Computer Science and Engineering 4422.03

Final
Dec. 12 2016

Answer all questions in the space provided

Student Last Name: _____

Student Given Name: _____

Student Id. No: _____

Question	Value	Score
1	50	
2	50	
3	30	
4	45	
Total	130	

Question 1. [50 points]

Consider the point matching problem again. This time the model is slightly different:

$$\vec{\Delta I} = \vec{n} + \vec{I}\, f$$

where $\vec{\Delta I} = \vec{I_2}\vec{I_1}$ is the difference of the two patches, $\vec{n}$ is an iid noise vector (like before where the variance covariance matrix is ${\sigma_n}^2\mathbf{1}$), $\vec{I}$ is the sum of the two patches $\vec{I_2} + \vec{I_1}$ and f is a random variable with variance ${\sigma_f}^2$.

Show the minimizing the Mahalanobis distance

$$\vec{\Delta I}^T {C_{\Delta I}}^{-1} \vec{\Delta I}$$

where

$$C_{\Delta I} = \mathbf{E}\left\{ \vec{\Delta I} \vec{\Delta I}^T \right\}$$

happens when

$$\mu_{12} = \vec{I_1} \cdot \vec{I_2}$$

is maximized when ${\sigma_f}^2$ goes to infinity.

Question 2.

[50 points]

Consider the polynomial fitting to an 1-D image I. Start by fitting a quadratic on points $I[i-1]$, $I[i]$ and $I[i+1]$. One can find the derivative on position i by taking the derivative of the polynomial. Do it symbolically, simplify the expression show it is a convolution and find the convolution kernel. Do the same by fitting a fourth degree polynomial on points $I[i-2]$ ... $I[i+2]$.