

Digital Photography With Flash and No Flash

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We calculate the final image using the following equation

$$A^{Final} = (1 - M)A^{NR}F^{Detail} + MA^{Base}$$

where A^{Final} is the final image, A^{NR} is the output after joint bilateral filtering, F^{Detail} is the detail layer, and, A^{Base} is the ambient image after bilateral filtering. We have used $\sigma_s = 3$ and $\sigma_r = 8$ for joint bilateral as well as bilateral filtering.

1 Microsoft Images



Figure 1: Ambient photography for carpet



Figure 2: Flash photography of carpet

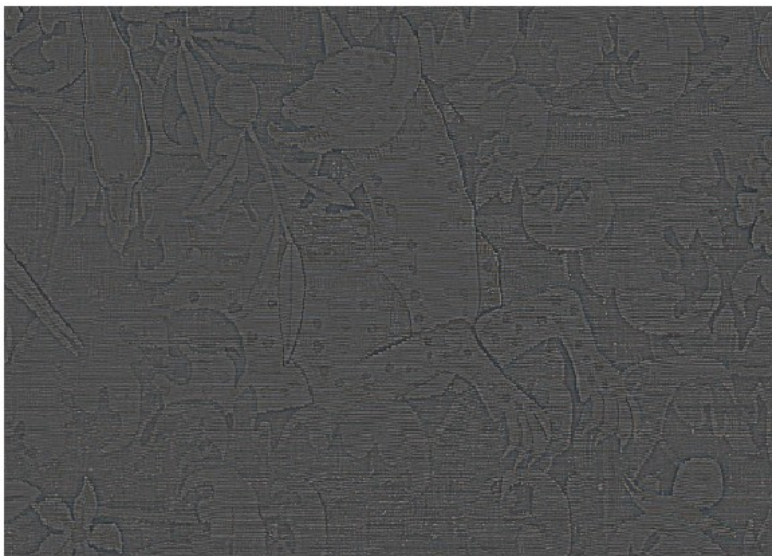


Figure 3: Detail layer for the carpet image



Figure 4: Final image of carpet

The detail layer contains the textural details (high frequency) of the carpet and combines them with aspects of the ambient image. The original image had little noise so there is no evident de-noising.

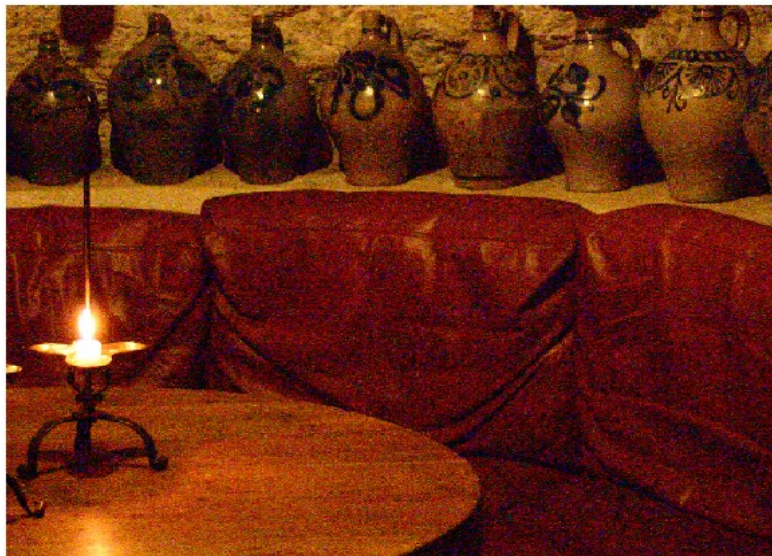


Figure 5: Ambient photography of cave



Figure 6: Flash photography of cave



Figure 7: Final image of cave

Here, we can distinctly see de-noising in the final image with respect to the ambient image. Also, the vases in the final image have sharper edges and features. However, the shape of the flame in the final image varies from the shape of the flame in the ambient image because the detail layer transfers the exact shape of the flame from the flash image.



Figure 8: Ambient photography of pots



Figure 9: Flash photography of pots



Figure 10: Shadow and specularity mask for pots



Figure 11: Final image of pots



Figure 12: Final image of pots with unity adjustment ratio for linear image

The final image is a de-noised version of the ambient image but when the adjustment ratio is not equal to 1 we can see a minor artifact that is created due to the handle shadow. This is largely suppressed by the mask but is not entirely removed. When the adjustment ratio is 1, that artifact is eliminated. This might be possible due to the unavailability of exposure time for both flash and ambient images, therefore we have to rely solely on the ISO ratio.

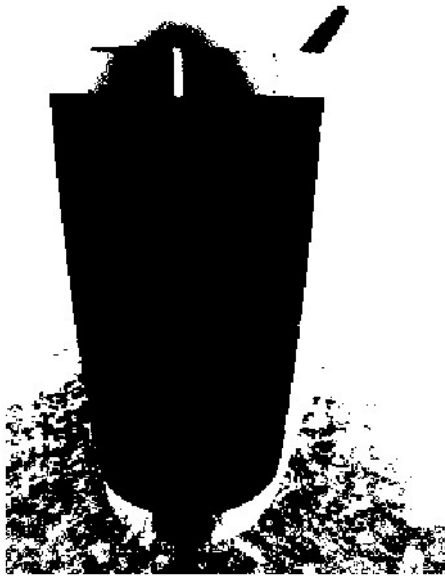
2 Dataset Images



(a) Ambient image of cup



(b) Flash image of cup



(a) Shadow and specularity mask for cup



(b) Final image of cup

The final image exhibits sharper details that have been brought over from the flash image. Furthermore, we can see that the mask appropriately removes the flash specularities and shadows from the flash image. The original image had little noise so there is no evident de-noising.



(a) Ambient image of package



(b) Flash image of package



Figure 16: Final image of package

We can see that the final image shows details such as sharpened features of the keychain. However, this effect is somewhat overblown along the edges of the package where the sharper details from the flash image are brought over. The original image had little noise so there is no evident de-noising.