Due on 15 April 2025

Computer vision - Assignment 5

1. Generate a filled white rectangle at the center of a 100×100 pixel image, with rest of the pixels being black and display its Fourier transform. Write a code that is flexible enough to generate any size of rectangle so that you can observe the different effects.

   (a) Display the magnitude spectrum, the phase spectrum and the power spectrum of the above image so that the avarage of the pixel values is visible at the center. You may find the following link useful: `https://opencv24-python-tutorials.readthedocs.io/en/latest/py_tutorials/py_imgproc/py_transforms/py_fourier_transform/py_fourier_transform.html`

   (b) How does increasing/decreasing the size of the white rectangle affect the above spectral images? Provide an explanation for these changes (or lack of changes).

2. Convolution in the spatial and the frequency domain: There are two ways to implement spatial filters - one is to apply convolution, the other is through multiplication in the frequency domain. Use "cameraman.jpg" from this folder as the testing image.

   (a) Apply a 11×11 average filter in the spatial domain.

   (b) Perform this enhancement in the frequency domain. Follow these steps:

   - pad both the original image and the kernel
   - transform both the padded original original image and the kernel
   - perform multiplication
   - perform inverse transform
   - cut and display the useful content of the transformed image

   (c) Compare the time required for parts (a) and (b).

3. Apply the following edge detection techniques to the image 'building.jpg' and compare the results. In each case apply Gaussian smoothing before applying edge detection and thresholding after. Experiment to see which thresholding method works best in the given case.

   (a) Sobel kernel

   (b) LoG (finding zero crossings)

   (c) Canny edge detector

   (d) Hough transform

   Repeat the above steps for the image 'objects.png'. Write down your observations. In particular, note the differences observed in results when the methods are applied to an image with more straight edges in contrast to an image that has more curves. Can you explain these observations?

4. Apply the following segmentation techniques to the images in this folder and compare the results. For each image, comment upon which segmentation method works best for that image and why that may be so.

   (a) Clustering

   (b) Superpixels

   (c) GrabCut

   (d) Watersheds