

## ADIP 2021 - 22

### Assignment 1 - Fundamentals of Image Processing

Read the image “Butterfly.JPG” and perform the following operations. Respective marks for your implementations are shown with the tasks being assigned here under.

1. For reading and conversion to gray. -- 2+3 = 5 marks
2. On the original image: add random noise (Gaussian noise of standard deviation 5 ) to it. Then apply denoising by performing wavelet analysis setting coefficients below a threshold value (to be provided by the user), and then apply wavelet synthesis on the image. Apply Le Gall (5x5 or 3x3) filters (separable in 2D) for this purpose. Coefficients of these filters (in 2D) are given in the table below.

	Analysis filter bank		Synthesis filter bank	
n	Low pass filter	High pass filter	Low pass filter	High pass filter
0	3/4	1	1	3/4
$\pm 1$	1/4	-1/2	1/2	1/4
$\pm 2$	-1/8			-1/8

For applying these filters, convolve the image row-wise and column-wise with 1-D filter responses for Low-Low (LL), Low-High (LH), High-Low (HL), and High-High (HH) bands. After applying analysis filters, downsample filtered images by half in both directions. Summation of responses from the synthesis filter will provide the reconstructed image. For details, refer to Fig. 3.1 of the attached document on tutorial of wavelet transforms.

Also apply median filtering and Gaussian filtering (of standard deviation 4) for denoising. Display the original, noisy and all filtered images. Compute the PSNR of the noisy, and filtered images with respect to the original image in each case. - Analysis (10 marks), downsampling (5 marks), thresholding (10 marks), upsampling (5 marks), synthesis (10 marks), Gaussian filtering (5 marks), median filtering (5 marks), computing PSNRs (5 marks), display images (5 marks) = Total 60 marks

3. On the original gray image apply the LoG (Laplacian of Gaussian) operator of standard deviation 5, and find edge pixels by computing its zero crossings.

Display both LOG image and its zero-crossings. LOG (5), zero crossings (5), display (5). Total 15 marks

4. Perform histogram equalization on the original grayscale image and perform the Otsu thresholding operation. Equalization (5 marks), thresholding (3 marks), and display both the images (2 marks) - Total 10 marks
5. Perform Harris corner detection on the gray image and display the detected corners. - 10 marks

Submission guidelines:

1. Submit a report describing the methods and experimental results.
2. You may implement the above tasks using Python/Matlab. Python is the most preferable coding language.
3. Do not use any packages in implementing the above tasks. You may use library functions only for reading, writing, and displaying images.
4. Provide a README file for compiling and running the programs.
5. Submit all the above mentioned files in a zip folder with your ID number as the zip folder name.