ASSIGNMENT 3

15663 Computational Photograpy Fall 2023
DUE: October 13, 2023

1 Bilateral Filtering

Implement bilateral filtering (40 points) We implemented bilateral filter as described in the Section 5 of the paper . The image is first normalized to $[0, 1]$, σ_r is set to 0.05, kernel size is set to 5 and σ_s for `gaussianblur` is set to 40.

Figure 1: Lamp image after bilateral filtering

Implement joint bilateral filtering (30 points) Joint bilateral filtering involves computing the intensity kernel using the flash image:

Figure 2: Lamp image after joint bilateral filtering

The difference image of the original image and the image after bilatering filtering:

Figure 3: Difference image $A^{Base} - A$

Implement detail transfer (20 points) We denote the flash image F and the result of bilateral filtering F^{Base}, the result of joint-bilateral filtering A^{NR}, the new estimate for the ambient image is then formed as

$$A^{Detail} = A^{NR} \frac{F + \epsilon}{F^{Base} + \epsilon}$$

Figure 4: Lamp image after detail transfer

Implement shadow and specularity masking (10 points) The mask is used to detect regions in the flash image that have shadows or specularities not present in the ambient image.

We first applied the gamma correction operator to the image, then normalize the linearized ambient image so that its ISO is the same as that of the linearized flash image (The ISO of the flash image is 200 and the ISO of the ambient image is 1600). The we applied the opening, closing and dilation operators to the mask to remove the disconnected areas. The resulting mask is shown as follows:

Figure 5: The shadow and specularity mask

Figure 6: Lamp image after detail transfer

To highlight where in the images the techniques perform differently, we computed the difference images $A^{NR} - A^{Base}$, $A^{Detail} - A^{Base}$ and $A^{Final} - A^{Base}$

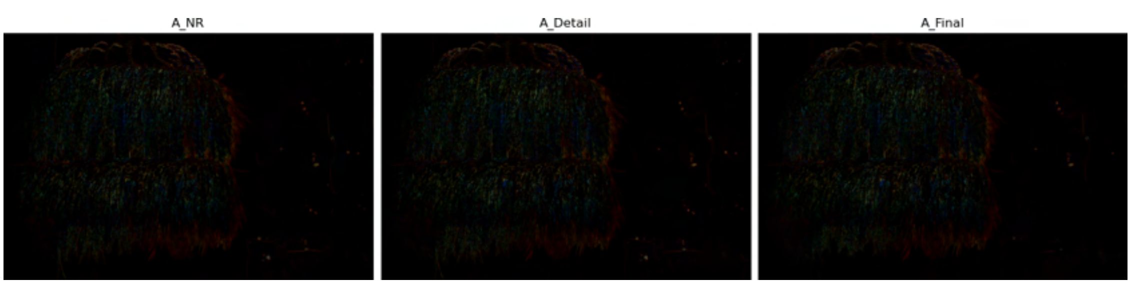

Figure 7: Difference images

2 Gradient-domain processing

Differentiate and then re-integrate an image (75 points)

Create the fused gradient field (25 points) We experimented with parameters $\sigma = 10, 20, 40, 80$ and $\tau_s = 0.3, 0.5, 0.7$, the results are as follow:

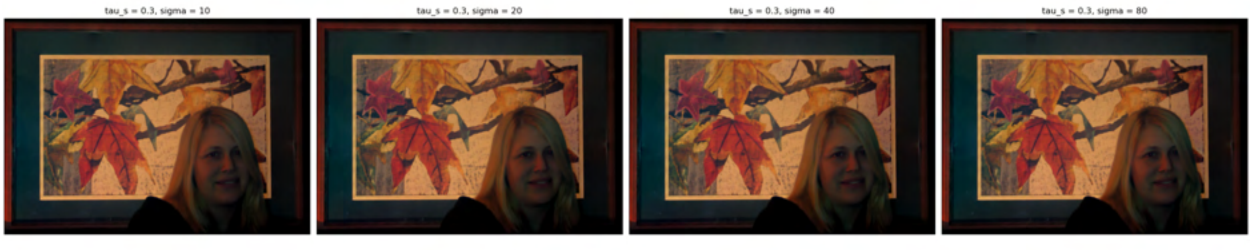

Figure 8: $\tau_s = 0.3$

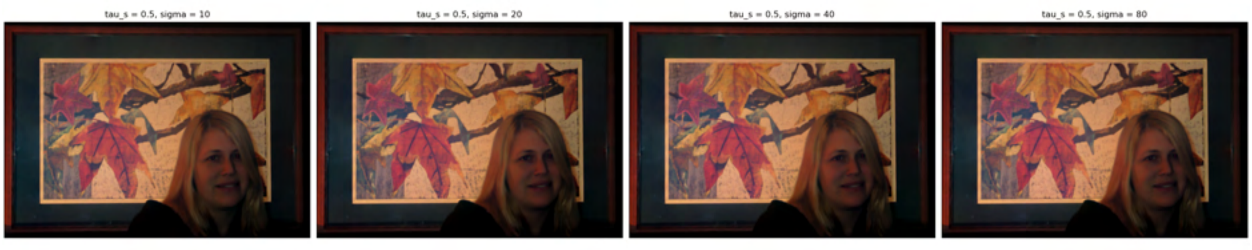

Figure 9: $\tau_s = 0.5$

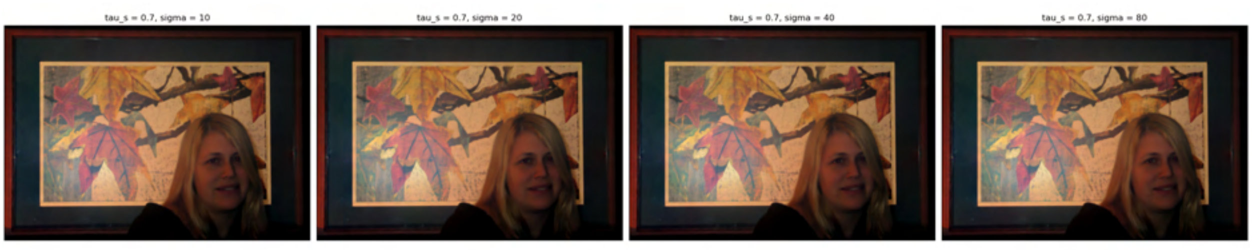

Figure 10: $\tau_s = 0.7$

We chose $\sigma = 20$ and $\tau_s = 0.5$ and computed the final result:

Figure 11: The fused image

Here, the outermost pixels at all four image edges are set to equal the corresponding pixels of the ambient image.

3 Capture your own flash/no-flash pairs (100 points)

The first pair of images:

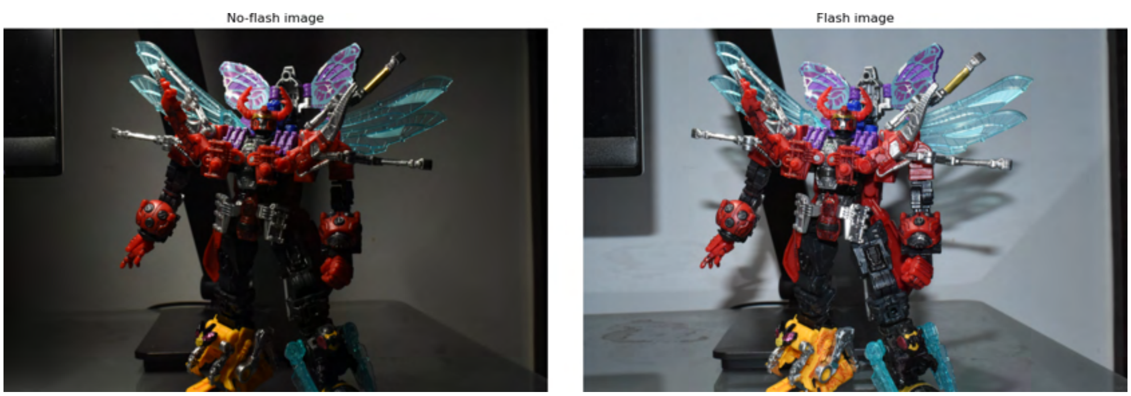

Figure 12: The no-flash/flash pair

The mask for shadow and specularity masking:

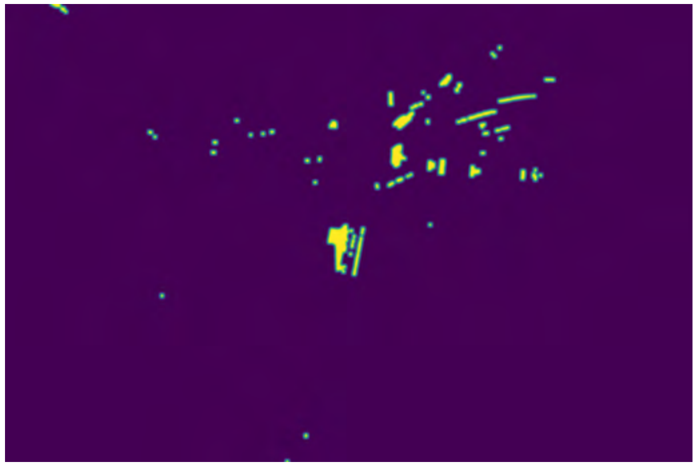

Figure 13: Mask for shadow and specularity masking

The result of bilateral filtering:

Figure 14: The fused image

The second pair of images:

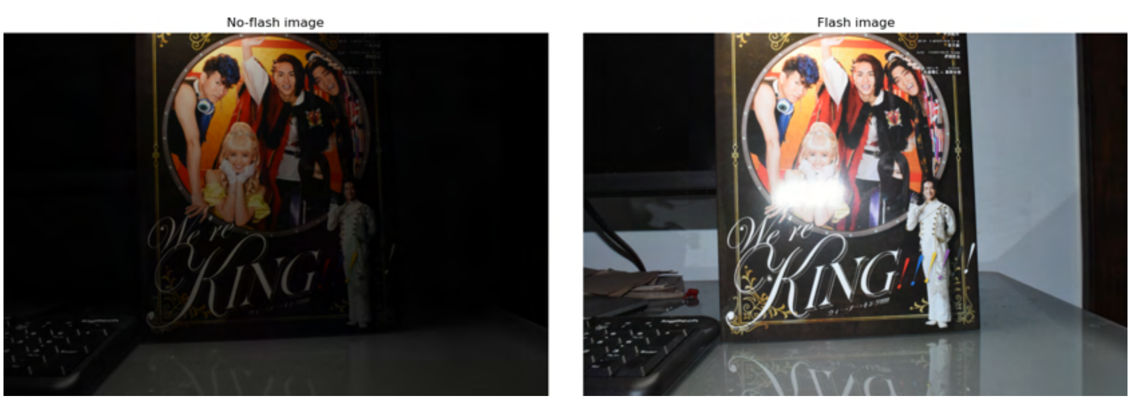

Figure 15: The no-flash/flash pair

We experimented with parameters $\sigma = 10, 20, 40, 80$ and $\tau_s = 0.5, 0.7, 0.9$, the results are as follow:

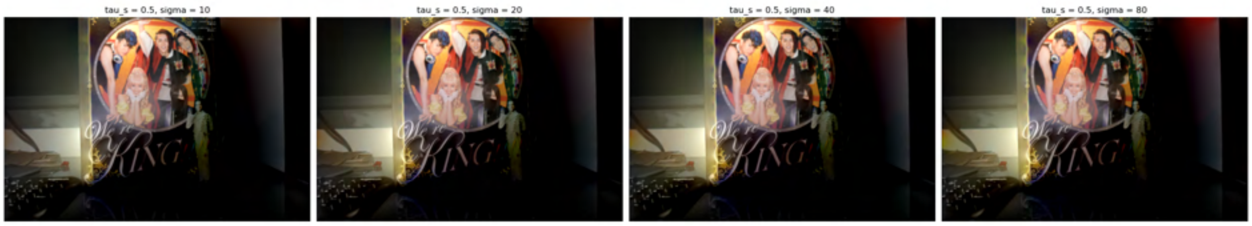

Figure 16: $\tau_s = 0.5$

Figure 17: $\tau_s = 0.7$

Figure 18: $\tau_s = 0.9$

We chose $\sigma = 20$ and $\tau_s = 0.9$ and computed the final result:

Figure 19: The final result