

E9 241 Digital Image Processing

Assignment 04

Due Date: November 10, 2023 - 11:59 pm

Total Marks: 70

Instructions:

For all the questions, write your own functions. Use library functions for comparison only.

- Your function should take the specified parameters as inputs and output the specified results.
- Also provide the wrapper/demo code to run your functions. Your code should be self-contained, i.e., one should be able to run your code as is without any modifications.
- For Python, if you use any libraries other than numpy, scipy, scikit-image, opencv, pillow, matplotlib, pandas, and default modules, please specify the library that needs to be installed.
- Along with your code, also submit a PDF with all the **results** (images or numbers) and **inferences** (very important: you may not be explicitly asked to give inferences in each question. You should always include your inferences from what you have observed). Include answers to subjective questions, if any.
- Put all your files (code files and a report PDF) into a single zip file and submit the zip file. Name the zip file with your name.

1. Image Denoising:

- (a) Use the bilateral filter to denoise the image `building_noisy.png` corrupted by the Gaussian noise and compare the results with the Gaussian smoothing. Use a window size of 7×7 and tune the other parameters to get a good result. Check Figure 1 for reference. It shows the optimal results on a patch of the image.

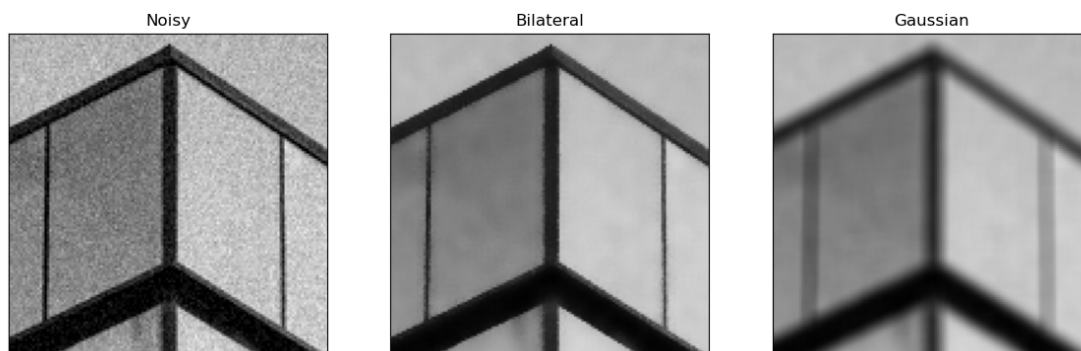


Figure 1: Expected results on a patch

- (b) Apply Laplace filter on the input image, bilateral filtered image and the Gaussian smoothed image. What do you observe from the results?

(20+5=25 Marks)

2. Edge Detection:

Perform edge detection on `book_noisy1.png`, `book_noisy2.png`, `architecture_noisy1.png` and `architecture_noisy2.png` based on the following instructions:

- (a) First smooth the images using a spatial domain Gaussian filter.

(b) Use one of the gradient based edge detectors to calculate gradients and compute the edges using thresholding.

(c) Analyse

- What is the effect of the amount of Gaussian smoothing on the detected edges.
- What is the effect of the gradient threshold on the detected edges?

(5+10+5=**20 Marks**)

3. **Hough Transform:** Create a synthetic image with few lines and other shapes. Implement Hough transform to detect lines. Try different number of bins and thresholds and observe whether the lines are detected. Analyze how the results are affected by (i) noise, (ii) occlusions and (iii) real images.

(**25 Marks**)