvolution

Amit Kohli
EE367, Stanford University

Introduction
Image priors are incredibly useful tools for making ill-posed image estimation problems more tractable. It is important to thoroughly test, classify, and organize these priors for various classes of images under different conditions. This treatment of image priors is fundamental for robust and novel image estimation to become an easily usable and intuitive technology that anyone and everyone can use. I specifically implemented spatial smoothness image priors for natural images using the ADMM model.

Results

High Blur

Results

Method

Image Formation Model

\[ b = Cx + \eta \]

Solution format with prior

\[
\min_x \frac{1}{2} \|Cx - b\|_2^2 + \Gamma(x)
\]

TV Prior

\[
\Gamma(x) = |Dx|_1, D = \begin{bmatrix} D_x \\ D_y \end{bmatrix}
\]

Laplacian

\[
\Gamma(x) = |Dx|_1, D = D_{xx} + D_{yy}
\]

Frobenius of Hessian

\[
\Gamma(x) = |H_x x|_F = \sqrt{2Dxx} x
\]

Performance on 24 Kodak Images

Certain priors performed better with different factors:
- Blur Amount
- Noise Amount
- Image Characteristics
- Convergence Time

Conclusion
Combining the priors into a single function proved beneficial:
- Ease of use and testing
- Adaptable to different needs
- Could have simple software integration

References