**CM0669 Machine Learning and Computer Vision**

**Lab 8** Image filtering, image enhancement, image denoising using wavelets, deblurring

**1. Image Filtering**

Open up Matlab and Type in ‘help fspecial’ and ‘help imfilter’. A helpful description will be given on the built-in functions ‘fspecial’ and ‘imfilter’ for defining a filter and using it to filter an image.

1. Create a Matlab code which reads a greyscale image (use image1, image2 and image3), then applies a filter and displays the filtered image for the following filters:

a. Average filter (3×3), (5×5), (7×7). Use the DFT of the filter to interpret the results.

b. Gaussian filter (5×5) with σ=0.2, σ=2, σ=10. Use the DFT of the filter to interpret the results.

c. Sobel’s filter: Horizontal, vertical. Use ‘abs’ for consistent display.

d. Prewitt’s filter: Horizontal, vertical. Use ‘abs’ for consistent display.

e. Laplace sharpening filter σ=0.4.

**2. Image denoising**

1. Download the noisy image ‘noisy.pgm’ and write a Matlab code to remove noise with:
2. (3×3), (5×5), (7×7) average filter.
3. Wavelet de-noising which consists of the following steps:

**b.1.** Transform the image to the wavelet domain using ‘Haar’ wavelet with two decomposition levels.

**b.2.** Apply a threshold at two standard deviations of each sub-band (any wavelet coefficient is set to 0 if its magnitude is smaller than the threshold).

**b.3**. Inverse-transform the image to the spatial domain.

**3. Image enhancement and de-blurring**

Download the blurry image ‘blurry.pgm’ and write a Matlab code to remove blur with the Laplace sharpening filter for different values of σ (0.2, 0.4, 0.6).

Download the blurry and noisy image ‘blurry\_noisy.pgm’ and write a Matlab code to remove blur with the Laplace sharpening filter for different values of σ (0.2, 0.4, 0.6).

Compare and interpret the results.