Department of Computer Science and Engineering
Indian Institute of Technology (ISM) Dhanbad

Exam: End Semester Monsoon, Session: 2024-2025	Date: Sunday, 24 NOV, 2024 Time:9AM-12NOON Venue: NLHC CR 1, Number of students 16	
Subject: **COMPUTER VISION NCSD503**	Full Marks:**100**	Course instructor: S Mukhopadhyay (845)

Instructions: (i) ANSWER ALL QUESTIONS (ii) DO NOT REPEAT ANSWERS OF SAME QUESTION ON TWO DIFFERENT SHEETS IN YOUR ANSWER SCRIPT (iii) SPECIFY QUESTION NUMBER CLEARLY =BEFORE YOUR ANSWER (iv) WRITE YOUR ADMISSION NUMBER AND NAME LEGIBLY. EVERY EXTRA SHEET YOU USE MUST CONTAIN YOUR ADMISSION NUMBER, NAME AND SHEET NUMBER (v) DO NOT USE RED INK or RED COLOR, Do not use PENCIL and use ink of deep colour (black/blue)

Q. No.	*Question*	*Marks*
1	**What is the importance of multi-resolution image processing? What is the general approach of multiresolution image processing? How would you perform multi-resolution noise suppression employing wavelets? Illustrate the working principle of watershed segmentation algorithm.** Processing at single resolution often makes use of mask/kernels/threshold values and other parameters. Setting these values same for features of all size cannot do justice to these feature. In multi-scale or multi resolution processing we can set these categorically for features of varying scales or features viewed at multiple resolution The image is first decomposed into multiple description based on resolution/scale using suitable transforms/filters like wavelets, multiscale morphology etc. These generated set of images are processed to produce partial results The partial results are then combined to obtain the final results Noise predominates at high resolution, due to its abrupt change over short spatial span. Decompose the image using wavelet. Threshold the detail coefficients – you can either reduce them, or truncate them or you can threshold them (hard or soft). Take the inverse transform to construct the smooth image. For watershed transform see any standard text book or the study material I had sent.	***3+4+5+5= 17***
2	**Define optical flow. What are the two basic assumptions you consider before computing optical flow? Explain in detail the working principle of Horn and Shunck method for computing optical flow. What are the differences between Horn-Shunck method and Lucas-Kanade method employed for optical flow?** Kindly refer to the materials I had sent Forsyth, Ponce “Computer vision: a modern approach”:-Chapter 10, Sec 10.6-Chapter 11, Sec 11.1Szeliski, “Computer Vision: algorithms and applications"-Chapter 8, Sec. 8.5	***2+4+8+2= 16***

3a	**Why do we need feature descriptors? What should be the desired characteristics of good feature descriptors that are widely used in computer vision tasks? What are the advantages of Laplacian of Gaussian filters in feature processing?** Leow Kindly refer to the notes of David Lowe and Computer Vision and Pattern Recognition by Leow Wee Kheng D,epartment of Computer Science School of Computing National University of Singapore	***2+3+3=8***
3b	**What is the difference between image alignment and image fitting? Illustrate the task of feature based alignment highlighting all its salient components** Kindly refer to the materials I had sent COS 429: Computer Vision note on image alignment and sticting Find keypoints; compute SIFT descriptors Generate candidate keypoint matches Use RANSAC to select a subset of matches Fit to find best image transformation Warp images according to transformation Blend images in overlapping regions	***2+8=10***
4a	**Illustrate how Hough transform works in detecting line structures present in a binary image. How can you extend this for detecting circular structures from binary images?** Please refer to my classes The input is a binary image, with only foreground and background pixels. Select a reference point as origin, x and y axis. For every foreground pixel at location x and y allow a line to pass through this. This line has parameters (p and theta) Allow theta to vary over a range of 0 to 179 degrees and calculate p for each theta for that x and y. Update the accumulator array. Finally carry out non-maximal suppression in the accumulator array. The prominent peaks correspond to potential lines Draw Bresenham lines with prominent p and theta values and take intersection with the original image. Remove small lines or dots. Save the lines with the coordinates of their extremities For finding circles use a 3D accumulator array indexed by a,b and r where a and b are the coordinates of centres of the circles to be detected and r is the radius of the	***8+4=12***

	circle to be detected. Proceed similarly. If you have incomplete circles you have to maintain the records on centre and radius of such circles alongwith the angle subtended by the circular arc at the detected centre.	
4b	**Illustrate the working principle of Harris Corner detector. What are the salient properties of Harris corner detector? Explain the working principle of SIFT operator.** Kindly refer to the materials I had sent COS 429: Computer Vision note on image alignment and sticting	*6+3+6=15*
5a	**Illustrate various salient components and functionalities of a video surveillance system with a suitable block diagram stating the roles and scopes of associated computer vision tasks** Kindly refer to (I had sent) **A System for Video Surveillance and Monitoring** _ Robert T. Collins, Alan J. Lipton, Takeo Kanade, Hironobu Fujiyoshi, David Duggins, Yanghai Tsin, David Tolliver, Nobuyoshi Enomoto, Osamu Hasegawa, Peter Burt1 and Lambert Wixson1 A review of video surveillance systems Omar Elharrouss, Noor Almaadeed, Somaya Al-Maadeed Journal of visual communication and image representation	*10*
5b	**What is the importance of dimensionality reduction in computer vision? Illustrate how a block based PCA on digital gray-scale image serves this purpose.** Kindly refer to Lindsey Smith paper I had sent	*2+10=12*

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