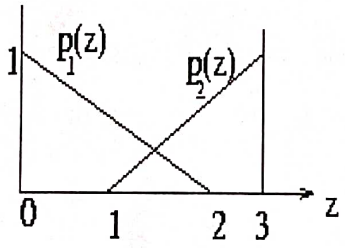
Department of Computer Science and Engineering, S V N I T, Surat
End Semester Examination, December 2021
M.Tech.-I Computer Engineering (First Semester)
Course: (CO611) Computer Vision and Image Processing

Date: 23 Dec 2021 Time: 9:30 am to 12:30 pm Marks: 50

Instructions:
1. Write your MTech Admission No/Roll No and other details clearly on the answer books.
2. Assume any necessary data but give proper justifications.
3. Be precise and clear in answering the questions.

Q.1 [10]

(a) Suppose that an image has the gray-level probability density functions shown. Here, $p_1(z)$ corresponds to objects and $p_2(z)$ corresponds to the background. Assume that $P_1 = P_2$ and find the optimal threshold between object and background pixels. [5]



(b) Derive the depth map of a sphere in the form of reflectance map. [2]

(c) What is albedo? How the albedo can be estimated? [1]

(d) What is the charateristic of Lambertian surface? Derive the value of BRDF for it. [2]

Q.2 Answer the following. [16]

(a) Describe the basic block diagram of MPEG encoder and decoder. [4]

(b) Explain the inttraframe and interframe encoding. [4]

(c) Define optical flow. What is an aperature problem? Derive the equations for determining the discrete value of optical flow parameters using calculus of variations technique. [6]

Q.3 Answer the following. [10]

(a) What is MRF? Explain various problems: depth evaluation, image restoration, image de-noising and edge detection as labelling problem in detail. [5]

(b) What is a clique? Explain the energy function and potential function with necessary equations for image segmentation problem using MRF based modelling. [5]

Q.4 Answer any two. [8]

(a) What is an expression for weighted averaging filter of size $m \times n$? Using this expression state the output for the following image segment and filter mask.

Image segment

10	20	30
25	15	35
65	45	55

Filter mask

1	2	1
2	4	2
1	2	1

(b) What is Histogram equalization? What is the transformation function to obtain the histogram equalized image if the histogram of input images is modeled as Gaussian probability density functions of the form

$$p_r(r) = \frac{1}{\sqrt{2\pi}\sigma} \exp - \frac{(r-m)^2}{2\sigma^2}$$

where m and σ are the mean and standard deviation of the Gaussian PDF. The approach is to let m and σ be measures of average gray level and contrast of a given image.

(c) Describe Laplacian and Gradient filters and state the output using each filter for the image segment given in Q.4 (a).

(d) Describe the camera calibration parameters with necessary equations. How these parameters are determined?

Q.5 What is a characteristic curve? Derive the necessary equations to compute changes in (p, q) and z along the characteristic strip for an image irradiance $E(x, y) = f(p^2 + q^2)$. [6]