CS 4/791E Computer Vision

Spring 2004 - Dr. George Bebis

Homework 3

Due date: 3/23/04

1. Consider the least-squares approach for finding the best line approximation to a set of points. Derive the least-square solution using the slope-intercept line representation instead of the polar line representation discussed in class. Then, find the parameters of the best line approximation given the points (0, -7), (3, -1), (3, 5), and (1, 4). Use *gnuplot* or any other software to plot the best fit line and the points.

2. Let us suppose that we want to search for straight lines in a binary image (i.e., created by thresholding the gradient magnitude) having size $N = N_1 x N_2$. The simplest approach is to find all possible lines determined by pairs of pixels and to check if subsets of the binary image pixels belong to any of these lines. What is the big-O (worst-case) complexity of this brute-force approach? How does it compare to the big-O complexity of the Hough transform? (you need to derive the big-O complexity of the Hough transform).

3. Let us suppose that the gray-level values of the object and background pixels are distributed according to the probability density function:

$$p(x) = \begin{cases} \frac{3}{4a^3}[a^2 - (x-b)^2] & b - a \le x \le b + a \\ 0 & otherwise \end{cases}$$

with $a = 1$, $b = 5$ for the background and $a = 2$, $b = 7$ for the object. Sketch the two distributions. If the object pixels are 8/9 of the total number of pixels, determine the optimum threshold.