ECE4580 FA23 - Prof. Jones – HW 4

Due Thursday, November 16, 2023 – 11:59 PM via Canvas

For both parts of this assignment, you will be using two images available in the Files->Images section of Canvas: "USAF-1951.png" and "Chartres-Cathedral.png".

PART I

1. Load the image from your Google Drive; convert to grayscale if necessary by averaging the color planes.
2. Create a plot of average gradient magnitude versus Gaussian filter sigma as follows:
3. For a range of sigma values from 0 to 20 by steps of 0.1:
    a. apply a Gaussian filter with the stated sigma to the original image
    b. find the gradient magnitude for the entire images, using an appropriate method
    c. compute the average gradient magnitude for the entire image
4. Show your plot using log scale for the Y axis (you can use Python, Excel or something else to create the plot).
5. Explain your plots as fully as possible. Why is it the shape that it is? What does it mean? Are there any interesting regions and what do they represent? Compare the plots for the two images, in light of the image contents.

PART II

1. Load the image from your Google Drive; convert to grayscale if necessary by averaging the color planes.
2. Find the magnitude of the Fourier transform of the original image; put the origin in the center of the image.
3. Find the gradient magnitude for the entire images, using an appropriate method.
4. Find the magnitude of the Fourier transform of the gradient magnitude image; put the origin in the center of the image.
5. Display the two Fourier transforms; you may need to do some contrast enhancement to see the detail.
6. Calculate the average Fourier transform magnitude as a function of radius from the center (that is, as a function of spatial frequency); do this for both the original and the gradient magnitude FTs.
7. For each image, plot the FT magnitudes (for the original image and the gradient magnitude image) as a function of spatial frequency.

Explain the appearance of the two Fourier transform magnitudes. Compare the results for the two images. (You should have a total of four FT plots: original and gradient for each image).

Explain your plots as fully as possible. Why is it the shape that it is? What does it mean? Are there any interesting regions and what do they represent? Compare the plots for the two images, in light of the image contents. (You are plotting four curves: FT magnitude versus radius for original image and gradient, for each image.)

SUBMISSION:

For your submission, paste all of your code, the resulting images and plots and your discussions for both Part I and Part II into a single well-organized Word (or pdf) file. Make sure that your images and plots are large enough to see. Paste code as plain text (no dark-mode or screenshots). Also submit your final Python notebook (as an ipynb file). Submit two separate files: your Word or pdf submission and your CoLab notebook. Submit your files using Canvas. Do NOT put your files into a zip file for submission; submit them as separate files.