Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

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 - 4039)

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

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

1A. Differentiate between Euclidean, Affine and Projective space. Explain the utility of the circular points situated on the line at infinity in recovering Euclidean geometry from Affine geometry. Justify your answer. Compute the intersection of the following pairs of lines (L1, L2) using homogeneous representation a) L1: x = 5, L2: y = 3; b)L1: x-1 = 0, L2: x = 5

1B. Define the Gaussian kernel. Given a grayscale image corrupted with noise. Assume that the Gaussian smoothing is utilized to reduce the noise. Discuss the effect of varying the standard deviation of the Gaussian kernel in Gaussian smoothing.

1C. Suppose we have a television view of a soccer field with players moving around. If each player occupies 10-30 pixels rectangular box, describe a procedure to track the rectangular box in the video (assume a pure translation motion model).

(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. Also, describe iterated closest point algorithm for registering a rigid object.

2B. Describe image registration using mutual information

2C. Define image rectification. Explain its utility in 3D scene reconstruction.

(5+3+2)

3A. Given two static cameras observing a scene. Assume the camera parameters (camera projection matrices) and the image points x, x' corresponding to the 3D scene point X are known. Describe two triangulation methods for computing the 3D scene point X. Describe correlation-based method for finding the pixel-wise image correspondence (binocular fusion). Describe one limitation of the correlation-based approaches for binocular fusion.

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

3C. Describe triangulation-based range sensors.

(5+3+2)

4A. For a 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 the uncalibrated perspective camera. Discuss benefits and limitations of bundle adjustment method.

4B. In a KLT tracker, given two local patches between two consecutive frames, describe the procedure to compute the affine transformation between these two patches.

4C. Discuss two application of range images.

(5+3+2)

5A. 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 using scene information.

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. Explain how Quaternions can be used to compute the rigid transformation for registering range images

(5+3+2)