

Non-Uniform Blind Deblurring by Reblurring (Supplementary Material)

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<http://www.wisdom.weizmann.ac.il/~vision/DeblurringByReblurring>

We evaluated our blind deblurring algorithm on both real blurry images and synthetically blurred ones. For evaluation on real blurry images, we used the database used by [11,18] and augmented it with a few more images with *severe* (unknown) blur that we downloaded from the Internet.

For evaluation on synthetically blurred images, we used the database created by [18] that included different non-uniform blur fields (motion of up to 16 pixels) applied to 5 different sharp images. We extended the evaluation to a wider range of blur-fields (we added both uniform and non-uniform blur fields, stronger blurs with motions of up to 38 pixels and more image types).

Results on all the above-mentioned images were compared to the CNN-based method of [18] (for which code is available, and is also considered the current state-of-the-art). We split the results into three categories: (i) Real blurry images, (ii) synthetically blurred images with moderate blur and (iii) synthetically blurred images with severe blur.

For the synthetically blurred images (for which we have ground truth) we further provide the PSNR and SSIM of the reconstructed images, as well as the average *End Point Error* (EPE) of the estimated blur field, measured in image pixels. The EPE is defined as $EPE = \sqrt{(u - u_{gt})^2 + (v - v_{gt})^2}$, where u_{gt}, v_{gt} denote the ground truth flow.

Run parameters: When producing the results below we used the following run parameters:

- The coarsest image-scale was 0.1 of the original image size.
- Patch size for blur field estimation (in coarsest level): 21×21 pixels.
- We increased the patch size proportionally to the increase in image size (scale), but did not surpass 45×45 .
- Maximum blur kernel magnitude was 38 pixels (this is a parameter to the algorithm). The blur kernels space was uniformly sampled at half pixel gaps.
- The balance between the data and prior terms in Eq. 13 was set to $\sim 30:1$, in favor of the data term.

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Real blurry image (#1)



Blurry image



Our result



Result of [19]

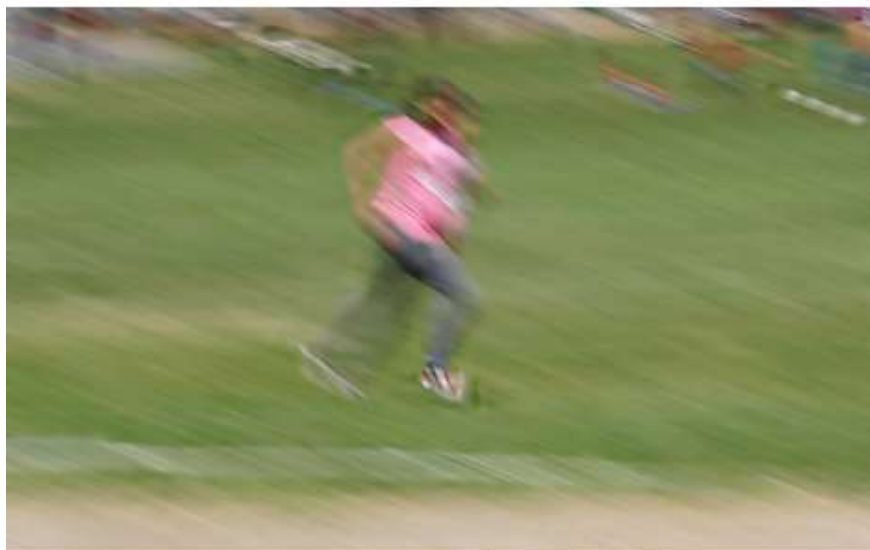
Real blurry image (#2)



Blurry image



Our result



Result of [19]

Real blurry image (#3)



Blurry image



Our result



Result of [19]

Real blurry image (#4)



Blurry image



Our result



Result of [19]

Real blurry image (#5)



Blurry image



Our result



Result of [19]

Real blurry image (#6)



Blurry image

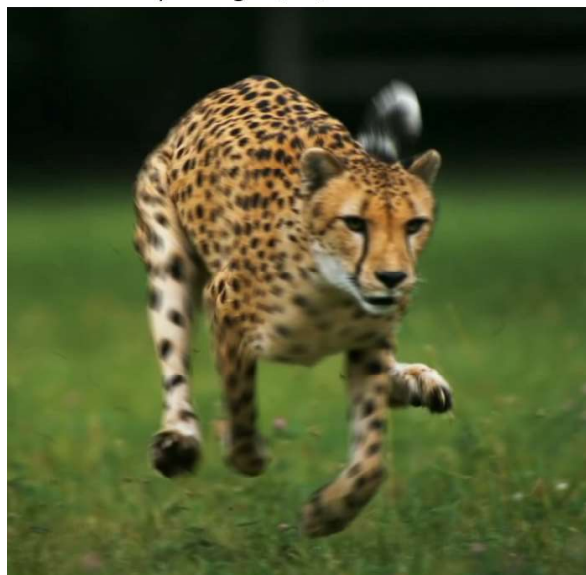


Our result



Result of [19]

Real blurry image (#7)



Blurry image



Our result



Result of [19]

Real blurry image (#8)



Blurry image



Our result



Result of [19]

Real blurry image (#9)



Blurry image



Our result



Result of [19]

Real blurry image (#10)



Blurry image



Our result



Result of [19]

Real blurry image (#11)



Blurry image

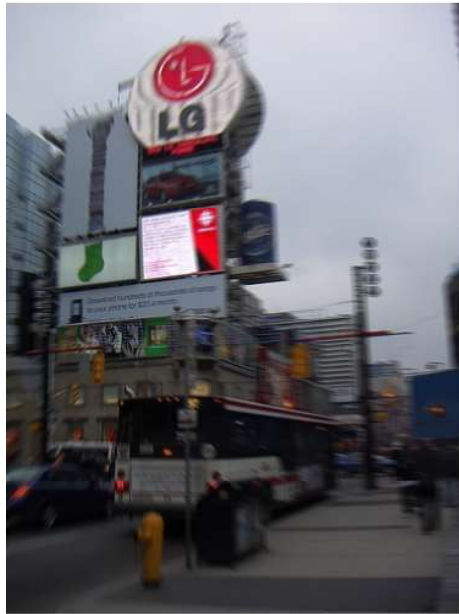


Our result



Result of [19]

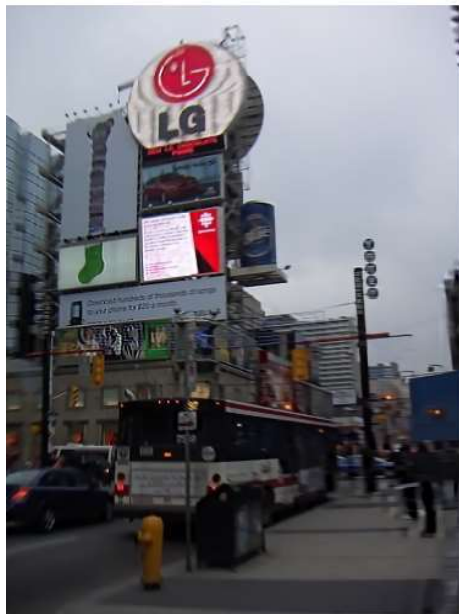
Synthetic image (#1) (moderate blur)



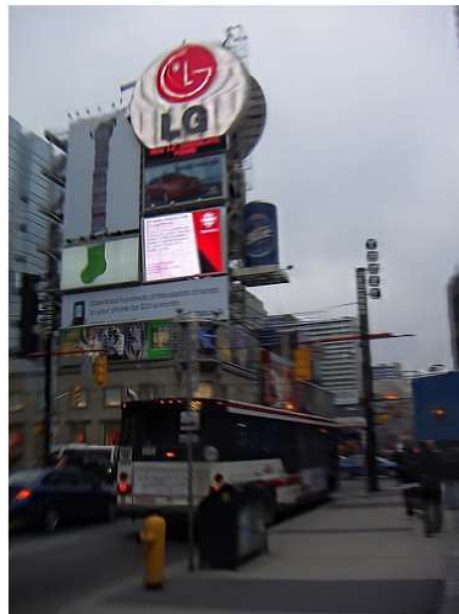
Blurry image



GT sharp image



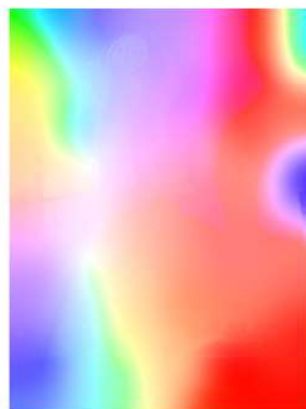
Our result. PSNR: 26.29 SSIM: 0.837



Result of [19]. PSNR: 25.97 SSIM: 0.821



GT blur field

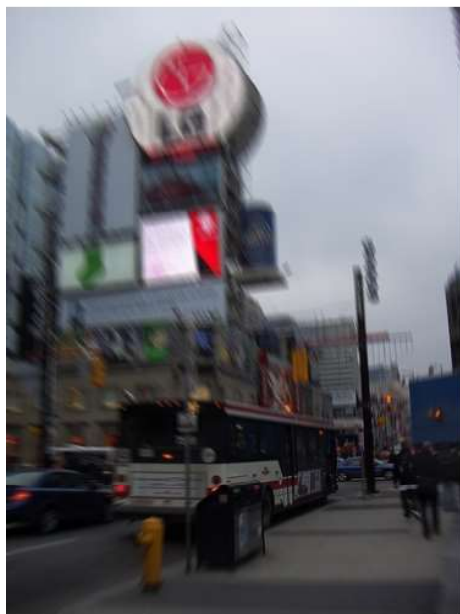


Ours. Average EPE: 1.92



[19]. Average EPE: 2.61

Synthetic image (#2) (moderate blur)



Blurry image



GT sharp image



Our result. PSNR: 25.44 SSIM: 0.801



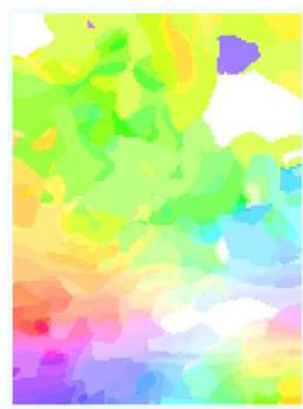
Result of [19]. PSNR: 23.41 SSIM: 0.739



GT blur field



Ours. Average EPE: 1.65



[19]. Average EPE: 3.67

Synthetic image (#3) (moderate blur)



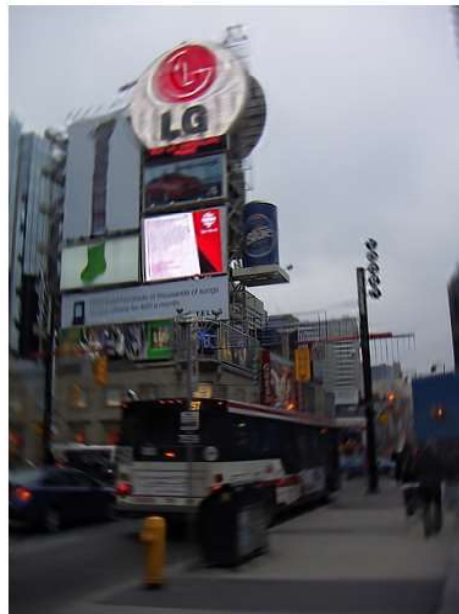
Blurry image



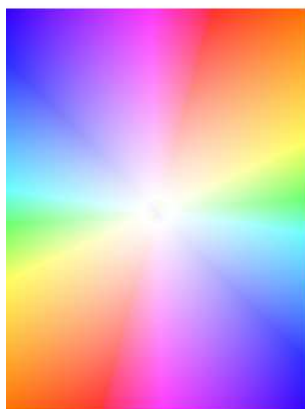
GT sharp image



Our result. PSNR: 26.27 SSIM: 0.833



Result of [19]. PSNR: 25.51 SSIM: 0.804



GT blur field



Ours. Average EPE: 1.41



[19]. Average EPE: 2.85

Synthetic image (#4) (moderate blur)



Blurry image



GT sharp image



Our result. PSNR: 21.84 SSIM: 0.702



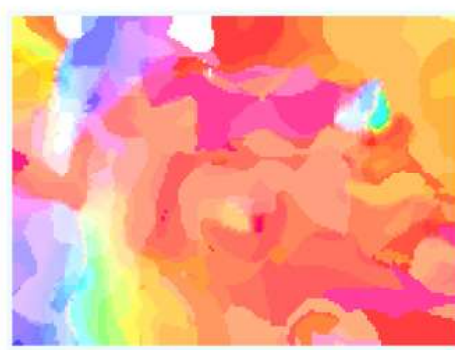
Result of [19]. PSNR: 21.88 SSIM: 0.680



GT blur field



Ours. Average EPE: 3.26



[19]. Average EPE: 3.79

Synthetic image (#5) (moderate blur)



Blurry image



GT sharp image



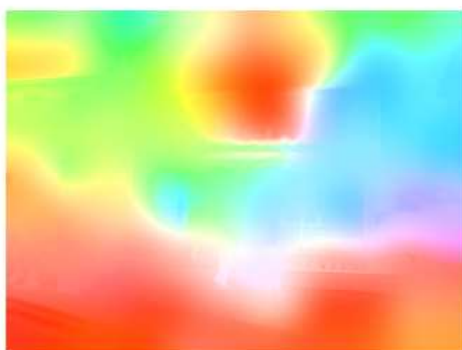
Our result. PSNR: 23.05 SSIM: 0.712



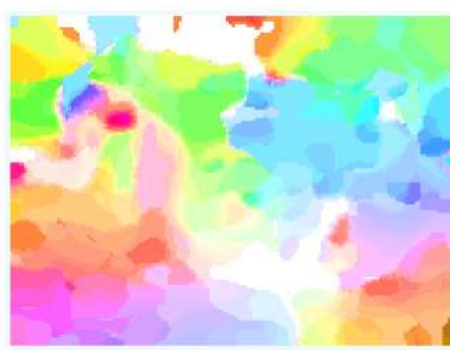
Result of [19]. PSNR: 23.13 SSIM: 0.707



GT blur field



Ours. Average EPE: 3.57



[19]. Average EPE: 3.22

Synthetic image (#6) (moderate blur)



Blurry image



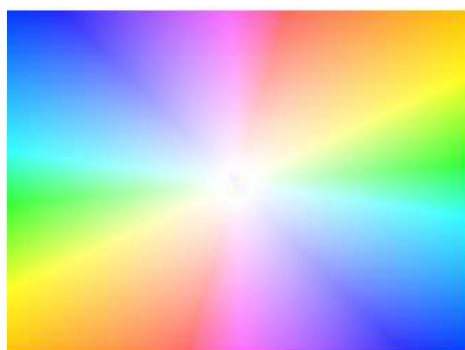
GT sharp image



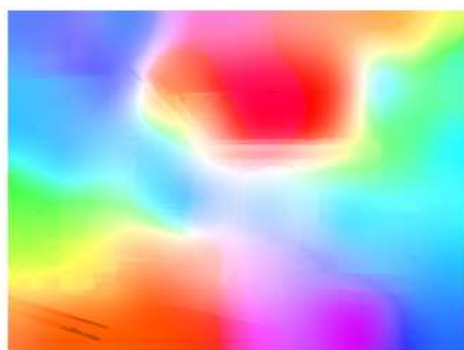
Our result. PSNR: 22.45 SSIM: 0.693



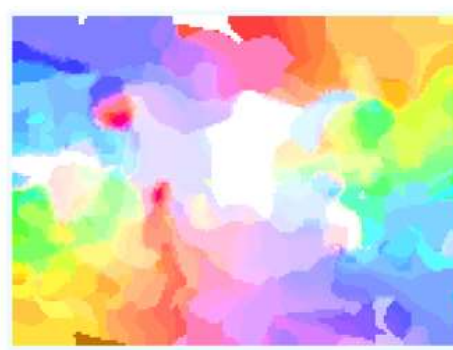
Result of [19]. PSNR: 22.38 SSIM: 0.687



GT blur field



Ours. Average EPE: 3.19



[19]. Average EPE: 3.22

Synthetic image (#7) (moderate blur)



Blurry image



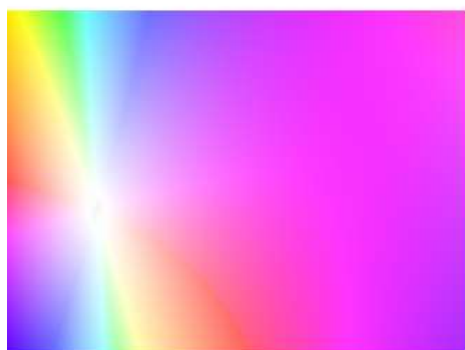
GT sharp image



Our result. PSNR: 25.04 SSIM: 0.764



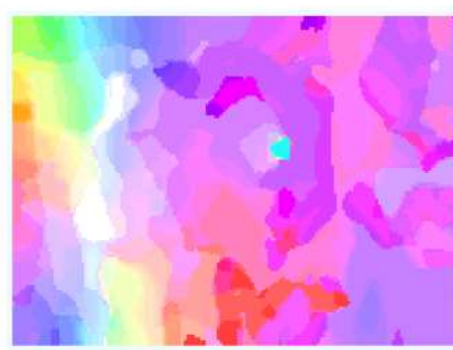
Result of [19]. PSNR: 23.35 SSIM: 0.711



GT blur field



Ours. Average EPE: 2.09



[19]. Average EPE: 3.21

Synthetic image (#8) (moderate blur)



Blurry image



GT sharp image



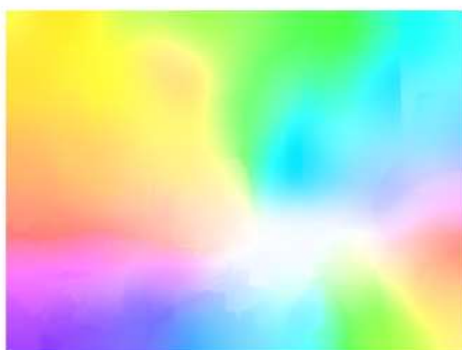
Our result. PSNR: 26.96 SSIM: 0.814



Result of [19]. PSNR: 25.53 SSIM: 0.789



GT blur field



Ours. Average EPE: 1.62



[19]. Average EPE: 2.64

Synthetic image (#9) (moderate blur)



Blurry image



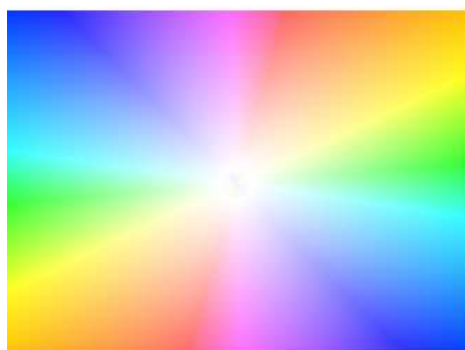
GT sharp image



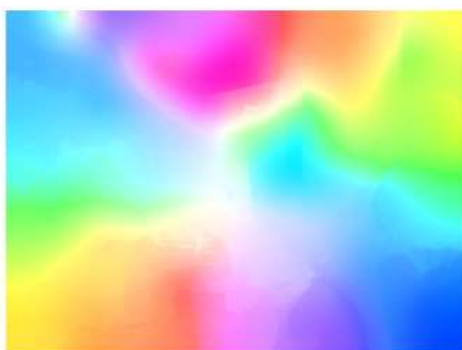
Our result. PSNR: 25.72 SSIM: 0.793



Result of [19]. PSNR: 24.76 SSIM: 0.775



GT blur field



Ours. Average EPE: 2.11



[19]. Average EPE: 2.55

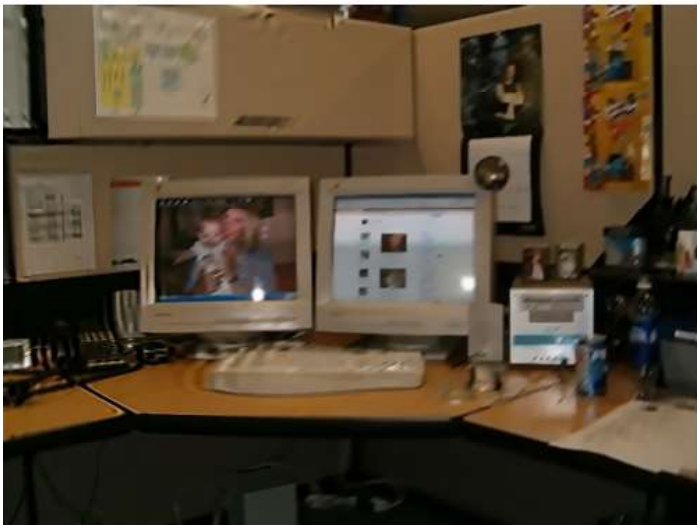
Synthetic image (#10) (moderate blur)



Blurry image



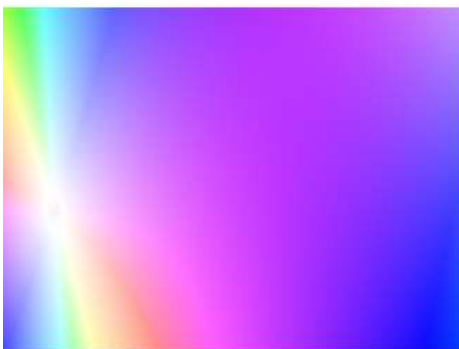
GT sharp image



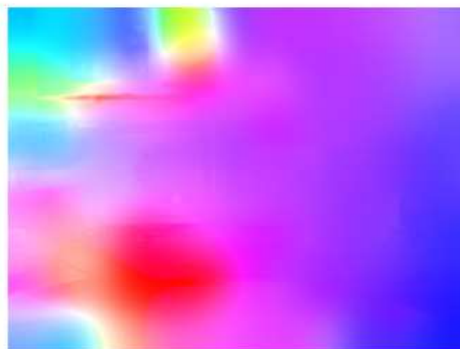
Our result. PSNR: 26.61 SSIM: 0.801



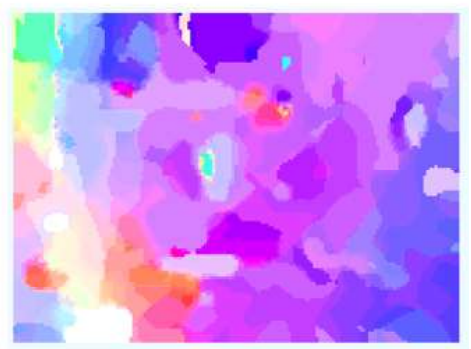
Result of [19]. PSNR: 24.57 SSIM: 0.737



GT blur field



Ours. Average EPE: 2.49



[19]. Average EPE: 3.22

Synthetic image (#11) (moderate blur)



Blurry image



GT sharp image



Our result. PSNR: 26.15 SSIM: 0.799



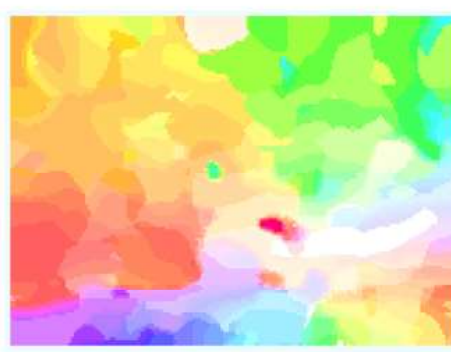
Result of [19]. PSNR: 26.84 SSIM: 0.805



GT blur field



Ours. Average EPE: 3.12



[19]. Average EPE: 2.90

Synthetic image (#12) (moderate blur)



Blurry image



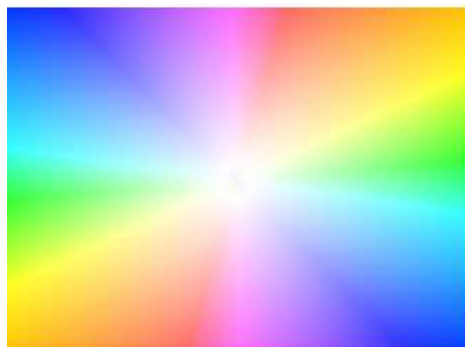
GT sharp image



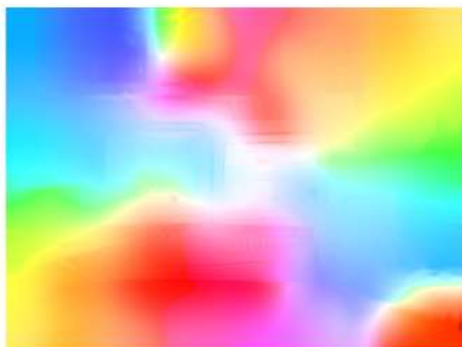
Our result. PSNR: 26.41 SSIM: 0.809



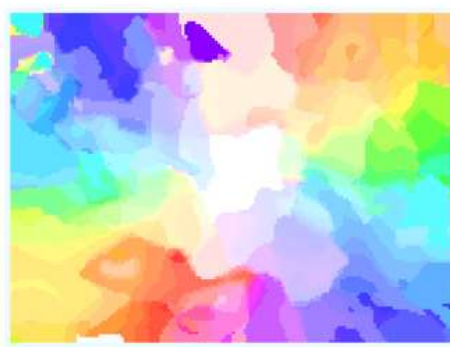
Result of [19]. PSNR: 26.25 SSIM: 0.798



GT blur field



Ours. Average EPE: 2.93



[19]. Average EPE: 2.98

Synthetic image (#13) (moderate blur)



Blurry image



GT sharp image



Our result. PSNR: 24.88 SSIM: 0.693



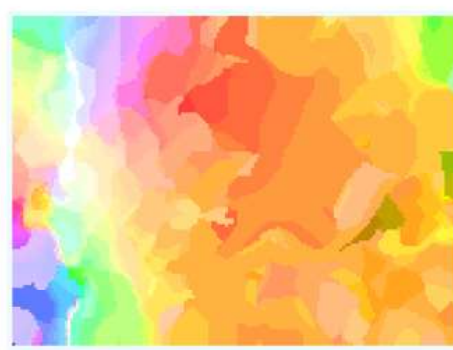
Result of [19]. PSNR: 23.86 SSIM: 0.642



GT blur field



Ours. Average EPE: 1.41



[19]. Average EPE: 2.78

Synthetic image (#14) (moderate blur)



Blurry image



GT sharp image



Our result. PSNR: 26.63 SSIM: 0.747



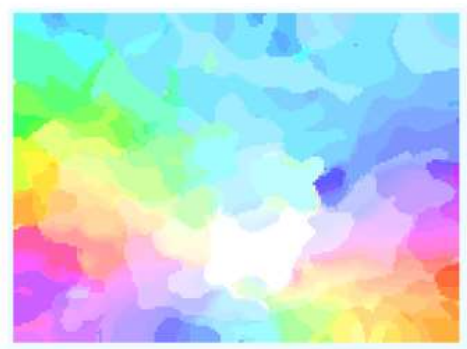
Result of [19]. PSNR: 25.85 SSIM: 0.727



GT blur field



Ours. Average EPE: 1.64



[19]. Average EPE: 2.16

Synthetic image (#15) (moderate blur)



Blurry image



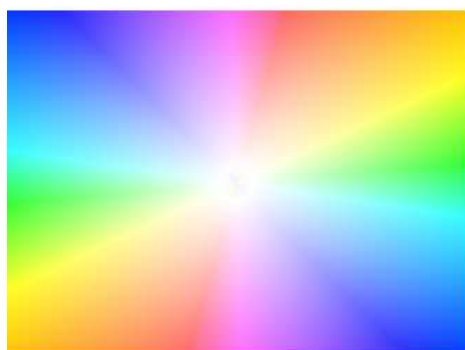
GT sharp image



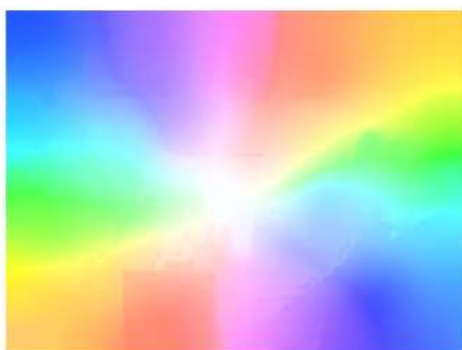
Our result. PSNR: 26.31 SSIM: 0.740



Result of [19]. PSNR: 25.18 SSIM: 0.697



GT blur field

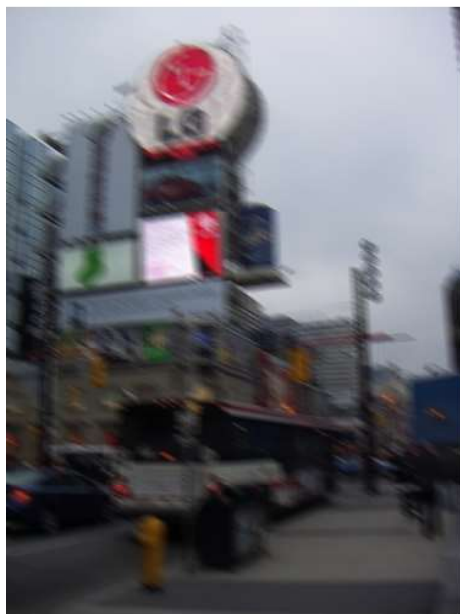


Ours. Average EPE: 1.04



[19]. Average EPE: 2.60

Synthetic image (#16) (moderate blur)



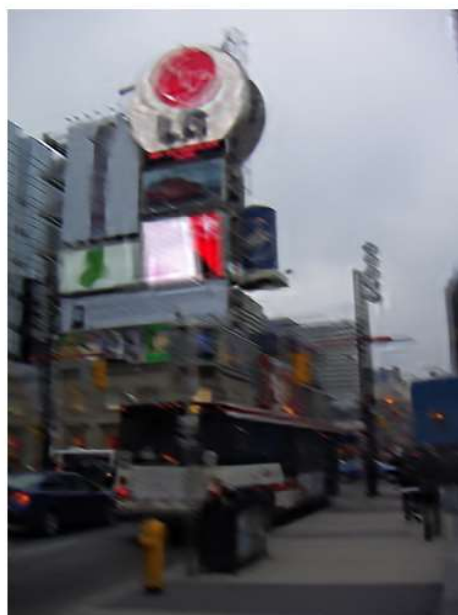
Blurry image



GT sharp image



Our result. PSNR: 25.22 SSIM: 0.777



Result of [19]. PSNR: 22.86 SSIM: 0.683



GT blur field



Ours. Average EPE: 1.16



[19]. Average EPE: 3.12

Synthetic image (#17) (moderate blur)



Blurry image



GT sharp image



Our result. PSNR: 22.19 SSIM: 0.658



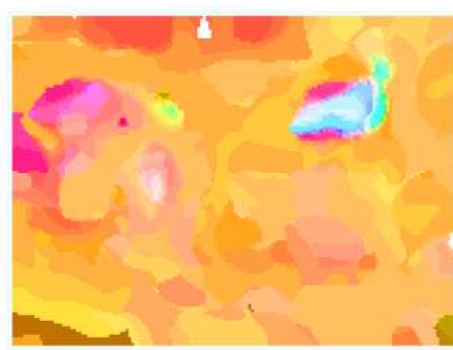
Result of [19]. PSNR: 21.46 SSIM: 0.596



GT blur field



Ours. Average EPE: 2.47



[19]. Average EPE: 3.38

Synthetic image (#18) (moderate blur)



Blurry image



GT sharp image



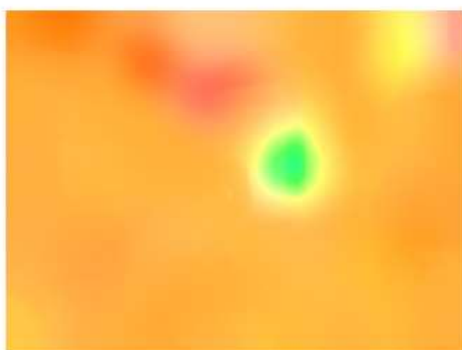
Our result. PSNR: 25.32 SSIM: 0.749



Result of [19]. PSNR: 23.03 SSIM: 0.684



GT blur field



Ours. Average EPE: 1.20



[19]. Average EPE: 2.53

Synthetic image (#19) (moderate blur)



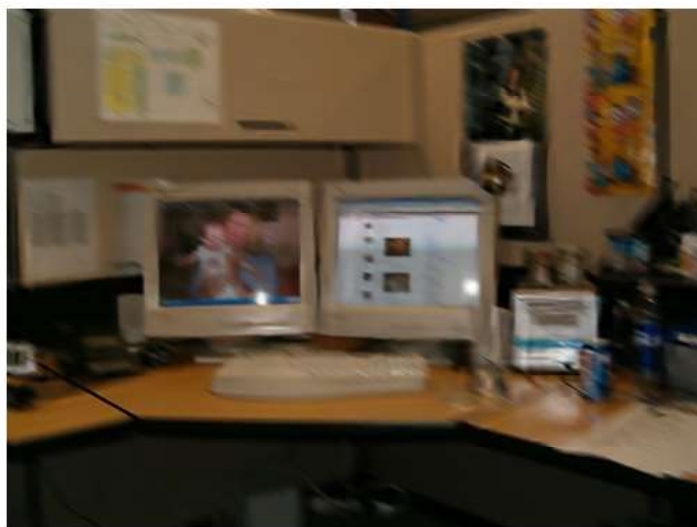
Blurry image



GT sharp image



Our result. PSNR: 26.34 SSIM: 0.781



Result of [19]. PSNR: 24.47 SSIM: 0.708



GT blur field



Ours. Average EPE: 1.80



[19]. Average EPE: 2.97

Synthetic image (#20) (moderate blur)



Blurry image



GT sharp image



Our result. PSNR: 25.07 SSIM: 0.683



Result of [19]. PSNR: 23.78 SSIM: 0.619



GT blur field



Ours. Average EPE: 0.87



[19]. Average EPE: 2.32

Synthetic image (#21) (moderate blur)



Blurry image



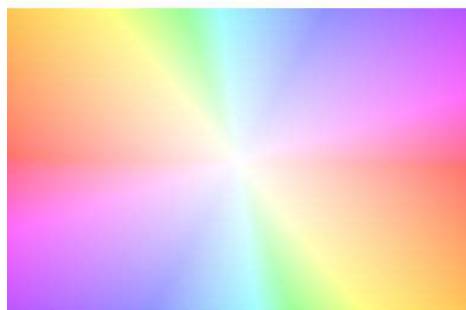
GT sharp image



Our result. PSNR: 22.65 SSIM: 0.922



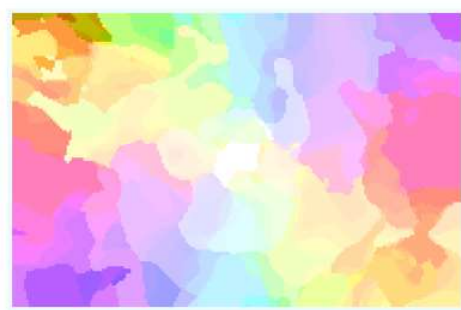
Result of [19]. PSNR: 20.53 SSIM: 0.869



GT blur field



Ours. Average EPE: 0.97



[19]. Average EPE: 1.90

Synthetic image (#1) (severe blur)



Blurry image



GT sharp image



Our result. PSNR: 20.32 SSIM: 0.693



Result of [19]. PSNR: 23.03 SSIM: 0.707



GT blur field

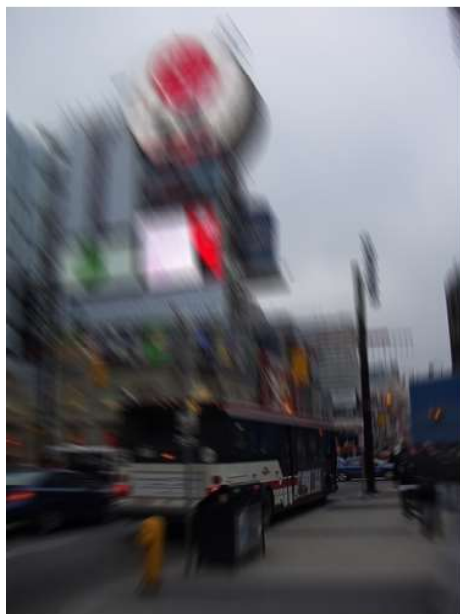


Ours. Average EPE: 5.80



[19]. Average EPE: 6.16

Synthetic image (#2) (severe blur)



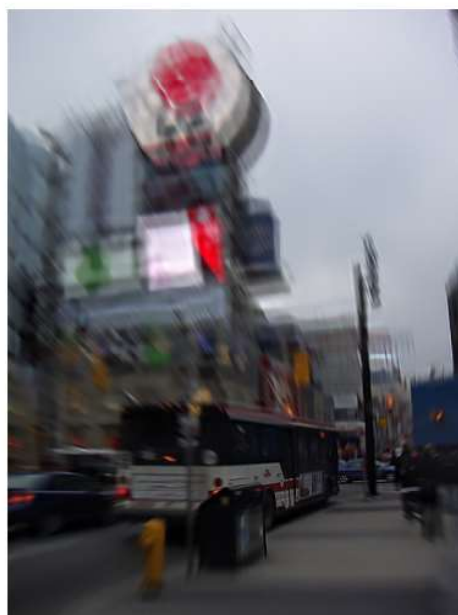
Blurry image



GT sharp image



Our result. PSNR: 23.71 SSIM: 0.725



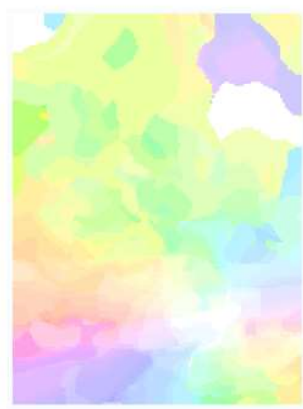
Result of [19]. PSNR: 20.71 SSIM: 0.618



GT blur field

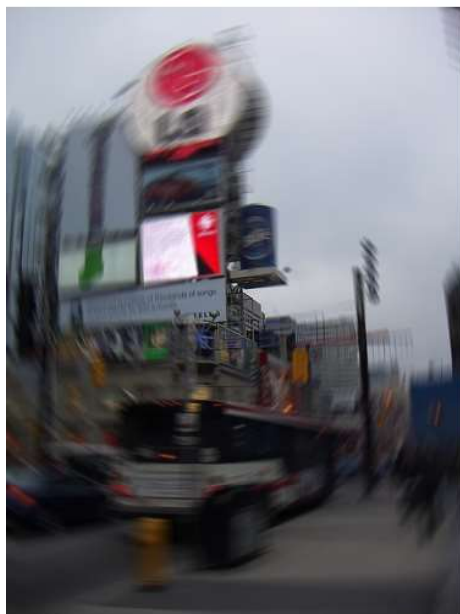


Ours. Average EPE: 4.84



[19]. Average EPE: 11.46

Synthetic image (#3) (severe blur)



Blurry image



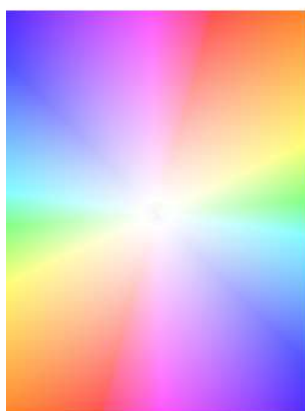
GT sharp image



Our result. PSNR: 24.01 SSIM: 0.751



Result of [19]. PSNR: 22.62 SSIM: 0.675



GT blur field



Ours. Average EPE: 3.55



[19]. Average EPE: 8.62

Synthetic image (#4) (severe blur)



Blurry image



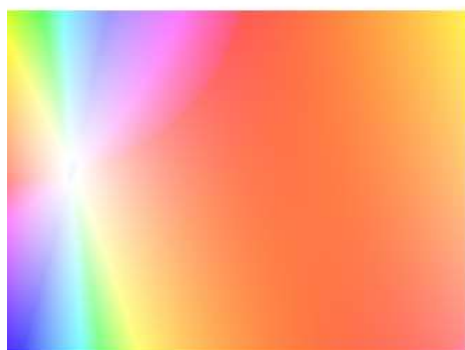
GT sharp image



Our result. PSNR: 21.30 SSIM: 0.642



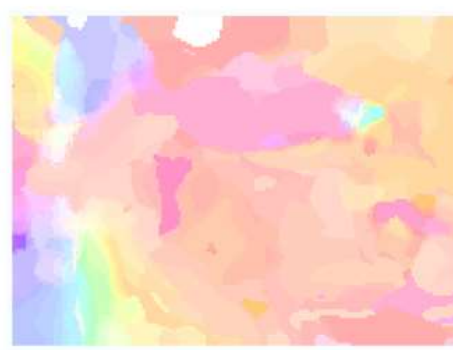
Result of [19]. PSNR: 19.71 SSIM: 0.546



GT blur field



Ours. Average EPE: 5.04



[19]. Average EPE: 11.93