Hough transform: Sample Problem

For this problem you will use the Matlab built-in function `hough()` which performs a Hough transform of a binary image. Functions `plotSHT(), plotPeaks(), and plotLines()` are provided to visualize the Hough transfrom result. The input image for the Hough transform is expected to be a binary edge map. The format of the function call is

```
[H,T,R] = hough(BW,'RhoResolution',rhoResol,'Theta',thetaResol);
plotSHT(H,T,R);
```

where BW is the binary edge map, and we will set the bin size `rhoResol = 0.5` and `thetaResol = -90:0.5:89.5`.

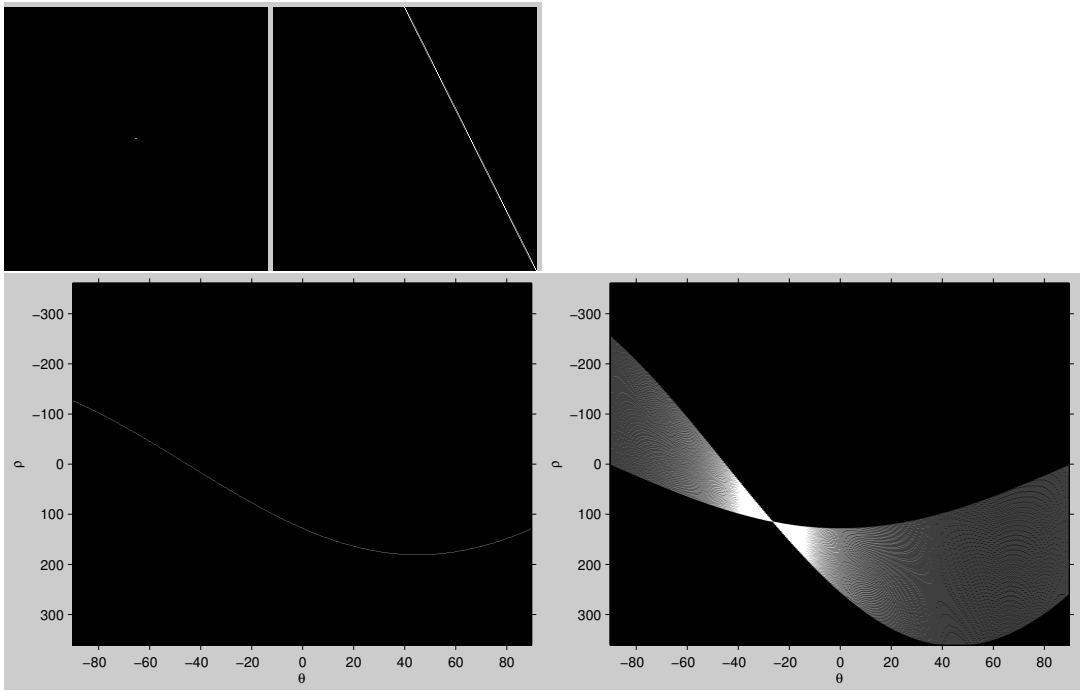
(a) Make at least 5 binary test images and run the Hough algorithm on them. You can make test images which have lines (individual lines, or many lines with the same slope, or many lines with the same intercept, etc.) or blobs, or circles. Here are some examples of test images:

In each case, look at the Hough output array using the plotSHT command, and *interpret it*. That is, what portions of the array correspond to what features in your image? Include in your homework printouts of your test images, and of the corresponding Hough arrays. You can try making the Hough array size mentioned at the beginning; you can also try other sizes if you want.

Hough transform: Solution to Sample Problem

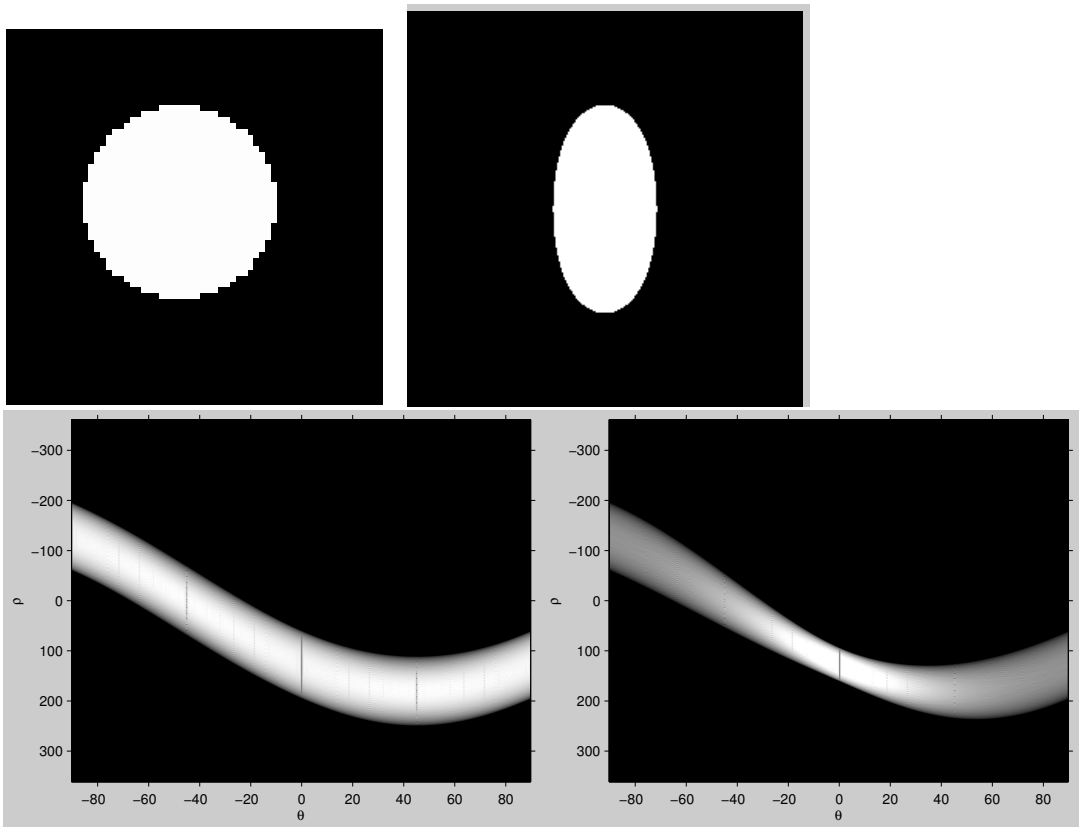
(a) Several examples are generated. We introduce some interesting pairs of comparison below.

A Point and A Line



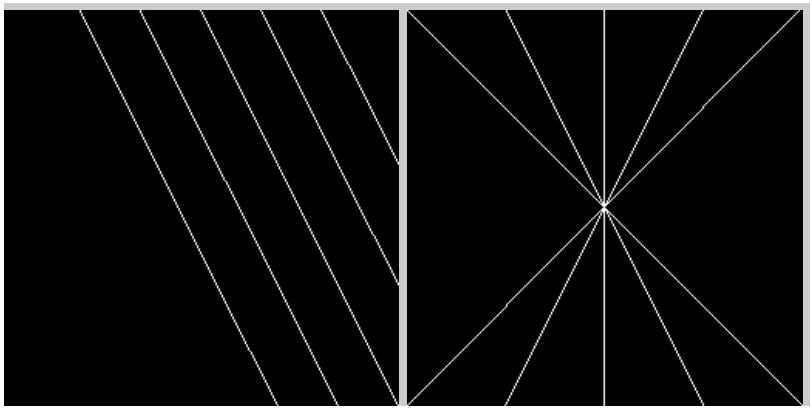
Hough transform of a point is a curve which goes through θ from -90 degree to 89.5 degree. The Hough transform of a line intersects curves at a point.

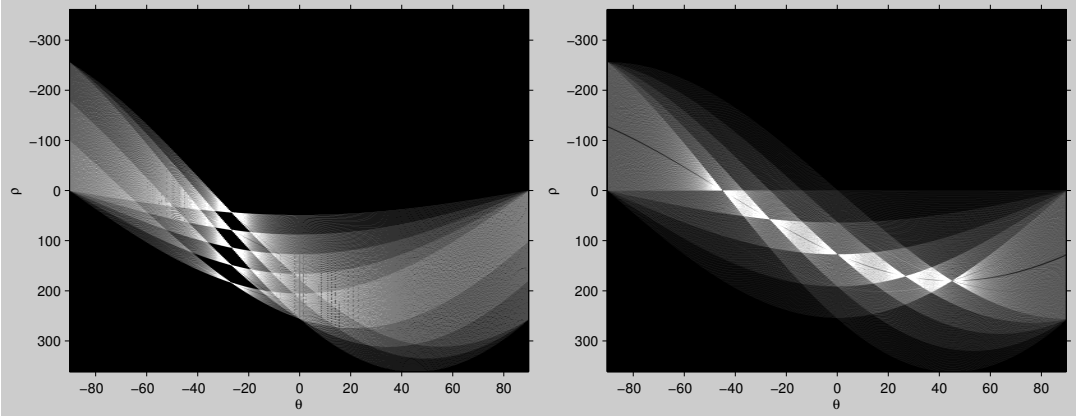
Circle and Ellipse



Hough transform of a circle by symmetry is a curve with constant width at ρ dimension through θ from -90 degree to 89.5 degree. The Hough transform of a ellipse is a curve with changing width at ρ dimension.

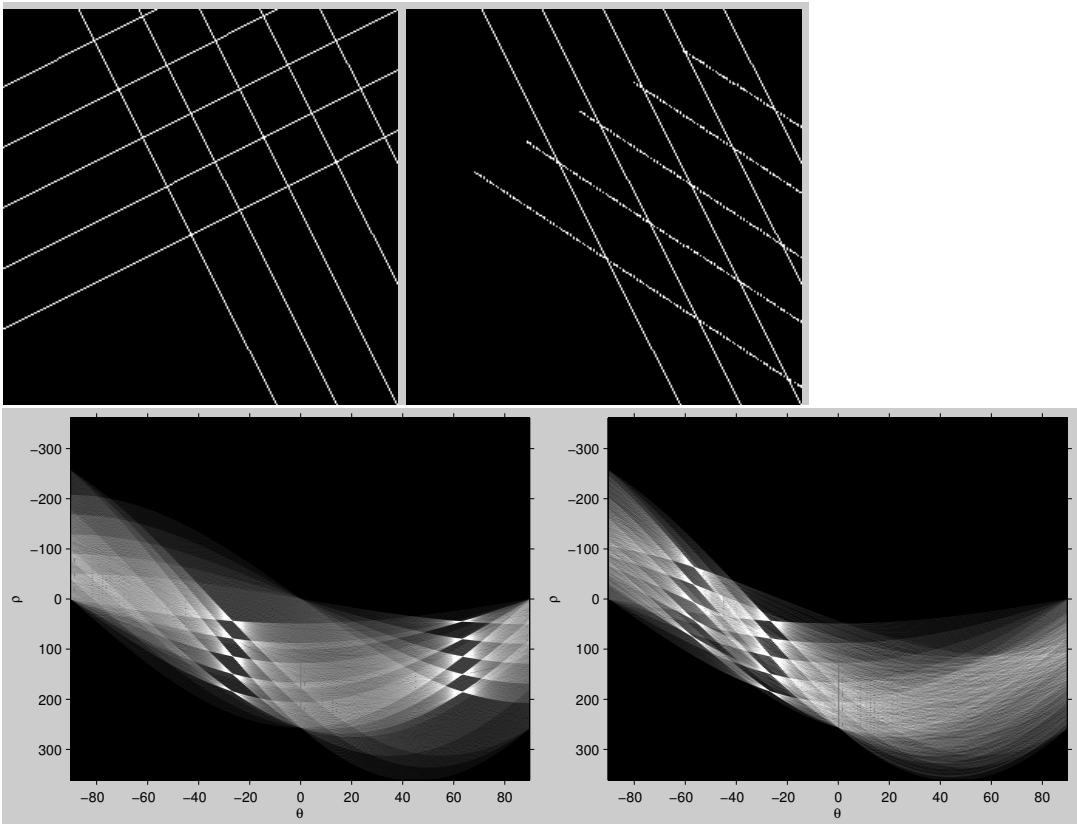
Parallel Lines and Intersecting Lines





Hough transform of k parallel lines has k intersections at the same θ value. The Hough transform of k intersected lines also has k intersections but with different θ values.

Perpendicular Lines and Non-perpendicular Lines



Hough transform of two perpendicular lines has two θ values. The differences of θ value should be 90 degree for perpendicular lines. So we can check if two lines are perpendicular by looking at the differences of θ values.