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**Homework Assignment 3**
CS 663: Digital Image Processing

2021-10-06

# Exercise 2

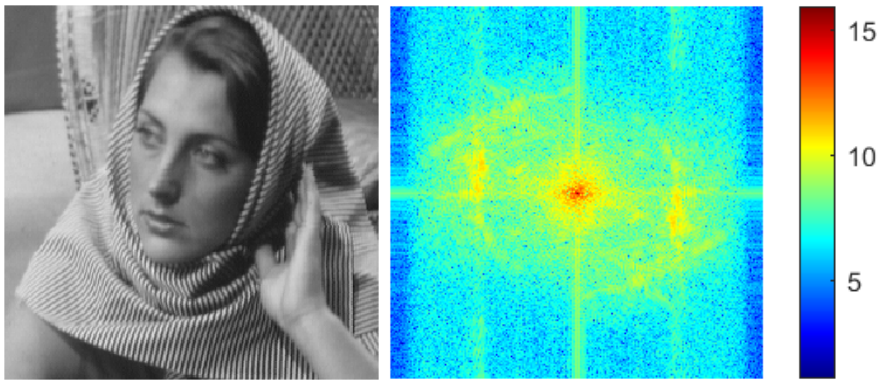


Figure 1: The original Barbara (left) image given to us in the problem statement. Fourier transform of the Barbara image (right).

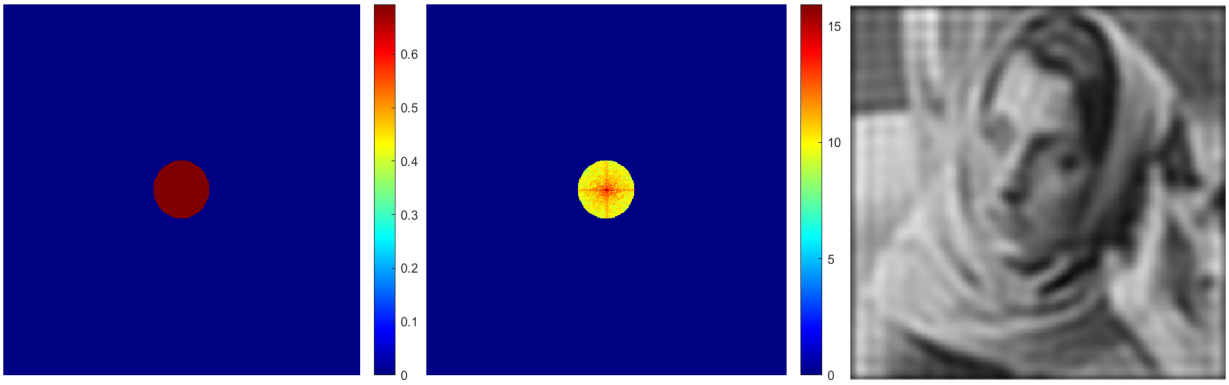


Figure 2: The frequency representation of the Ideal Low Pass Filter with a cut-off frequency of 40 Hz (left), the filter applied to the image in frequency domain (center) and spatial representation of the filtered image. We observe a significant ringing effect in the filtered image.

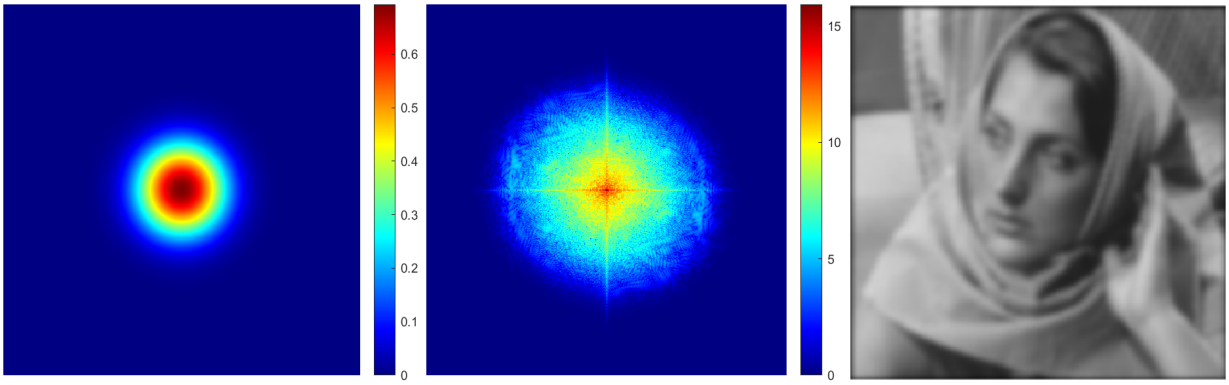


Figure 3: The frequency representation of the Gaussian Low Pass Filter with $\sigma = 40$ (left), the filter applied to the image in frequency domain (center) and spatial representation of the filtered image. Note that the ringing artifacts (which we observed in the filtering with ideal low pass filter) are now gone. We observe a significant smoothing effect in the filtered image.

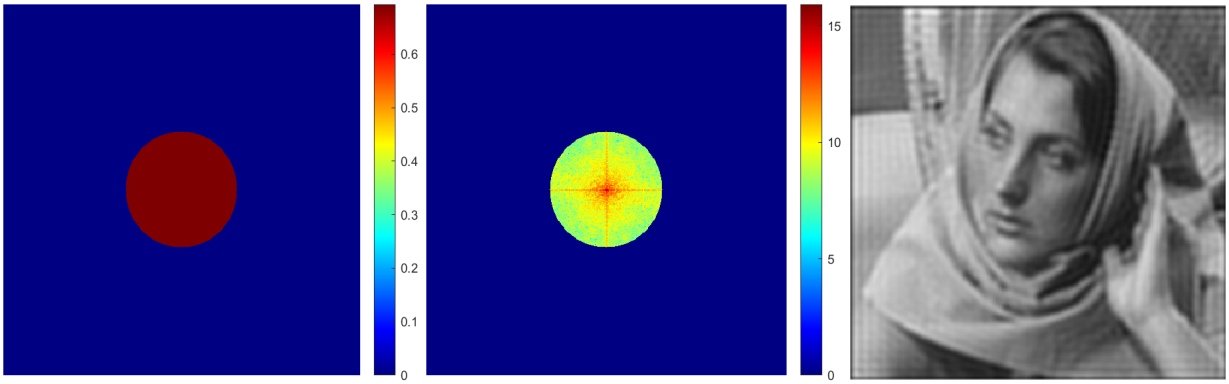


Figure 4: The frequency representation of the Ideal Low Pass Filter with a cut-off frequency of 80 Hz (left), the filter applied to the image in frequency domain (center) and spatial representation of the filtered image (right). We observe that the ringing effect in the filtered image is now lower as compared to the case where the cut off frequency was 40 Hz.

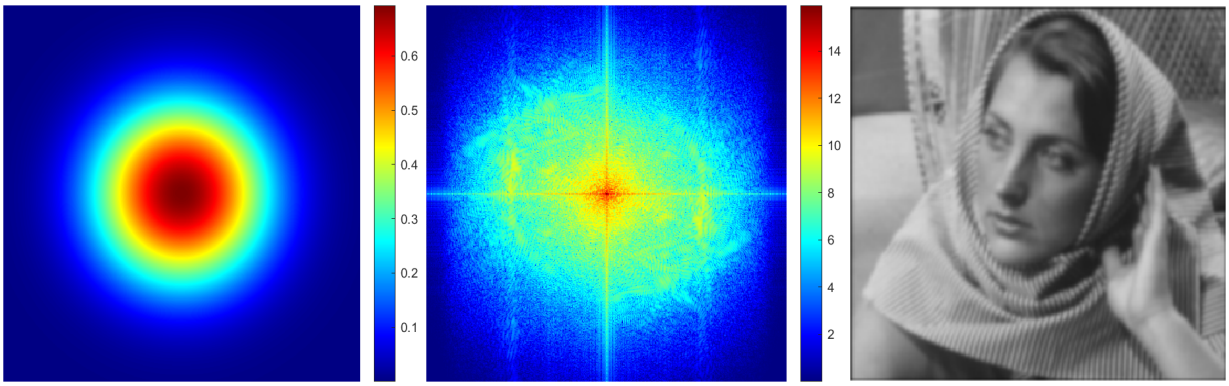


Figure 5: The frequency representation of the Gaussian Low Pass Filter with $\sigma = 80$ (left), the filter applied to the image in frequency domain (center) and spatial representation of the filtered image (right). Note that the ringing artifacts (which we observed in the filtering with ideal low pass filter) are now gone. The smoothing effect is lower than the case where $\sigma = 40$, but is visually better than the $\sigma = 40$ case.