Lecture: Mapping and Perception for an autonomous robot ,0510-7951

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Project 3

Topics:

- Particle Filter
- ICP- Iterative Closest Points
- Visual Odometry

2. ICP- Iterative Closest Points (35%)

In this section you will implement the algorithm of Iterative Closest Point on 2 scans (frames) in different conditions. And then analyze the results. Use the attached Google Colab notebook.

A. Implement vanilla ICP algorithm! (%10)
Set frame 2 as base, and match frame 1 to frame 2. Use K-D tree for data association and run maximum 50 iterations of ICP before breaking. Complete the code in the Google Colab notebook (fill #TODO). Describe the process.

B. Run ICP using three different mechanisms and conditions, as follows: (%10)
- Input: Full point cloud with associations pairs based on KDTree
- Input: Filtered point cloud with associations pairs based on KDTree
- Input: Filtered point cloud with associations pairs based on Nearest Neighbors

**Use Record 2011_09_26/0117. Point cloud 5 and 9

Analyze and compare the results for each case. In your answer, address the following points:

i. Show figures of the point clouds before scan correction. Explain and manually measure the expected distance between the two-point clouds.
ii. Include in the report the final scan correction results animations of the correction process (saved automatically in HTML file).

iii. Compare the performance of the full and the filtered point cloud with number of iterations , convergence time and error.

iv. Compare the results of ICP using Nearest Neighbor and K-D tree with number of iterations ,convergence time , and error. Please explain.

v. Analyze the final result of scan correction in each case. Was the correction performed properly? Are there any objects that didn't match? Why is it happening? If the scan correction failed- what might be the reason for this?

C. Run ICP on another test case- repeat section B on other test case. (%10)
Use record 2011_09_26/0013. Use Point clouds 10 and 15.

D. Advanced ICP mechanisms: "KISS-ICP" (https://www.ipb.uni-bonn.de/wp-content/papercite-data/pdf/vizzo2023ral.pdf)
Describes at least two contributions of this paper to ICP process. Briefly state the paper's assumptions and mechanism for them. (%5)