EN 520.665 Machine Perception Fall 2021

Last homework!

1. Assume you are given n 3D points from frame 1 (*Xi, Yi, Zi, i*= 1, n ) and corresponding 3D points *(Xi’, Yi’, Zi’, i*= 1, n) from frame 2. These 3D points related by a rotation matrix R and a 3D translation vector T as

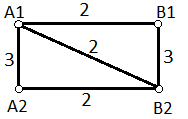
Derive an algorithm for estimating R and T. How many points are needed for producing a solution?

2. In edge-based stereo methods, edges in the left image are matched with edges in the right image to obtain disparity measurements. In this problem, we limit ourselves to matching along a single epipolar line, thus reducing the problem to one of matching in one dimension.

1. Suppose there are n edges in each image along an epipolar line. If each edge has a unique match in the other image, how many different mappings are there? Do not include the constraints that edges must be ordered the same way in both images.
2. Now add the constraint that edges must be ordered the same way in both images. If every edge has a unique match, how many different mappings are there?
3. Now let the right image have m edges (m < n). Then n – m of the left edges will be matched with the “null edge”. How many different mapping are there if we do not require that order be preserved?
4. Repeat part © for the case in which the edges are ordered the same way in both images.

3. Formulate the classical shape from shading problem using the variational approach assuming that depth values are available at an arbitrary number of points. Construct the functional to be optimized and then derive the Euler equation. Discretize the Euler equation and derive an iterative equation for estimating depth. State the assumptions you have made.

4. Consider a four nodes graph as follows. Nodes A1 and A2 are from the same class while nodes B1 and B2 are from another class. The weights for each edge are shown in the graph. Apply the normalized cut algorithm and show the results.



Due 12/13/21