

COMP4421 Assignment 1

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1 Exercises

1. Fourier Transform

- (a) The significant increase across the vertical and horizontal axes in the frequency domain is caused by the abrupt changes in intensity between the image and the black padding. The vertical and horizontal boundary between the image and the black padding have a large gradient with respect to the y and x axes respectively. These large changes contribute to the vertical and horizontal axes in the frequency domain representation.
- (b) The significant increase in the low frequency region is caused by the black padding which does not change intensity accross a large area. This contributes to the low frequency components in the frequency domain representation.

2 Programming Tasks

1. Spatial Linear Filtering

(a) Average filter



(c) Sobel Y



(b) Sobel X



(d) Laplacian filter



2. Spatial Non-linear Filtering (*5x5 median filter*)

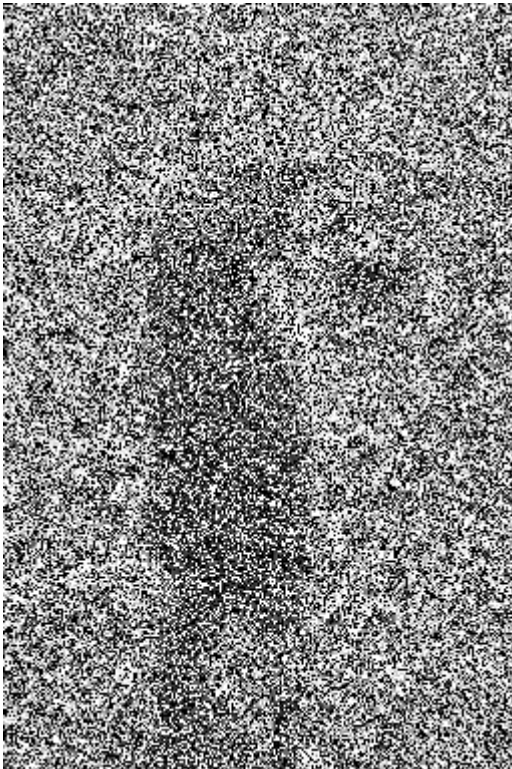
(a) Added gaussian noise



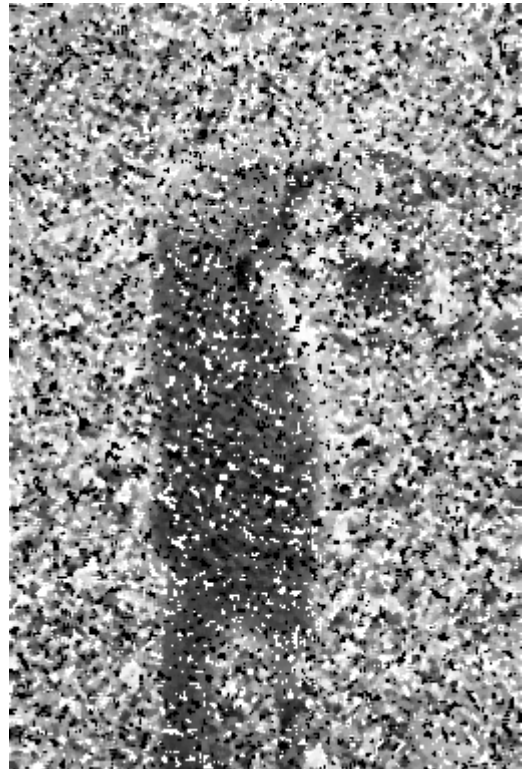
(c) Median filter on (a)



(b) Added salt and pepper noise

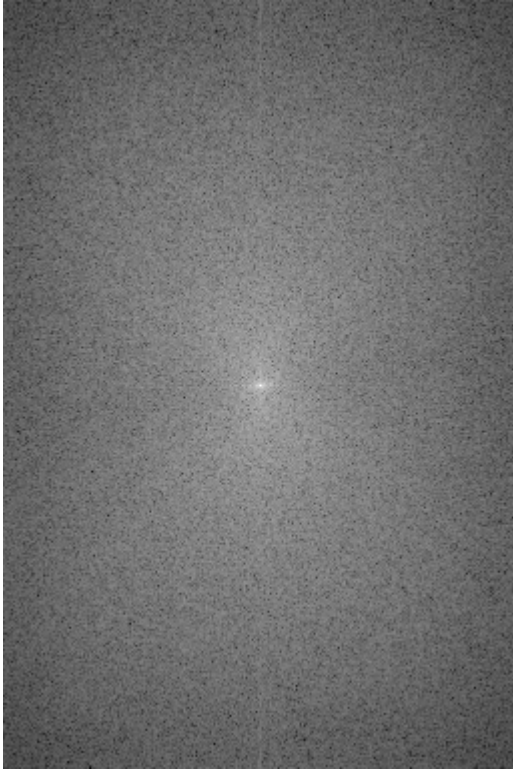


(d) Median filter on (b)



3. Discrete Fourier Transform

(a) Frequency spectrum



(b) Inverse DFT real component

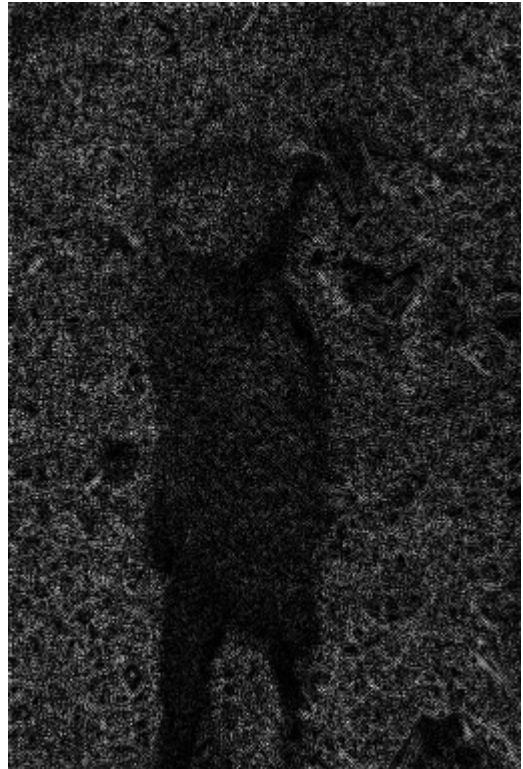


4. Filtering in the Frequency Domain

(a) Average filter



(b) Laplacian filter



5. **High-Frequency Emphasis** ($a = 0.5$, $b = 2.0$)

(a) Butterworth



(b) Gaussian

