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MSAI 495 Computer Vision
MP #6

Hough Transform Report

In this assignment we implement a hough transform to fit lines to the edges of an image. These lines will be parameterized with *rho* and *theta*, where rho represents the radial distance of some point *p* from the top-left corner. The angle between the top border of the image and the ray through p is theta. Define our line as the only line that is perpendicular to the ray and passes through p. We then initialize a 2D array called the *parameter space* to all 0s. Indexes in this array represent possible values of rho and theta. Then for each pixel in the edges, we increment the value at each possible (rho, theta) pair that passes through this pixel. This is called *voting*, as each point in the edge map "votes" for a specific pair of parameters. After this, we are left with a voting map with some number of votes for each pair of parameters considered. We then treat the parameter space as an image, and identify local maxima in the image. These local maxima correspond with lines in the original edge map, and so can be reparameterized into slope/y-intercept form and superimposed on the original image.

In my implementation, I considered a parameter space of 200x200. I identified local maxima in the parameter space by using a 7x7 dilation of the parameter space, and identifying where a pixel in the parameter space was greater than or equal to the corresponding pixel in the dilated image. Then, pixels that had this property, and were above the *significance threshold* of 50% of 255, were chosen as local maxima.

My results were promising but not ideal. I considered many permutations of the above hyperparameters, of which the above were the best I found. Changing any of these parameters resulted in the most significant lines being lost, or so many lines being superimposed that it was useless. These blurry lines were tricky to identify the best local maximum given my approach. Below are images of the parameter space, the dilated parameter space, the local maxima identified, and the final edges. Also note that very steep lines are dotted, as I draw these lines without anti-aliasing.