2016 Remote Sensing - Homework 2

Gaussian Maximum Likelihood Classification (GMLC) and Uncertainty Assessment

A 2-class (ω_1 and ω_2) and 2-D feature space problem. Let $X^T = (X_1 \quad X_2)$ be a Gaussian feature vector having the following parameters:

Parameters of the bivariate Gaussian distributions of individual classes

	Parameters	
	Class 1	Class 2
Mean vector	$\begin{bmatrix} 70 \\ 130 \end{bmatrix}$	$\begin{bmatrix} 148 \\ 160 \end{bmatrix}$
Covariance matrix	$\begin{bmatrix} 784 & -546 \\ -546 & 900 \end{bmatrix}$	$\begin{bmatrix} 484 & 285.1 \\ 285.1 & 324 \end{bmatrix}$

(1) In the 2-D feature space ($0 \le X_1, X_2 \le 255$), determine and delineate the class boundary between ω_1 and ω_2.

(2) Generate 1,000 sets of random samples for ω_1 and ω_2, respectively, each of sample size 100.

$$X^{(j)}(\omega_i) = \begin{bmatrix} X_{1,1}^{(j)}(\omega_i) & X_{1,2}^{(j)}(\omega_i) & \cdots & X_{1,100}^{(j)}(\omega_i) \\ X_{2,1}^{(j)}(\omega_i) & X_{2,2}^{(j)}(\omega_i) & \cdots & X_{2,100}^{(j)}(\omega_i) \end{bmatrix}^T, \quad j = 1, \cdots, 1000.$$

These samples are considered as training or reference samples.

(3) For each set of random samples of ω_1 and ω_2, i.e. [$X^{(j)}(\omega_1)$, $X^{(j)}(\omega_2)$], estimate the mean vector and covariance matrix of individual classes and then use these estimates to determine and delineate the class boundary.

(4) Using the estimates of the mean vector and covariance matrix in (3), conduct the GMLC for each set of [$X^{(j)}(\omega_1)$, $X^{(j)}(\omega_2)$] and establish the corresponding confusion matrix.

(5) Calculate the mean and standard deviation of the producer's, user's, and overall accuracies.

(6) Plot the histograms of the producer's, user's, and overall accuracies.