HW3

Moneish Kumar

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1 Bilateral filtering

The Difference image is calculated with the original lamp_ambient.png and all comparisions are made on the basis of that.

1.1 Implement bilateral filtering

Instead of using pixel size for the blur kernel I have used the following way to implement it , $cv2.GaussianBlur(< image >, ksize = (0, 0), sigmaX = gamma\_s)$ and I have varied the gamma s in the range [0, 0.5] instead of [1, 64].

Parameters used:

```
gamma_s = 0.25
gamma_r = 0.05
```

Figure 1: (Left) Image is the difference of the piecewise bilateral output with the lamp_ambient.png and (Right) is the output image of piecewise bilateral.

In the difference image we can see that only edges are visibile and the grainy noise in the ambient image is reduced.

1.2 Implement joint-bilateral filtering

Parameters used:

```
gamma_s = 0.15
gamma_r = 0.10
```

In the difference image we can see edges are visibile, unline bilateral filterring we see that that the blur is better on the areas surrounding the edges and the noise is reduced more than in the case of bilateral filtering.

Figure 2: (Left) Image is the difference of the joint bilateral output with the lamp_ambient.png and (Right) is the output image of joint bilateral.

1.3 Implement detail transfer

Parameters used:

```
gamma_s = 0.15
gamma_r = 0.05
```

Figure 3: (Left) Image is the difference of the detail transfer output with the lamp_ambient.png and (Right) is the output image of detail transfer.

In the difference image contains the edges and around the edges we see that the areas of shadows and lights are also better visible. This image has better details around such areas as can be seen in the right image.

1.4 Implement shadow and specularity masking

Parameters used:

```
gamma_s = 0.25
gamma_r = 0.15
```

Figure 4: (Left) Image is the difference of the piecewise bilateral output with the lamp_ambient.png and (Right) is the output image of piecewise bilateral.

Apart from all the places in detail transfer, this method also has certain differences in regions with shadows caused due to the flash.

2 Gradient-domain processing

I experimented with various values of sigma and tau. Figure 5 is obtained with values sigma = 10 and tau = 0.6.

Figure 6 shows the output with various border conditions.

The final image can be seen in Figure 7.

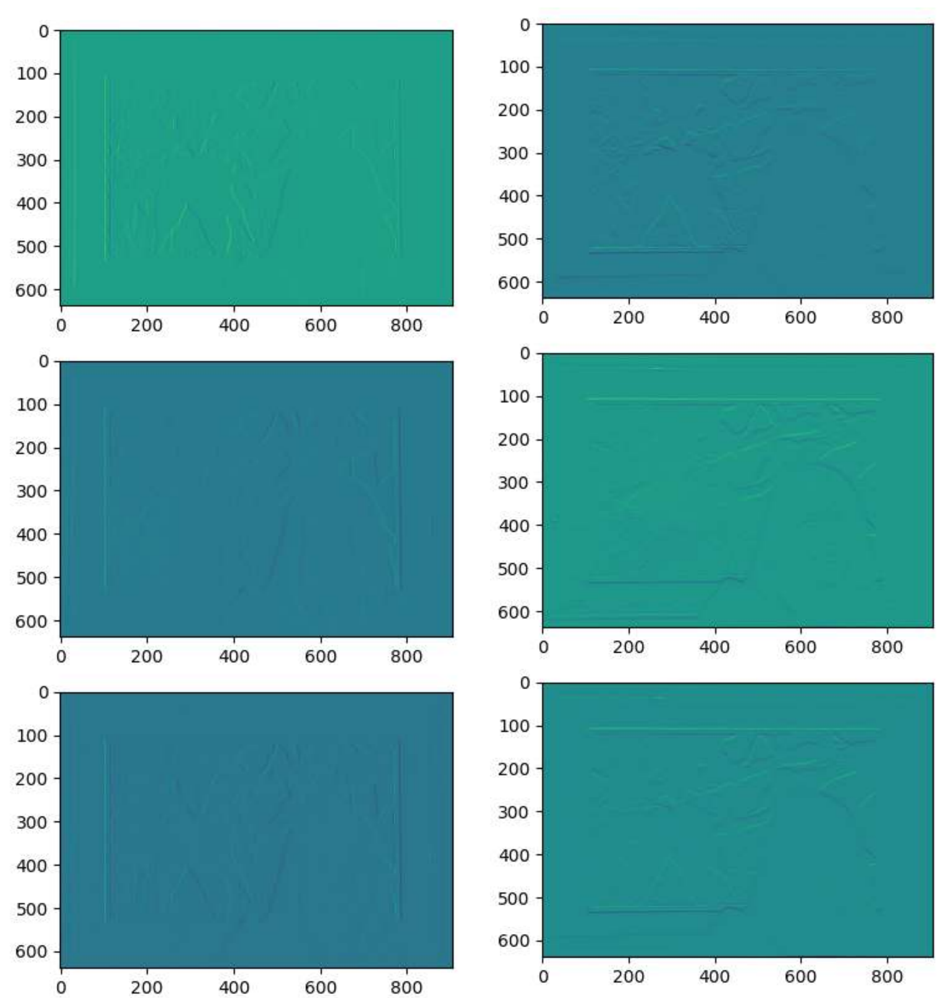

Figure 5: Each row contains the x and y gradients for the R channel of the following: (Top) Δa, (Middle) $\Delta\Phi^{|}$, (Bottom) $\Delta\Phi^{*}$

Figure 6: From left the figure shows the output with with border conditions got via 1) ambient image, 2) average of ambient and flash image and 3) flash image.

Figure 7: Final Image with sigma = 10 and tau = 0.6

Figure 8: From left the figure shows 1) Flash Image, 2) Ambient Image and 3) Final image with detail transfer.

3 Capture your own flash/no-flash pairs

Figure 8 shows the denoising based on bilateral filtering.

Figure 9 shows the difference between them better.

Figure 10 shows the gradient based intergradtion on flash/ no flash image.

Figure 9: Left image shows a zoom in version of the text in the Ambient images and the right image shows the zoomed in version of the same text in the composite images. The text is much clearer in the composite image.

Figure 10: From the left 1) image with flash, 2) Ambient light image 3) Output of the gradient field algorithm.