Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SEVENTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION NOV/DEC 2016

SUBJECT: MOTION AND GEOMETRY BASED METHODS IN COMPUTER VISION (ECE - 445)

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

Instructions to candidates

- Answer **ANY FIVE** full 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. Explain why an RANSAC-based approach cannot be used to register deformable objects. List at least two applications that require registering deformable objects.

(5+3+2)

3A. Describe the different steps of a simple KLT tracker. In a KLT tracker, given two local patches between two consecutive frames, explain the procedure to compute the affine transformation between these two patches.

3B. Describe Lucas and Kanade method to compute optical flow. Discuss the advantages 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. For an unknown 3D scene point X, assume that the corresponding image points (x,x') are known. Derive the relationship ($x'^T F x = 0$) between the image points x, x' and F using canonical cameras. Explain the bundle adjustment method for recovering the projective structure of the scene for uncalibrated perspective camera. Discuss advantages and disadvantages of bundle adjustment method.

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 range images. Describe triangulation-based range sensors and time of flight range sensors.

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)