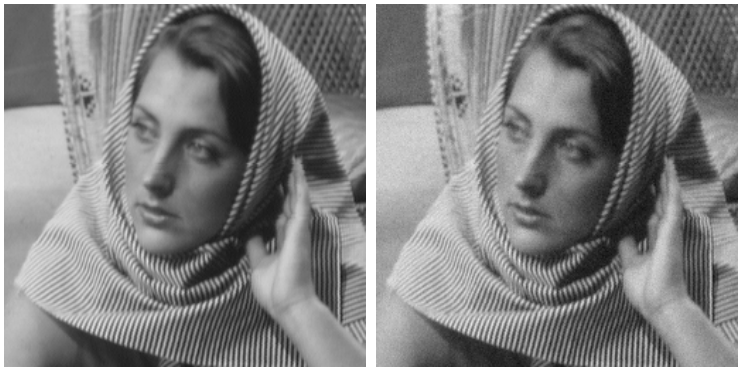
CS663 Assignment 3

Saksham Rathi, Kavya Gupta, Shravan Srinivasa Raghavan

September 2024

Question 3

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



(a) Original (b) Noisy

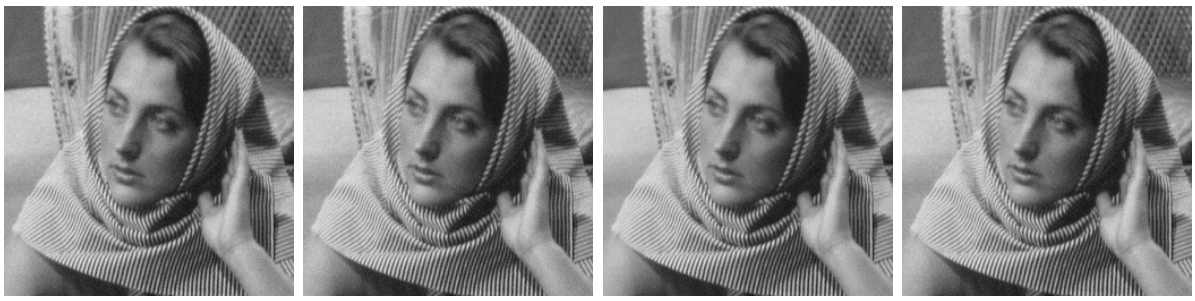
Figure 1: Versions of barbara image

(a) Original (b) Noisy

Figure 2: Versions of kodak image

The code for this question is present in ../code/myMainScript.m, ../code/mybilateralfilter.m and ../code/mymeanshiftfilter.m. The window size of the bilateral filter and the meanshift 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:



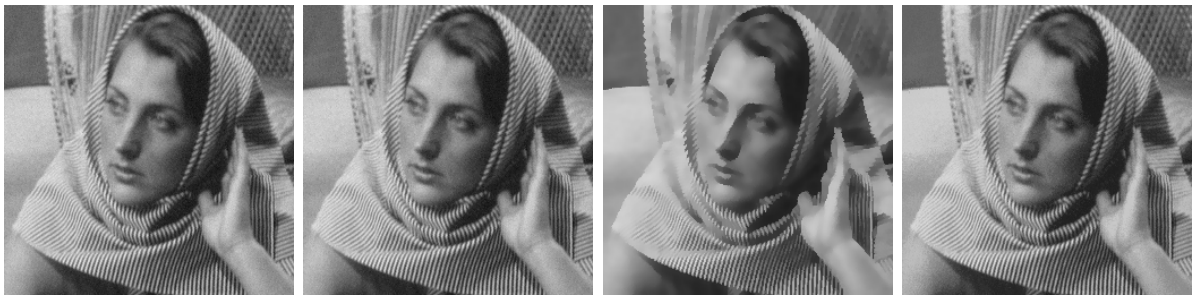
(a) sigma=5 (b) $\sigma_s = 2; \sigma_r = 2$ (c) $\sigma_s = 3; \sigma_r = 15$ (d) $\sigma_s = 15; \sigma_r = 3$

Figure 3: Bilateral Versions of barbara image

If we talk with respect to the face of the barbara image, we can see that the image with $\sigma_s = 3$ and $\sigma_r = 15$ has a more clear face. Higher σ_s actually incorporates intensity

values from far neighbourhood too, which decreases the clarity of the face. Higher σ_r means that the intensity values are taken from a larger range of intensity values, which makes the face more clear. Edges are preserved for all the images. All the other parts of the image have similar texture and hence the difference is not very visible.

Here are the results of applying mean-shift 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) $\sigma_s = 3; \sigma_r = 15$ (d) $\sigma_s = 15; \sigma_r = 3$

Figure 4: Mean-shift Versions of kodak image

If we talk with respect to the face of the barbara image, we can see that the image with $\sigma_s = 3$ and $\sigma_r = 15$ has a blurred face. This is because a high value of σ_r incorporates values from a larger intensity range which is clearly not good in this case. Moreover for this case, the edges are not preserved too. The image with $\sigma_s = 15$ and $\sigma_r = 3$ has more clarity over the image with $\sigma_s = 2$ and $\sigma_r = 2$. Edges are preserved for both of the images. Moreover, the texture of all the other parts of the image is more clear for both of these than the third one.

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) $\sigma_s = 3; \sigma_r = 15$ (d) $\sigma_s = 15; \sigma_r = 3$

Figure 5: Bilateral Versions of kodak image

Overall, the quality of the image with $\sigma_s = 2$ and $\sigma_r = 2$ is the best. One of the possible reasons for this is that kodak24 has a variety of intensities and edges. A high value of σ_s incorporates values from a larger neighbourhood which is not good in this case. A high value of σ_r incorporates values from a larger intensity range which is also not good in this case. The image with $\sigma_s = 3$ and $\sigma_r = 15$ has more clarity over the image with $\sigma_s = 15$ and $\sigma_r = 3$. Edges are preserved for all the images. The overall texture looks quite similar for all the three images.

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

The image with $\sigma_s = 3$ and $\sigma_r = 15$ has the lowest quality. The image looks really blurred and the edges are not preserved. The possible reason is that larger value of

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

Figure 6: Mean-shift Versions of kodak image

$\sigma_r = 15$ incorporates values from a larger intensity range which is not good in this case. The image with $\sigma_s = 15$ and $\sigma_r = 3$ has more clarity over the image with $\sigma_s = 2$ and $\sigma_r = 2$. Edges are preserved for both of the images. The overall texture looks quite similar for both of these images.