Assignment 5: Discrete Fourier Transform

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Q4: Low Pass Filters

1. Output Images

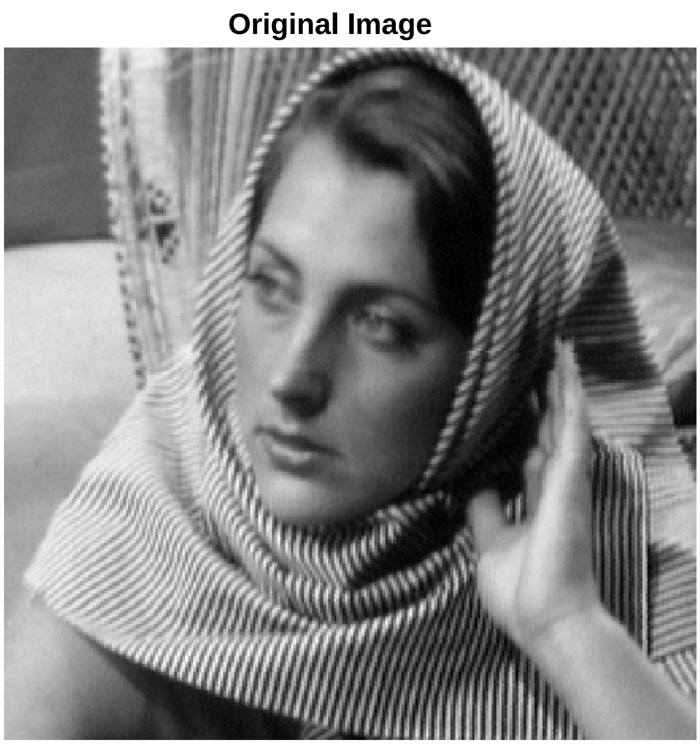

Fig 1: Original Image

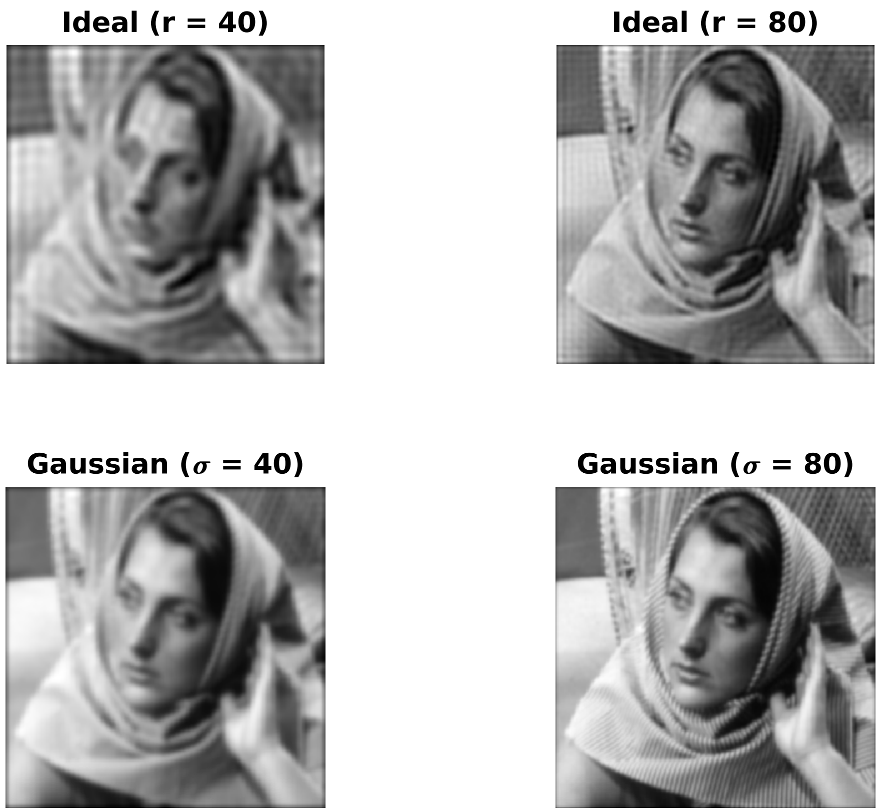

Fig 2: Effect on original image corresponding to filters and parameters

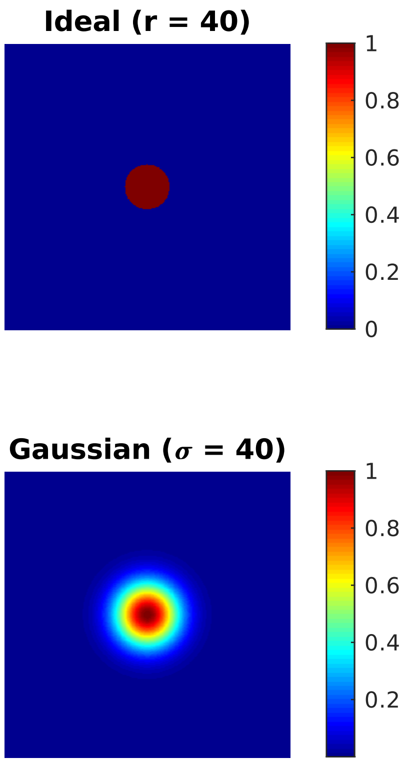

Fig 3: Frequency response (in log Fourier format) corresponding to the filters

2. Differences in Filtered Outputs

- The ideal low-pass filter of smaller radius (r = 40) produces more blur that that with the larger radius (r = 80) since it only allows smaller frequency componentes to pass through.
- The Gaussian low-pass filter with $\sigma = 40$ produces more blur than the filter with $\sigma = 80$ because a smaller σ in the frequency domain corresponds to convolution with a Gaussian of larger σ in the spatial domain, leading to more blurring
- On applying the ideal low-pass filter, the output images clearly show undesirable 'ringing' artifacts as expected due the convolution with the corresponding Sombrero function in the spatial domain
- These ringing artifacts are not present on using a Gaussian low-pass filter. Thus, Gaussian low-pass filters are an effective solution to avoid ringing (ripple) artifacts in low-pass filtering.