HomeWork-1: Change Detection using Fitting Models

Due Date: 11:59 PM, 28th February, 2017

I_1	I_2
	

Let I_1& I_2be two registered images of size (n, m) as shown above. Let $D = \{d_{11}, d_{12}, \ldots, d_{nm}\}$ such that $d_{ij} = \{I_1(i,j), I_2(i,j)\}$ be a set of data points, where $I_1(i,j)$is the intensity of the pixel located at (i,j)in image I_1.

Assuming $I_1 and\ I_2$were grey scale images, $0 \leq I_1(i,j), I_2(i,j) \leq 255\ \forall\ (i,j)$,

If the two images were equal, the plot of these points in the Euclidian space would be symmetrical as $I_1(i,j) = I_2(i,j) \forall\ (i,j)$, shown in Figure 1.

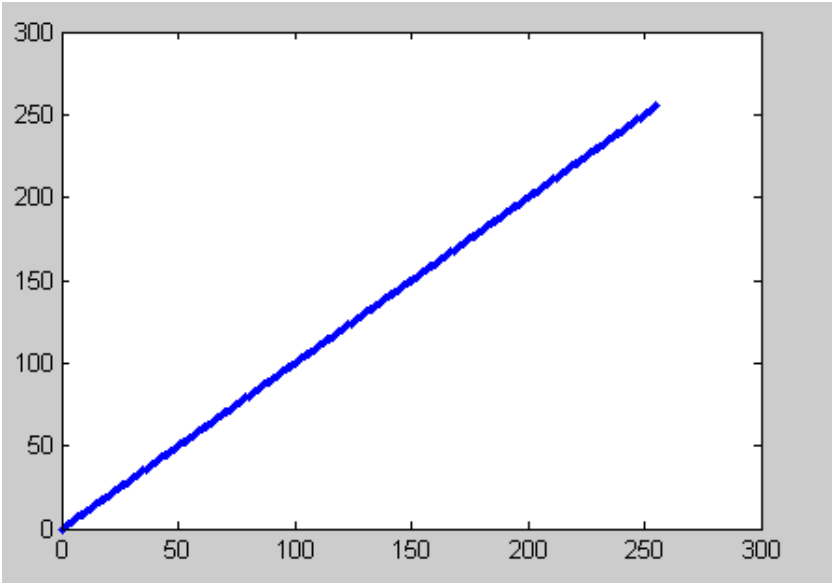

Figure 1

However, there is noise and the plot would look more like Figure 2.

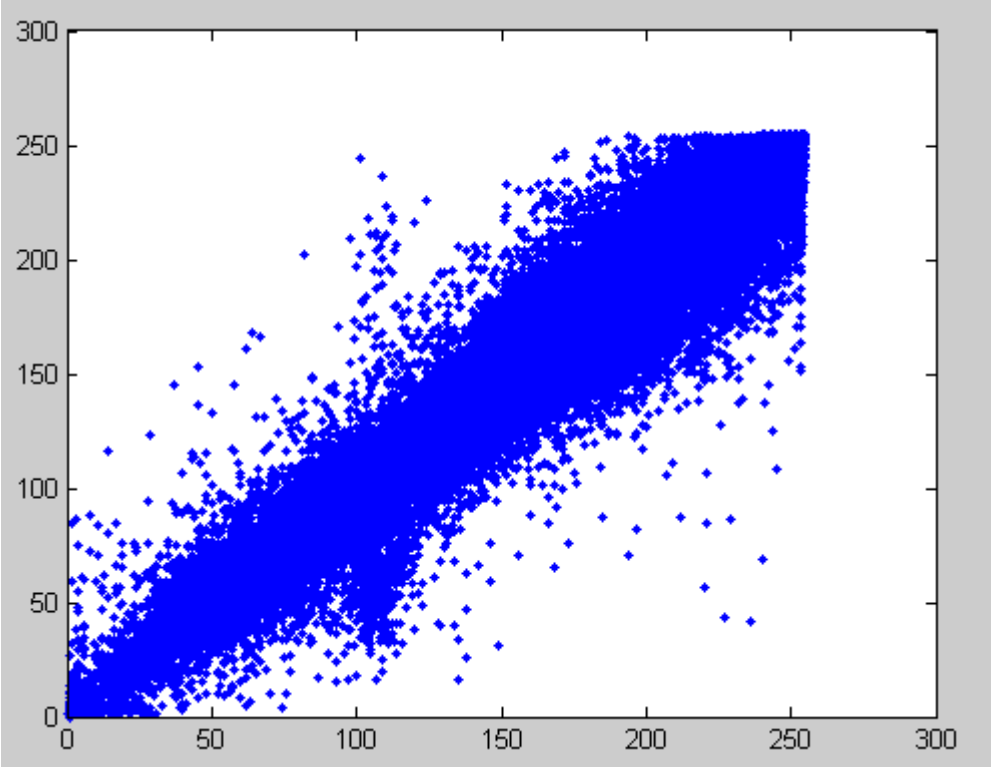

Figure 2

If there was a model that represents these points, the data points that show a large deviation from the model would be considered to be pixels that have changed. The goal of the homework is to use fitting approaches to identify the model. Then use the model to identify the pixels that show a large deviation from the scene.

A. Fitting (8 Pts):
    a. Plot the data points on an image.
    b. Line fitting: Use total least squares to fit a line to the model and report the parameters of the line. Plot the line along with the data points. See Figure 3
    c. Use robust estimators to fit a line and report the parameters of the line. Report the value of the scale used and justify. Plot the line along with the data points.
    d. Fit the data points to a Gaussian and report the parameters of the model. Plot the mean and the Gaussian using an ellipse along with the data points.

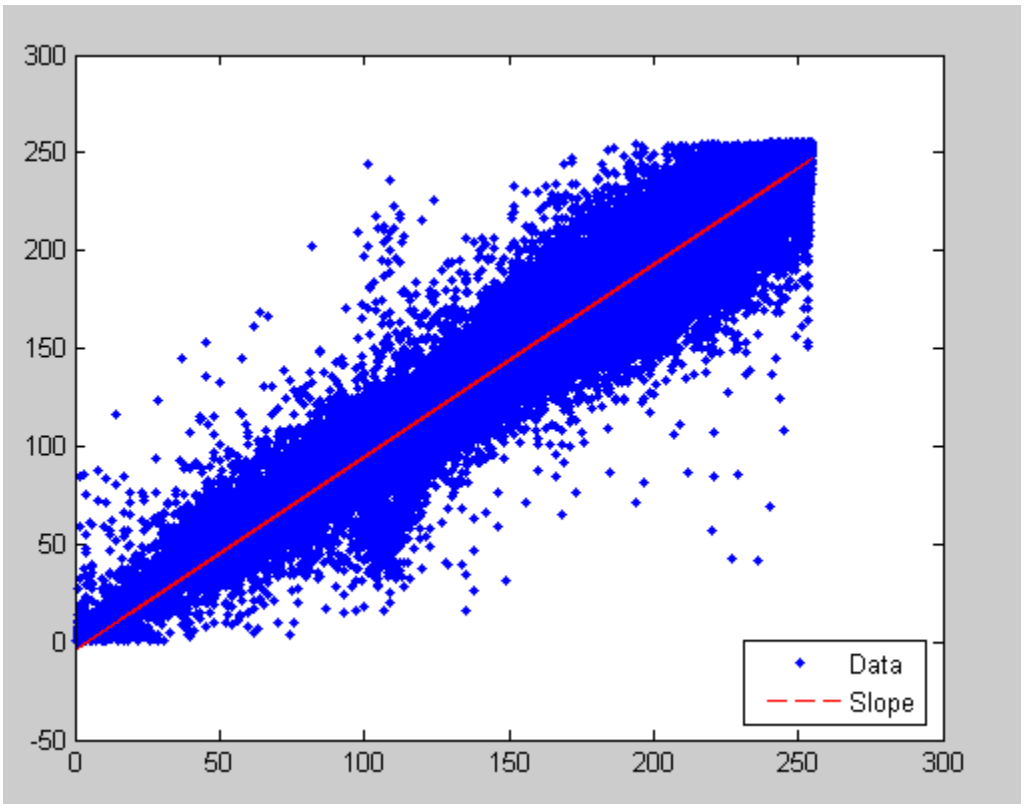

Figure 3

B. Changed pixel detection(6 Pts):
   a. Line model: For the line parameters obtained above, identify the pixels that are far from the line by thresholding the perpendicular distance. Report and justify the threshold value used and compare the parameters from least squared error with the parameters from Robust estimators. Plot the data points that are outside the threshold. See Figure 4
   b. Gaussian Model: For the Gaussian parameters obtained above, Identify the pixels that are far from the model by thresholding the probability and the distance from the mean. Report the threshold values and justify.

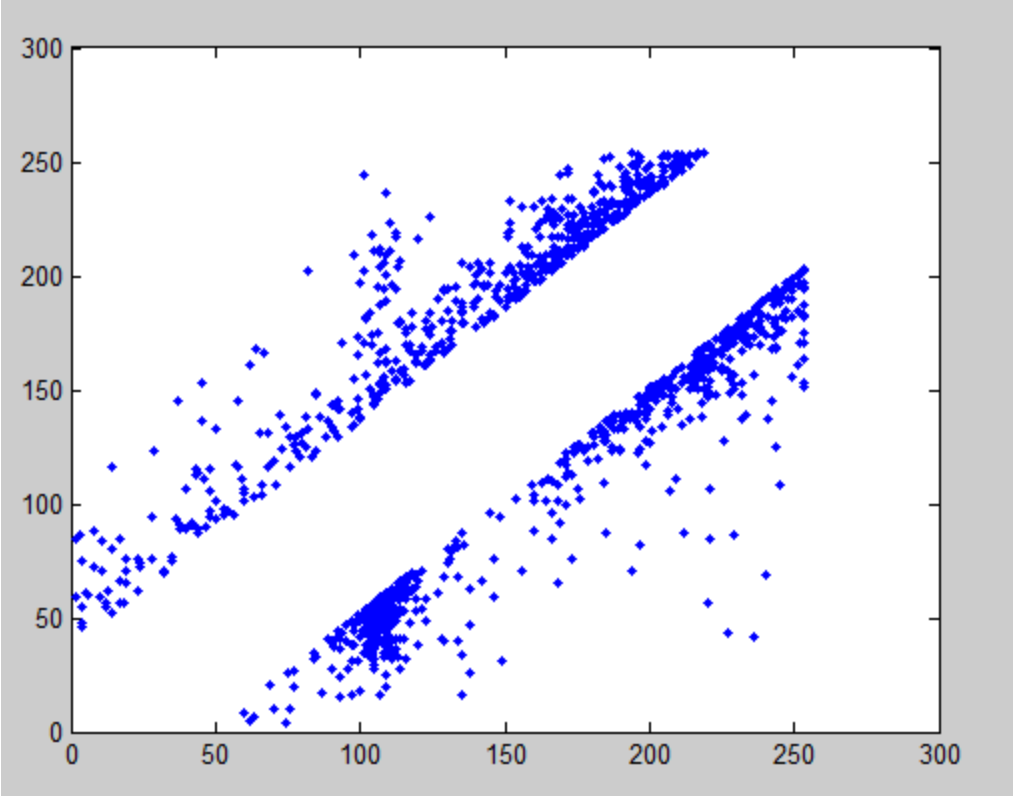

Figure 4

C. Segmentation (3 Pts):
    a. Identify these pixels in the image that are detected in the previous step. Apply Image morphological operators to remove noise (Hint: Erosion, Dilution) See Figure 5 & 6.

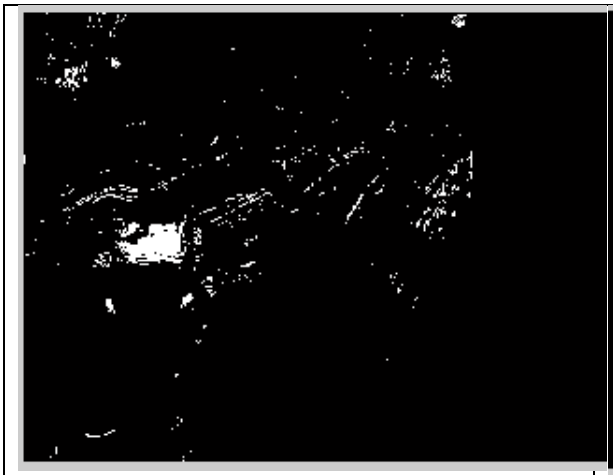

Figure 5

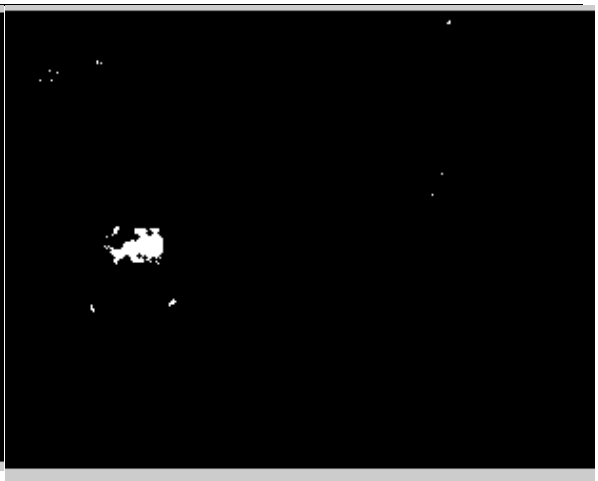

Figure 6

D. Report (3 Pts):
    a. Document your finding in the report.

Instruction:

1. Put the contents in a zip file (FileName: “firstname_lastname_HW_1.zip)
2. Email completed assignment to the TA by deadline.
3. Late submissions incur penalty. (Refer to late submission policy from the Lecture1.)
4. All coding must be done using **C/C++**.
5. The homework must utilize **OpenCV 3.1** library.

Submission Instructions:

1. TBA