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# MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

A Constituent Institution of Manipal University

**SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION**
**NOV/DEC 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. (i) Define the following 3D transformations: Similarity, Euclidean, and Projective. Also, state degree of freedom for each transformation along with the transformation equation indicating the dimension of the respective matrices.

(ii) 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.

1B. Define textures. Describe the procedure to synthesize one missing pixel from a texture image.

1C. Differentiate between local and global approaches for finding the corresponding image points x, x' for a given 3D scene point X (binocular fusion). State smoothness constraint which are incorporated in global approaches for establishing pixel wise image correspondence.

(5+3+2)

2A. In registering a rigid object by searching the space of correspondence, there might be multiple correspondences between source and the target. Describe a RANSAC-based approach to estimate the transformation parameters in this scenario. Explain why a RANSAC based approach cannot be used to register deformable objects. List at least two applications that require registering deformable objects.

2B. Given six images I1 , I2, I3, I4, I5, and I6. Describe the bundle adjustment based method for creating image mosaic from these six images. State one limitation of this approach.

2C. Define range images. Explain the utility of range images in 3D reconstruction.

(5+3+2)

3A. Define optical flow. Describe Lukas and Kanade (LK) method to compute optical flow. Explain the reason for a poor estimate of optical flow in the areas of large motion using LK method. Mention a possible solution to overcome this limitation.

3B. List one limitation of flow based trackers. Describe the different steps of a simple KLT tracker.

3C. Discuss two limitations of triangulation-based range sensors.

(5+3+2)

4A. Define affine camera. Explain affine epipolar geometry and affine epipolar constraint. Assume that the affine fundamental matrix has been computed, describe the procedure to compute the camera matrix from the affine fundamental matrix using the affine epipolar constraint.

4B. With the help of a suitable example, explain how dynamic programming could be used to develop an algorithm incorporating ordering constraint to compute corresponding image points x, x' for a 3D scene point X.

4C. For an internally calibrated perspective camera, discuss the usefulness of data normalization proposed by Hartley in estimating the fundamental matrix

(5+3+2)

5A. Given two uncalibrated cameras, describe the method to compute a metric reconstruction of the scene from projective reconstruction using ground control points. Also, state the minimum number of ground control points required to compute a metric reconstruction of the scene from projective reconstruction.

5B. 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 and uncalibrated weak perspective camera. Justify your answer.

5C. Define step and roof edges in range images.

(5+3+2)