

UniHIST: Supplementary Material

Xing Mei Weiming Dong Bao-Gang Hu Siwei Lyu

Nov. 14, 2014

Content

- ▶ Complete Results of Pattern Image Denoising
- ▶ Visual Results of Detail-Enhanced Non-Blind Deconvolution

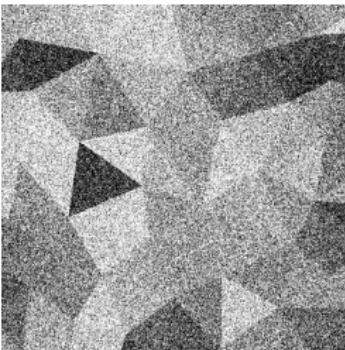
Pattern Image Denoising

- ▶ 8 pattern images (collected from the internet)
- ▶ Images are degraded with a strong Gaussian noise ($\sigma^2 = 0.1$).
- ▶ 4 denoising methods are tested:
 - ▶ Non-Local Dual Denoising (NLDD) [3]
 - ▶ NLDD + UniHIST (Our Method)
 - ▶ Block-Matching and 3D Filtering (BM3D) [2]
 - ▶ BM3D + UniHIST (Our Method)

Pattern Image Denoising: Example 1



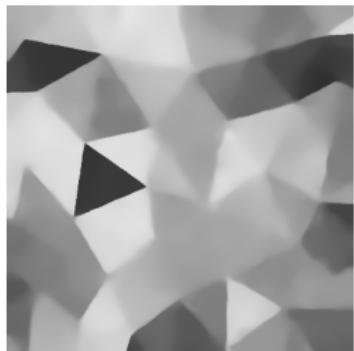
Pattern Image



Noisy Observation



NLDD



NLDD+UniHIST



BM3D

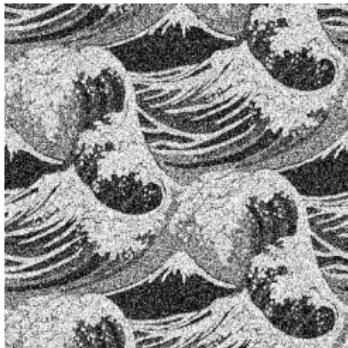


BM3D+UniHIST

Pattern Image Denoising: Example 2



Pattern Image



Noisy Observation



NLDD



NLDD+UniHIST

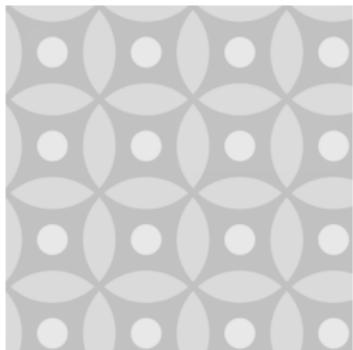


BM3D

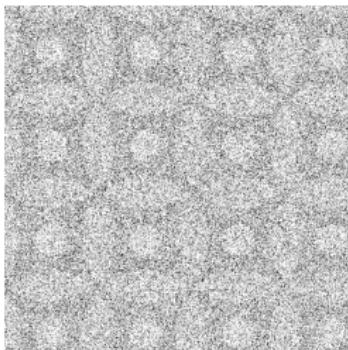


BM3D+UniHIST

Pattern Image Denoising: Example 3



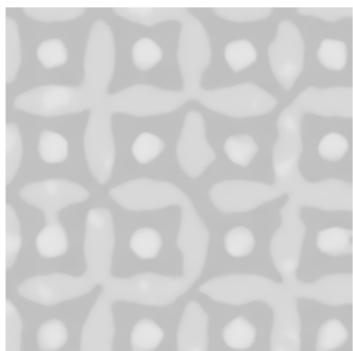
Pattern Image



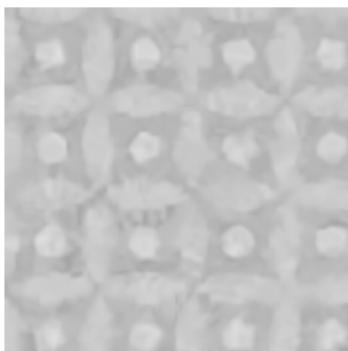
Noisy Observation



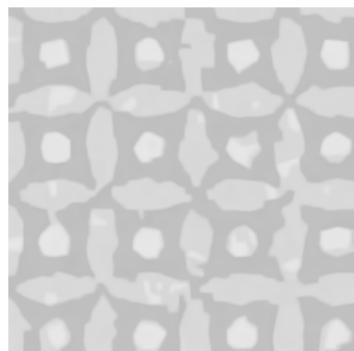
NLDD



NLDD+UniHIST



BM3D



BM3D+UniHIST

Pattern Image Denoising: Example 4



Pattern Image



Noisy Observation



NLDD



NLDD+UniHIST

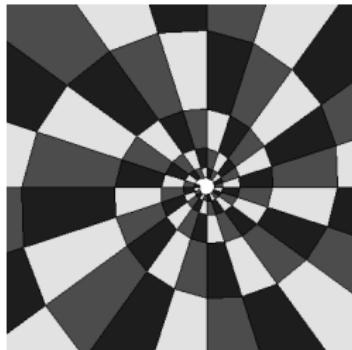


BM3D

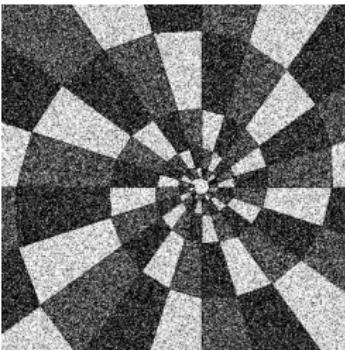


BM3D+UniHIST

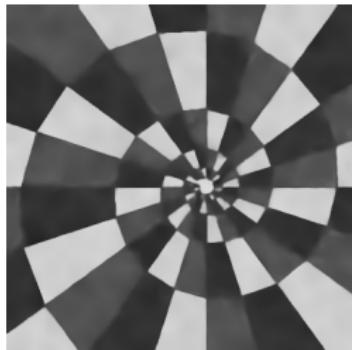
Pattern Image Denoising: Example 5



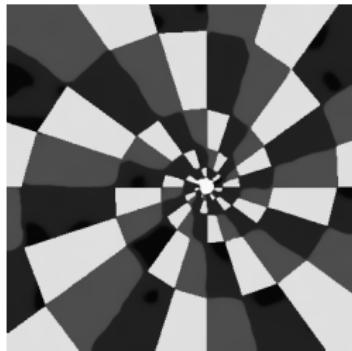
Pattern Image



Noisy Observation



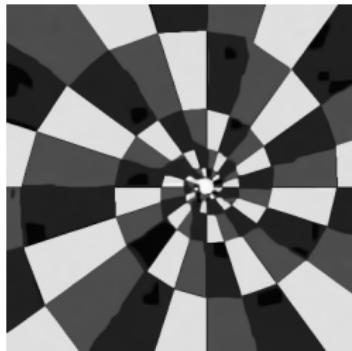
NLDD



NLDD+UniHIST



BM3D

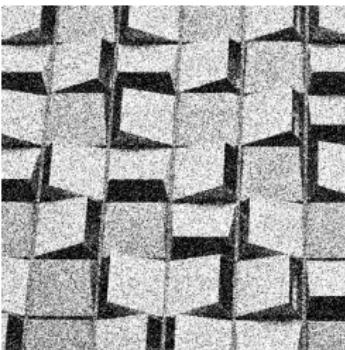


BM3D+UniHIST

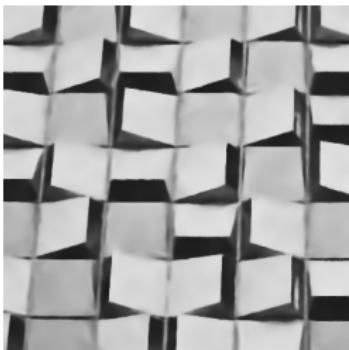
Pattern Image Denoising: Example 6



Pattern Image



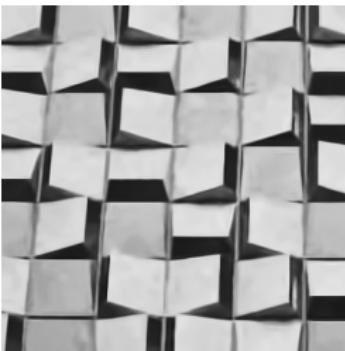
Noisy Observation



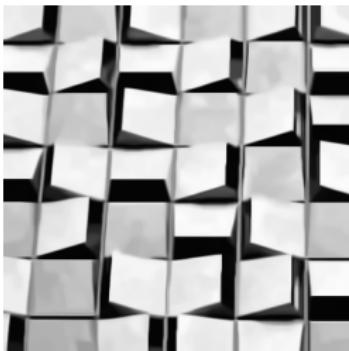
NLDD



NLDD+UniHIST

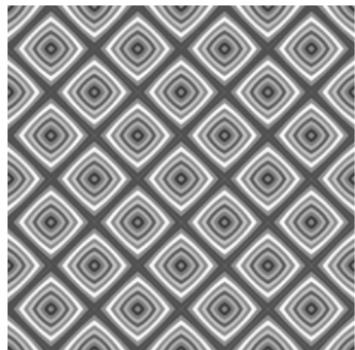


BM3D

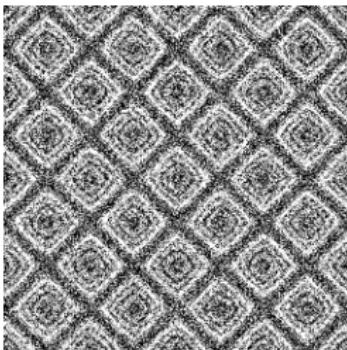


BM3D+UniHIST

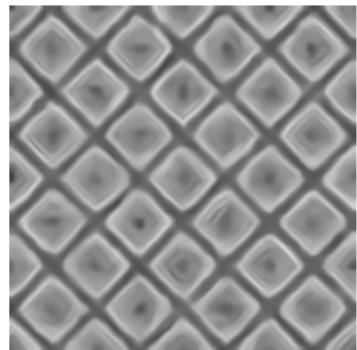
Pattern Image Denoising: Example 7



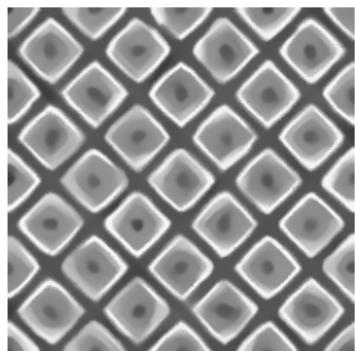
Pattern Image



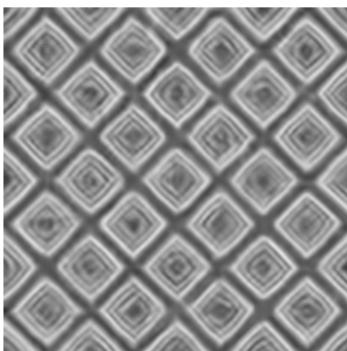
Noisy Observation



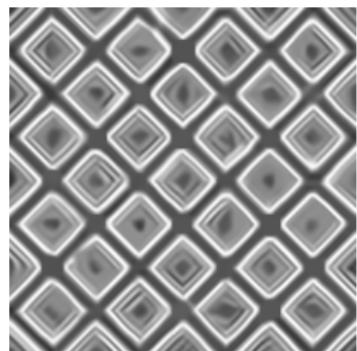
NLDD



NLDD+UniHIST

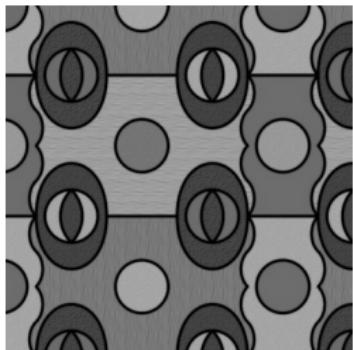


BM3D

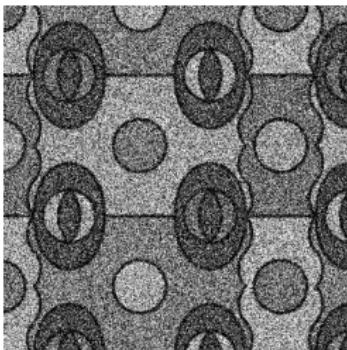


BM3D+UniHIST

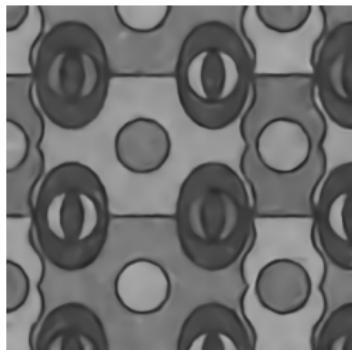
Pattern Image Denoising: Example 8



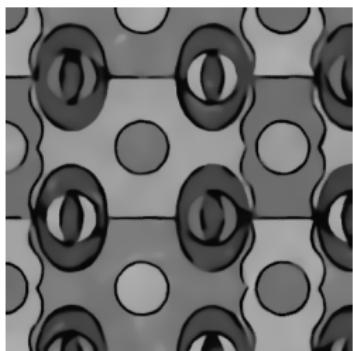
Pattern Image



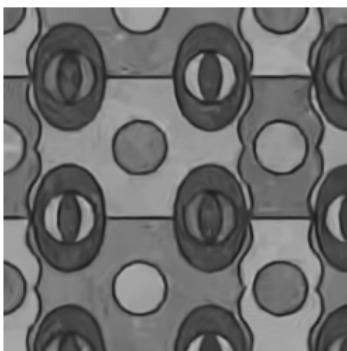
Noisy Observation



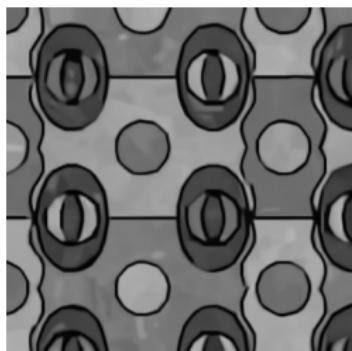
NLDD



NLDD+UniHIST

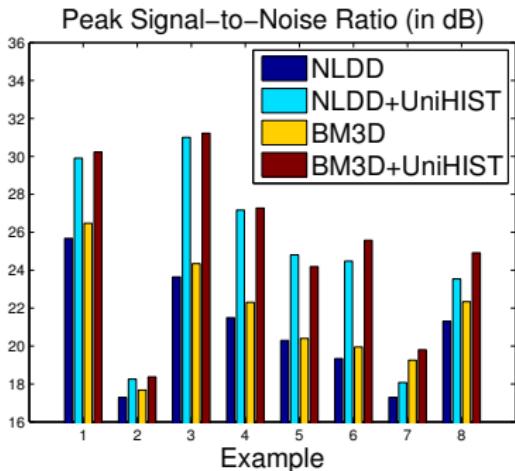


BM3D



BM3D+UniHIST

Pattern Image Denoising: PSNR and SSIM



Average PSNR

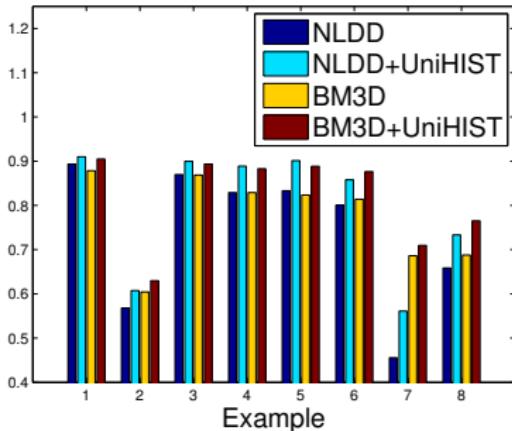
NLDD: 20.79dB

NLDD+UniHIST: 24.65dB

BM3D: 21.59dB

BM3D+UniHIST: 25.20dB

Structural Similarity Index



Average SSIM

NLDD: 0.74

NLDD+UniHIST: 0.80

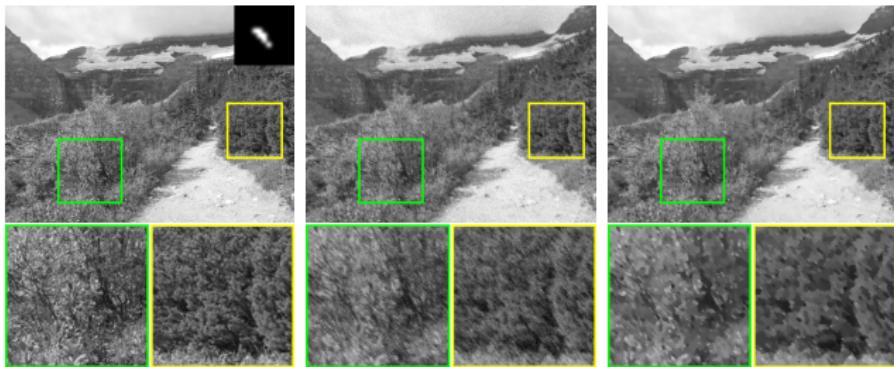
BM3D: 0.77

BM3D+UniHIST: 0.82

Detail-Enhanced Non-Blind Deconvolution

- ▶ 6 images from [1]
- ▶ Images are degraded with various blur kernels and different Gaussian noises.
- ▶ Visual output results of 4 non-blind deconvolution methods:
 - ▶ The hyper-Laplacian based deconvolution method
 - ▶ The Iterative Distribution Reweighting method (IDR) [1]
 - ▶ The Expected Patch Log Likelihood method (EPLL) [4]
 - ▶ EPLL + UniHIST (Our Method)

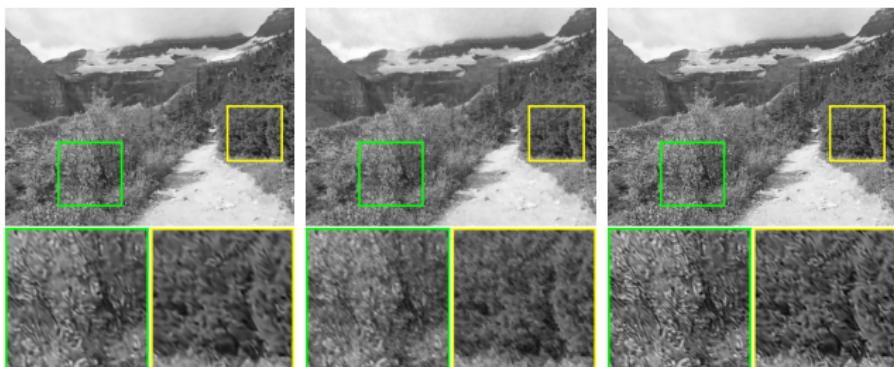
Detail-Enhanced Non-Blind Deconvolution: Example 1



Original Image

Degraded Image

hyper-Laplacian

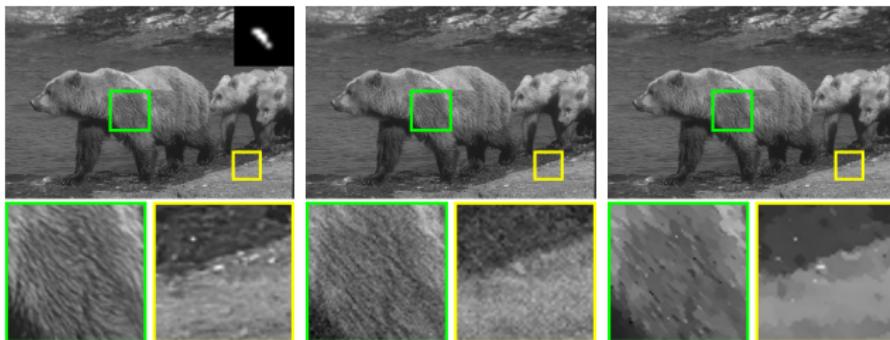


EPLL

IDR

EPLL+UniHIST

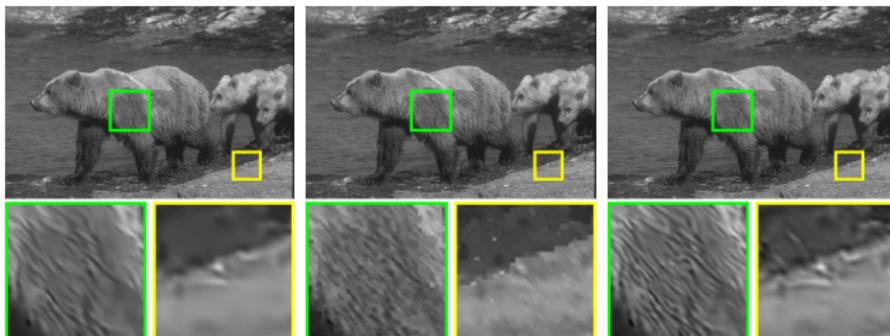
Detail-Enhanced Non-Blind Deconvolution: Example 2



Original Image

Degraded Image

hyper-Laplacian



EPLL

IDR

EPLL+UniHIST

Detail-Enhanced Non-Blind Deconvolution: Example 3



Original Image

Degraded Image

hyper-Laplacian

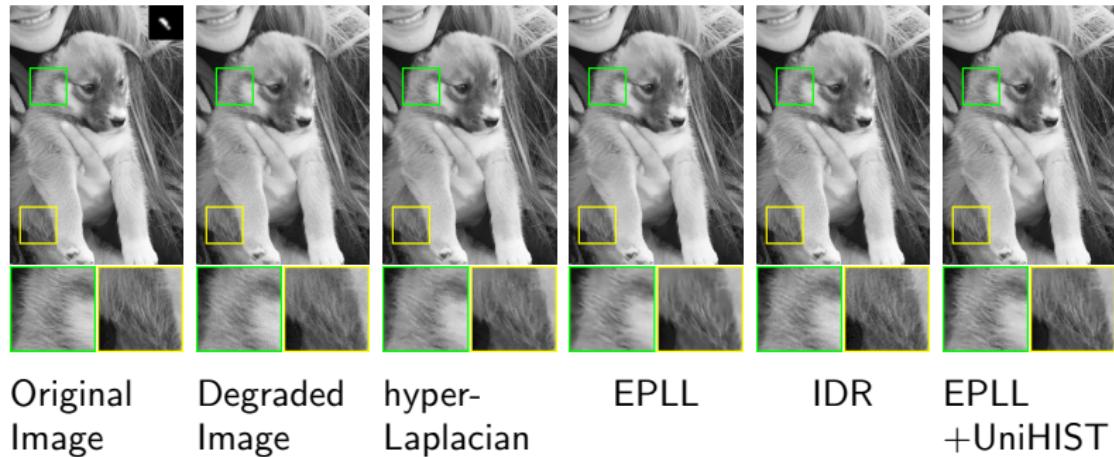


EPLL

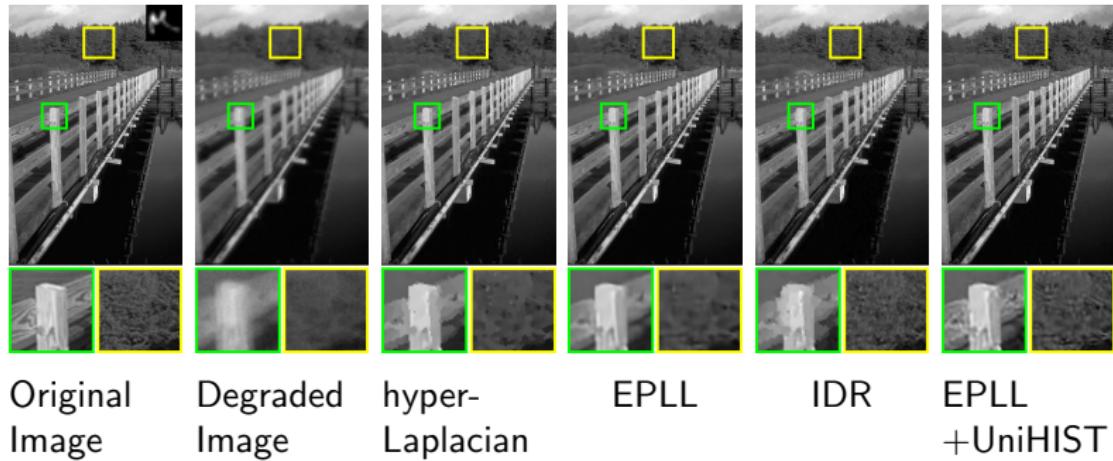
IDR

EPLL+UniHIST

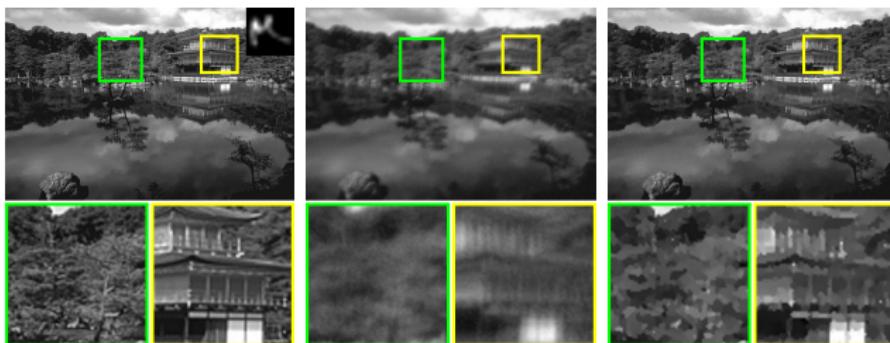
Detail-Enhanced Non-Blind Deconvolution: Example 4



Detail-Enhanced Non-Blind Deconvolution: Example 5



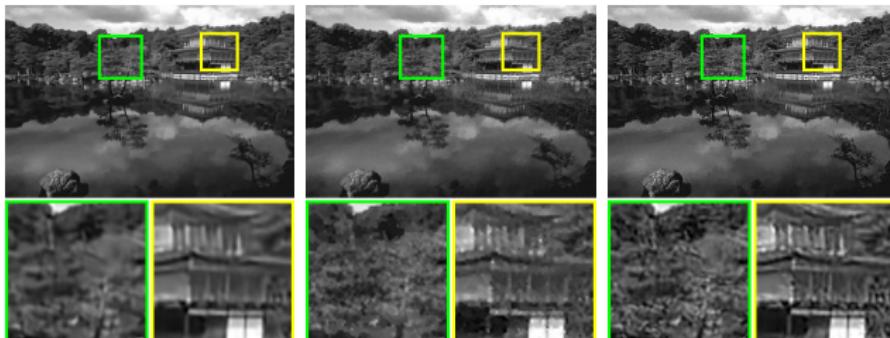
Detail-Enhanced Non-Blind Deconvolution: Example 6



Original Image

Degraded Image

hyper-Laplacian



EPLL

IDR

EPLL+UniHIST

 T. S. Cho, C. L. Zitnick, N. Joshi, S. B. Kang, R. Szeliski, and W. T. Freeman.

Image restoration by matching gradient distributions.

TPAMI, 34(4):683–694, 2012.

 K. Dabov, A. Foi, V. Katkovnik, and K. Egiazarian.

Image denoising by sparse 3-d transform-domain collaborative filtering.

TIP, 16(8):2080–2095, 2007.

 N. Pierazzo, M. Lebrun, M. E. Rais, J. M. Morel, and G. Facciolo.

Non-local dual denoising.

In *ICIP*, 2014.

 D. Zoran and Y. Weiss.

From learning models of natural image patches to whole image restoration.

In *ICCV*, pages 479–486, 2011.