Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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A Constituent Institution of Manipal University

SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: Motion and Geometry Based Methods in Computer Vision (ECE - 445)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** questions.
- Missing data may be suitably assumed.

1A. Define the following 2D and 3D transformations along with their transformation matrix: Projective, Affine, and Euclidean. Also, state the degree of freedom (DOF) in each case.

1B. Describe the different steps of Histogram of Oriented Gradient (HOG) feature extraction for a 64 x 128 image.

1C. Given three planes in the 3D space represented by $\pi_i, i = 1,2,3$. Describe a procedure to calculate the point of intersection of these planes using homogenous vector representation.

(5+3+2)

2A. Given a rigid object, where the target set ($T = \{y_j\}$, $j=1,..N$) is rotated, translated and scaled version of the source set ($S = \{x_i\}$, $i=1,..M$) and there might be some noise. Describe a least square based procedure for estimating the rotation, translation and scale parameter(s). Also describe iterated closest point algorithm for registering a rigid object.

2B. Describe image registration using mutual information.

2C. Describe the procedure to build image mosaics from more than two images.

(5+3+2)

3A. Define optical flow. Describe in detail the method proposed by Horn and Schunck to compute optical flow.

3B. Describe Lucas and Kanade method to compute optical flow. Discuss the advantages (if any) of using Gaussian pyramids while computing Lucas-Kanade optical flow.

3C. Compare the two simple strategies for tracking an object: Tracking by detection and tracking by matching.

(5+3+2)

4A. Differentiate between stratified approach and direct approach for upgrading a projective reconstruction to metric reconstruction. Describe an approach for upgrading a projective reconstruction to affine reconstruction. Clearly identify the extra information needed (about the scene, motion or camera calibration) for upgrading projective to affine reconstruction.

4B. Describe correlation based method for finding the pixel-wise image correspondence. Discuss the disadvantage(s) of the correlation based approaches for binocular fusion.

4C. Given $M_i, i = 1, .. m$ projection matrices, and $X_j, j = 1, ... n$ 3D points, state the minimum number of corresponding image points necessary to recover the projective structure of the scene from an uncalibrated perspective camera. Justify your answer.

(5+3+2)

5A. Show the algebraic and geometric derivation of fundamental matrix..

5B. Assume *x, x'* are the two image points of the 3D scene point *X*. With the help of a neat diagram, define the following terms: Epipolar line, Baseline, Epipolar plane, Epipoles for the corresponding points *x,x'.*

5C. Define image rectification. Explain its utility in scene reconstruction.

(5+3+2)

6A. Define step and roof edges in range images. Describe in detail the procedure for finding step and roof edges in range images using computational molecules. Explain why the methods using to calculate edges in grayscale images cannot be used in case of range images.

6B. Define Quaternions. Describe how Quaternions can be used to compute the rigid transformation for registering range images.

6C. Assume we wish to find the corresponding image points *x, x'* for a given 3D scene point X. State ordering and smoothness constraint which are incorporated in global approaches for establishing pixel-wise image correspondence.

(5+3+2)