COM-SGN.110 Introduction to Image and Video Processing

EXERCISE 5

13.11.2023 - 15.11.2023

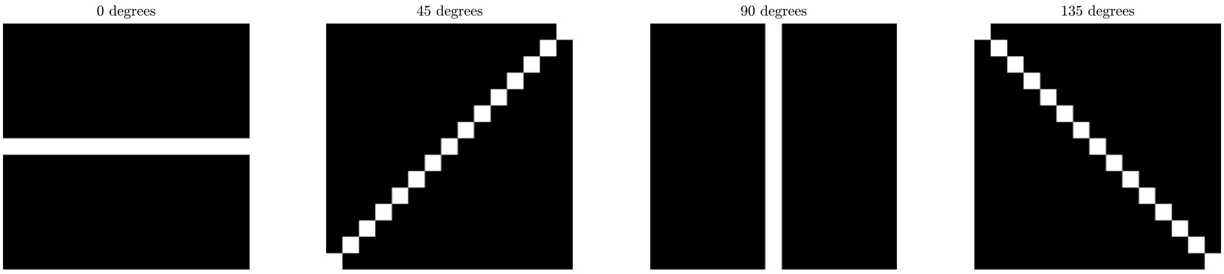
The tasks should be completed and presented to TA during the lab session. **Do not forget to upload your solutions to Moodle!** Questions about exercises should be addressed to the TA personally, through Moodle messages or via email, which can be found on the Moodle page of the course.

1. Laplacian filter with high-boost filtering

Create a Laplacian kernel of size 3x3 with the center values A = {8, 9, 9.7}. Use the created kernels to enhance edge information in "*cameraman.tif*". Present your results in a 2x2 subplot.
(Hint: `imfilter`)

2. Directional filtering

Directional filters, or kernels, smooth an input image in one or multiple orientations. They are generally used to compensate for motion blur and to facilitate edge detection.
The figure below shows 4 example directional kernels with different directions.



a. Load "*cameraman.tif*" and add random white noise with maximum intensity of 10. Display the original and the noisy images in the same figure.

b. Create a function called "`directional_filtering`" in MATLAB.
- The function takes two input arguments: a grayscale image and the filter size.
- The function internally creates 4 directional filters of the following degrees: (0, 45, 90, 135).
(Hint: a directional filter of size 3x3 at 0 degree is the following: [0,0,0 ; 1,1,1; 0,0,0]/3, see the figure above)
- The function uses the created filters to perform filtering on the input image.
- The function outputs 4 filtered images.

Use "*directional_filtering.m*" to filter the noisy version of "*cameraman.tif*". Try kernels of the following sizes: 3, 5, 7. Present your results in 3 different figures with each one containing 2x2 subplots of the filtered images.

c. How would you combine the results from 4 filtered images?

3. Threshold Median Filtering

a. Load "*miranda1.tif*" and add some white noise in the image center area of size 100x100.

b. Implement a median filtering function called "*med_filter.m*" which takes 2 input arguments: an image and the filter size. The function outputs the filtered image.

Hint: given a filter of size 3x3 and an image patch [3, 4, 1; 0, 0, 1; 3, 20, 4], the filter will return value 3, which is the median value in the image patch.

Use "*med_filter.m*" to filter the noisy image from part a). Try with a different filter size and present your results in the same figure.

c. Let I be the input and O be the output image of your "*med_filter.m*" function. Implement another function, which differs from "*med_filter.m*" as follows:

if |I(x,y)-O(x,y)| > alpha, then O(x,y)=I(x,y).

"alpha" is a threshold value which is given as an extra argument to the function. That is, during filtering we retain the original pixel intensity if the change exceeds a given threshold. Adjust the value of threshold and observe the result with noisy "*miranda.tif*". Explain: in what situation we would prefer to use a thresholded median filter?