LAB # 06: Edge Detection

Lab Objective:

The objective of this lab is to apply differential spatial filters and Canny edge detector on images to detect edges.

Lab Description:

Different **spatial filters** allow us to enhance the details in an image as per our requirement. In order to find out the boundary or edges of objects in an image, **Differential** filters come in handy. One of the differential filter is Sobel filter

Difference Formula (1st order accurate)

$$f'(x) = \frac{f(x) - f(x-h)}{h}$$

Horizontal Sobel filter is used to find out the edges along x-axis as it calculates the derivative of an image in x direction.

-1	0	1
-2	0	2
-1	0	1

While Vertical Sobel filter is used to find out the edges along y-axis.

-1	-2	-1
0	0	0
1	2	1

The edges obtained from applying both this filters can then be added to obtain all the edges in an image.

The result of either sobel filter ranges from **-1020 to +1020**. Where 0 stands for no change while -1020 and 1020 suggest maximum change from light to dark and dark to light respectively, but we are interested in change not light to dark or dark to light change so in order to achieve that we can take absolute values only.

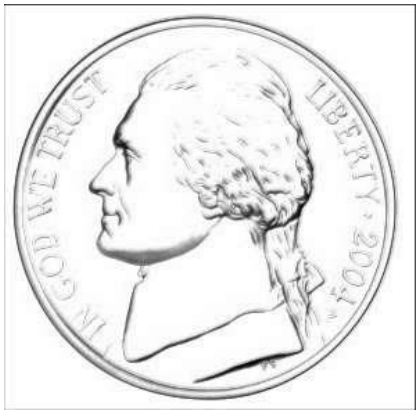
Canny Edge Detection: is a popular edge detection algorithm. Steps are as follows.

i) Noise Reduction: Using 5x5 Gaussian filter ii) Sobel kernel in both horizontal and vertical direction.

iii) Non-Maximum suppression: Suppress all the gradient values to 0 except the local maxima.

iv) Hysteresis Thresholding: we need two threshold values, minVal and maxVal. Any edges with intensity gradient more than maxVal are sure to be edges and those below minVal are sure to be non-edges, so discarded. Those who lie between these two thresholds are classified edges or non-edges based on their connectivity. If they are connected to "sure-edge" pixels, they are considered to be part of edges

Lab Task:



1: Apply Horizontal Sobel and Vertical Sobel separately on the figure.

- Now find the magnitude of the two edges and save it. Show only those whose magnitude are in top 30%

$$\mathbf{G} = \sqrt{\mathbf{G}_x{}^2 + \mathbf{G}_y{}^2}$$

- Now find phase of the image and show the lines that are on 45 and 90 degrees.

$$\mathbf{\Theta} = \operatorname{atan}\left(\frac{\mathbf{G}_y}{\mathbf{G}_x}\right)$$

- Now show the lines that are on 45 and 90 degrees and have top 30% magnitude.

2: Apply canny edge detector to find edges in the imag.

References:

I. https://www.owlnet.rice.edu/~elec539/Projects97/morphjrks/moredge.html

Applications:

I. Depth Discontinuities
II. Surface orientation Discontinuities
III. Changes in material properties
IV. Variations in scene brightness

Home Task

We have 502*564 aerial image of an airport.

- Apply Hough transform on the edge detected ima ge using cv2.HoughLines (). // Fig 10.34