CS663 Assignment 2

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Contents

Question 7

Here are the original and the noisy versions of the images:

(a) Original (b) Noisy (sigma=5) (c) Noisy (sigma=10)

Figure 1: Versions of barbara image

(a) Original (b) Noisy (sigma=5) (c) Noisy (sigma=10)

Figure 2: Versions of kodak image

The code for this question is present in ../code/myMainScript.m and ../code/mybilateralfilter.m. The window size of the bilateral filter is chosen to be $2 \times [3 * \sigma_s] + 1$, where [] denotes the ceiling function.

Here are the results of applying bilateral filter on noisy ($\sigma = 5$) barbara image with various values of σ_s and σ_r:

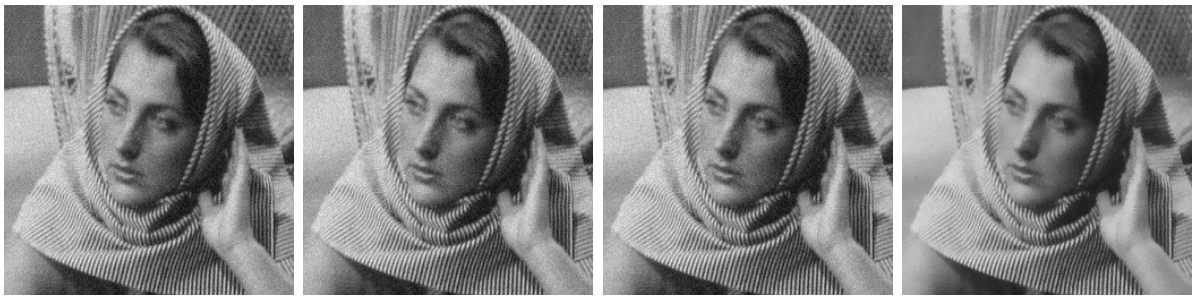
(a) sigma=5 (b) $\sigma_s = 2; \sigma_r = 2$ (c) $\sigma_s = 0.1; \sigma_r = 0.1$ (d) $\sigma_s = 3; \sigma_r = 15$

Figure 3: Versions of barbara image (sigma=5)

As we can see from the images, as we increase σ_r, the images get smoother (for example the face gets clearer). This is because of contribution from a wider range of

intensity values in case of higher σ_r. So, with respect to the clarity of the image, the fourth one resembles more to the original image. The same effect can be observed due to higher σ_s values, which essentially reduce the noise. Moreover, it is worth noting that edges are preserved for all three cases.

Here are the results of applying bilateral filter on noisy ($\sigma = 10$) barbara image with various values of σ_s and σ_r:



(a) sigma=5 (b) $\sigma_s = 2; \sigma_r = 2$ (c) $\sigma_s = 0.1; \sigma_r = 0.1$ (d) $\sigma_s = 3; \sigma_r = 15$

Figure 4: Versions of barbara image (sigma=10)

For a sigma value of 10, even after bilateral filter, the images are far more different than the original without-noise image (unlike the previous case). For example, a cut on the nose, is still present in all the cases. Here too the face is clearer, for a higher value of σ_s and σ_r (because of considering larger range of intensity and space). Edges also became more prominent in the last image.

Here are the results of applying bilateral filter on noisy ($\sigma = 5$) kodak image with various values of σ_s and σ_r:

(a) sigma=5 (b) $\sigma_s = 2; \sigma_r = 2$ (c) $\sigma_s = 0.1; \sigma_r = 0.1$ (d) $\sigma_s = 3; \sigma_r = 15$

Figure 5: Versions of kodak image (sigma=5)

The difference between the various versions of the images is less prominent than barbara because of larger variety of intensity values. Here too, the fourth image looks more clear than the other ones.

Here are the results of applying bilateral filter on noisy ($\sigma = 10$) kodak image with various values of σ_s and σ_r:

In this case, the higher σ_s and σ_r create more difference.

(a) sigma=5 (b) $\sigma_s = 2; \sigma_r = 2$ (c) $\sigma_s = 0.1; \sigma_r = 0.1$ (d) $\sigma_s = 3; \sigma_r = 15$

Figure 6: Versions of kodak image (sigma=10)