CS/RBE 549 Computer Vision Name:_____
Fall 2022

HW #4 (100 pts = 3% in final grade)

0. **Project Teams:** You should organize into teams of three students (including yourself). If you cannot find a 3rd team member, let the instructor know and we will try to help you find teammates. 2-student teams may be allowed in case of extenuating circumstances.

   Teams will need to submit a project proposal report due Oct 13, right before the Fall break. Popular topics from past years include object recognition, image stitching, motion tracking.

1. **Hough Display (10 pts)** Use OpenCV, Matlab, or other software to compute and display the Hough Transform of the Sobel or LoG edges of an image that you found last week. Where is the peak and what line does it correspond to? Submit the Hough Transform image. You do not need to submit your code.

2. **Hough Example (40 pts)** In this Hough Transform problem *x, y, b, c, m* and *n* may be positive or negative, integers or fractions. 2 points in (*x,y*) space are given by

   P1: (2,4)

   P2: (4,3)

   Hint: It might help to construct (*x,y*) and (*m,b*) spaces.

a. What are lines L1 and L2 in (*m,b*) space corresponding to each of these points?

b. Where do these lines intersect in (*m,b*) space?

c. Using part b., what equation describes the line passing through points P1 and P2?

d. Line L3 in (*m,b*) space passes through (*m,b*) = (0,0). What is its corresponding P3 such that P3 lies along the line from part b?

3. **Square Hough Transform (30 pts)** Ima Robot proposes to use the Hough Transform to detect squares in images. First, edges are detected, then every edge point causes certain bins (accumulators) to be incremented in the Hough array. If the image contains a square, she expects to find that the bin corresponding to that location and size will have the highest count.

For simplicity, we only consider squares that are aligned with the x and y axes.

a. Suggest a parametrization of the Square Hough space such that every possible square corresponds to a single point in that space. What are the Square Hough space axes?

b. Draw the Square Hough space that corresponds to detecting an edge point at (4, 6) in an image.

c. A second edge point is detected at (6,8) in the image. Describe all possible squares that these two points together define. Relate your description to the Square Hough space.

4. **Feature Detectors (20 pts)**

a. In the SIFT feature detector, the local histogram of edge directions is computed. In 1 or 2 sentences, describe how this information is used and why it is needed.

b. In the HOG feature detector, why is a 128 x 64 window used?