CS 6643 Computer Vision, Spring 2018, **G. Gerig**

Assignment 3 Theoretical Part

Out: 4/03/2018

Due: 4/10/2018 (deadline: midnight)

Late submissions: Late submissions result in 10% deduction for each day. The assignment will no longer be accepted 3 days after the deadline.

Office hours:

		Monday	Wed	Thu	Fri
Guido Gerig	office 10.094	2 - 4pm			
Yida Zhou	yz4499@nyu.edu			1-3pm	
Zebin Xu	zebinxu@nyu.edu		2 - 4pm		
Andrew Dempsey	ad4338@nyu.edu				10 - noon
Monil D. Shah	mds747@nyu.edu	4 - 6pm			

Location: Cubicle spaces in front of my office named 10.098 A,B,D,E,H.

A) Theoretical questions:

A1) Hough Transform: Parametrization

The standard parametrization of a line, $y = m_0 x + b_0$, with m_0 and b_0 slope and intercept, has not become the standard parametrization for the Hough transform for finding lines.

- Explain why this option did not become a popular choice.
- Would you still use it, what can you say about the discrete grid of the Hough space with axes m_0 and b_0 in regard to Hough space cell spacing and its representation of lines.

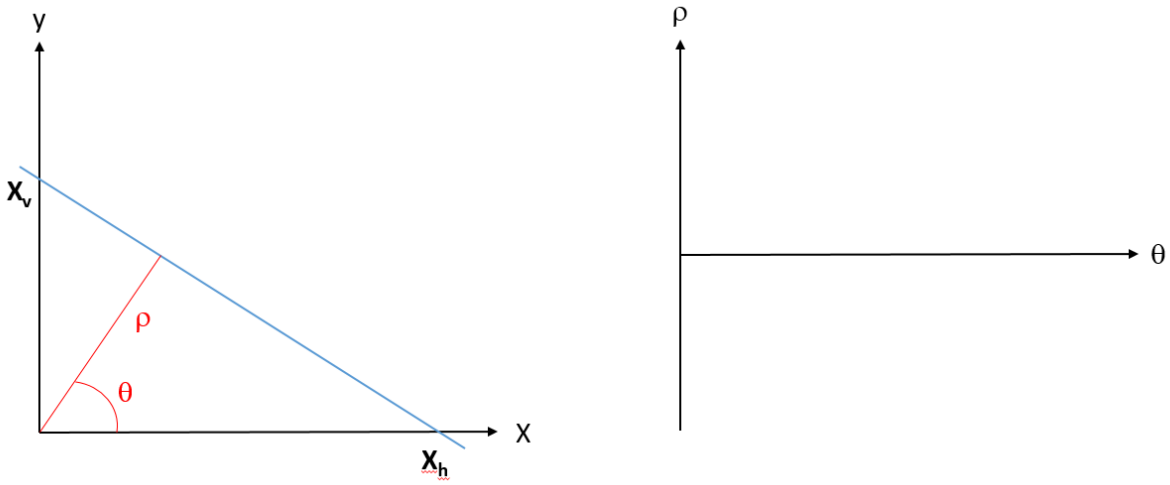
A2) Hough Transform: Polar representation I

Show that the polar representation of a line, $x\cos\theta + y\sin\theta = \rho$, represents a Cosine function in parameter space with axes Θ and ρ. (Remember that a general Cosine function is given as y=a cos (α-δ)), with a=amplitude and δ= phase shift).

A3): Hough Transform: Polar representation II

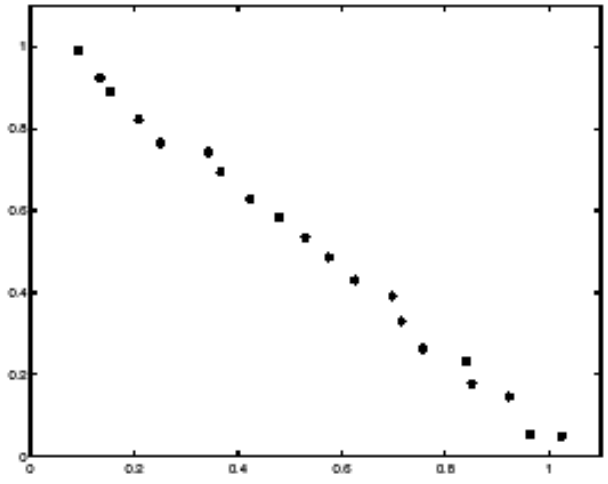
Given a scenario with a line in (x,y)-space intersecting with the horizontal axis at $\overline{x}_h$ and with the vertical axis at $\overline{x}_v$, calculate and plot the corresponding Cosine curves in the (θ, ρ) parameter space.

Calculate the intersection of the two parameter curves and discuss how its coordinates (θ, ρ) represent the line l in image space.



A4) Noisy line structures

Given points forming a line but its locations corrupted by noise (see below), how would noise affect the clustering of curves in Hough space? What could you do to still find a peak with associated parameters that would represent the noisy line?



A5) Hough Transform for Ellipses

We have learned that the Hough transform for circles requires three parameters, two for the center and one for the radius, thus spanning a 3-D parameter space. Now let us find ellipses in its standard form (no orientation) with varying size?

Would the Generalized Hough Transform (GHT), as discussed in the course using R-tables for creating a template, eventually offer a solution? Sketch it with a drawing and some short explanation. What about finding ellipses in different orientations given the GHT?