Assignment 1

Iterative Closest Point Algorithm

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Theory:

Let P and Q be a point cloud. And let p_i's and q_i's be the points in P and Q respectively.

$$\overline{p} = \frac{1}{N}\sum_{i}^{N} p_i$$

$$\overline{q} = \frac{1}{N}\sum_{i}^{N} q_i$$

where $\overline{p}$ is mean of p_i's and $\overline{q}$ is mean of q_i's

X is a matrix with the columns as $(p_i - \overline{p})$'s and Y is a matrix with the columns as $(q_i - \overline{q})$'s.

Let the singular value decomposition of XY^T be as follows

$$XY^T = U\Sigma V^T$$

Then,

$$R = VU^T$$
$$t = \overline{q} - R\overline{p}$$

Procedure:

1. Find the correspondences between p_i's and q_j's in P and Q, respectively.
2. Apply the formula $t = \overline{q} - R\overline{p}$ and $R = VU^T$ for the correspondences found in the previous step.
3. Repeat steps 1 and 2 until $\|t_{k+1} - t_k\| \approx 0$ and $\|\theta_{k+1} - \theta_k\| \approx 0$

Note:
The method used for finding correspondences in the assignment is least distance method, i.e., p_i's and q_j's are aligned such that q_j corresponding to p_i has the least distance for all j=0,1,2,…,N.