ROB312-TP5

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1 Incremental SLAM

1.1 Question 1

Incremental SLAM is the algorithm that uses more and more scan in the localisation and mapping. In the code, after we finish the initialisation of display and the necessary parameters, we use the ICP location algorithm to locate by choosing the closest scan. Then it correct the position of the scan by using the rotation matrix. Next, it compares the scan and its position and adds the scan which is far from it. At last, it displays the scan and the map. This is what it does in one iteration. It continues until it has got more the max scan.

The scan used as the reference is the scan sorted by the distance.

The difference between ICP algorithm in this code and ICP in the first practice work is that this ICP algorithm adds the scan that is far from it, while in the first practice work it doesn't. There are other small differences like that ICP in this code doesn't fill out the scan which is too near but uses the rotation matrix to correct the result.

1.2 Question 2

When the loop is closed in the environment, the odometry position is corrected in the localisation but the map built is not corrected in the figure 1.

1.3 Question 3

The role of step is the iteration times. The larger the step is, the less the iteration times will be and the number of scan will also get smaller. If the step is too large like in the figure 2, it has too few scan and it loses accuracy. The distThresholdAdd decides the number of scan that we can add in each iteration. If this parameter is small, it will add too much scan in one iteration. If it is too large just like the figure 3 shows, it does not add many necessary scan and it is not accurate. After I tested with different combination of these two parameters, I propose that step = 2 and distThresholdAdd = 0.3 to maintain a good quality of map and have small iteration times.

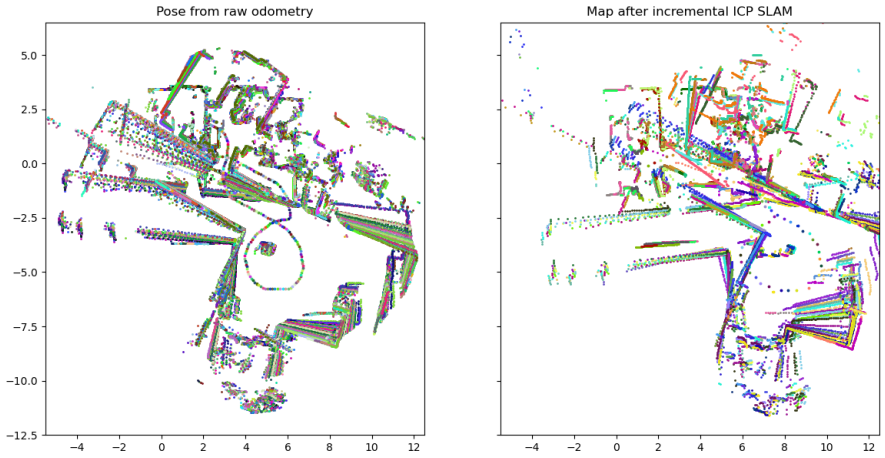

Figure 1: result of Incremental SLAM

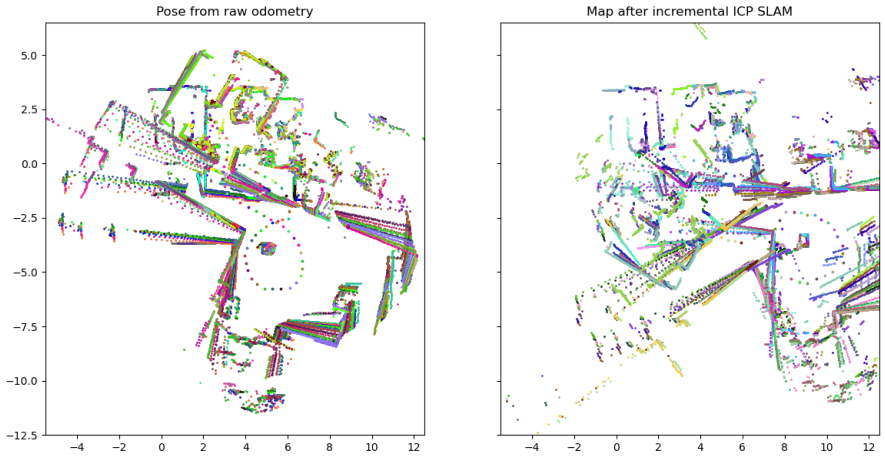

Figure 2: result of too large step

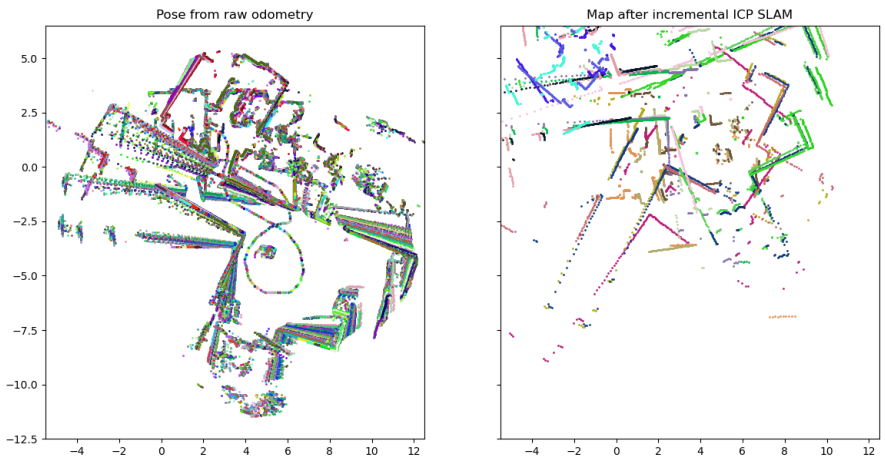

Figure 3: result of too large distThresholdAdd

2 GraphSLAM

2.1 Question 4

The Graph SLAM not only uses more and more scans in the iteration, but also uses the relative position to bulid one graph. After it finishes its initialization of parameters and graph, it reads the data sort by the distance. Then it eliminates the scan which is too far and perform the ICP algorithm choosing the closest. After it correct the result of ICP by using the rotation matrix, it adds the scan which is far enough in both map and its graph.

The main difference between Graph SLAM and Incremental SLAM is that the Graph SLAM builds its graph with the result of ICP algorithm, updates its graph and uses it to locate its position while the Incremental SLAM locates directly with the result of ICP algorithm. Moreover, the Graph SLAM fill out the scan which is too close while the Incremental SLAM does not.

2.2 Question 5

When the loop is closed in the environment, the relative position in the localisation is correct but the map it builds is not correct as the figure 4 shows.

2.3 Question 6

The parameter distThresholdAdd is used for adding the scan that is far enough. If it is growing larger, the number of scan added will decrease. The parameter distThresholdMatch is used to get the closest scans. If it gets smaller, the scans

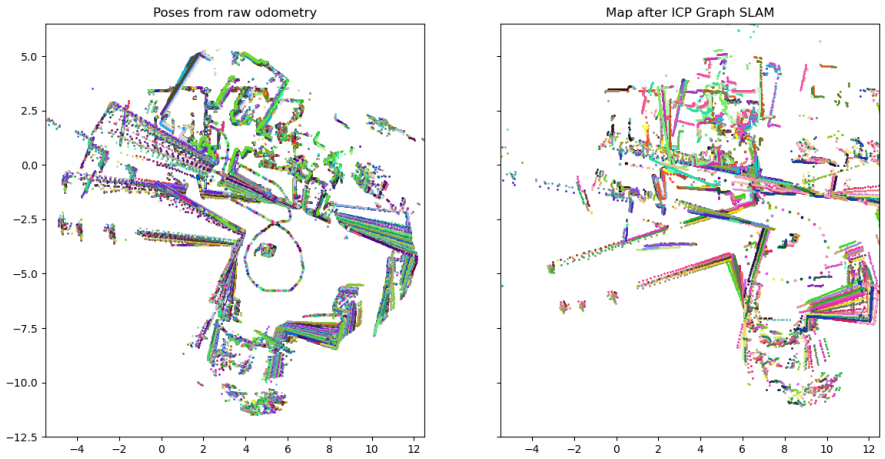

Figure 4: result of Graph SLAM

we get is smaller. If the distThresholdAdd is bigger than the distThreshold-Match, this means the number of scan we can add in each iteration will become limited. This leads to a low accuracy map construction just like the figure 5.

3 Influence of the environment

3.1 Question 7

The best parameter I found for the Incremental SLAM is that distThresholdAdd = 0.5 and step = 3. The result is shown in the figure 6. The best parameter for the Graph SLAM is that distThresholdAdd = 0.5 and distThresholdMatch = 0.8. The result of Graph SLAM is shown in the figure 7. From my point of view, the key difference is density of obstacle in the environment. In the U2IS data set, the structure of map is clear and there isn't much obstacle but in the FR79 data set, there is too much obstacle in the right side of map.

References

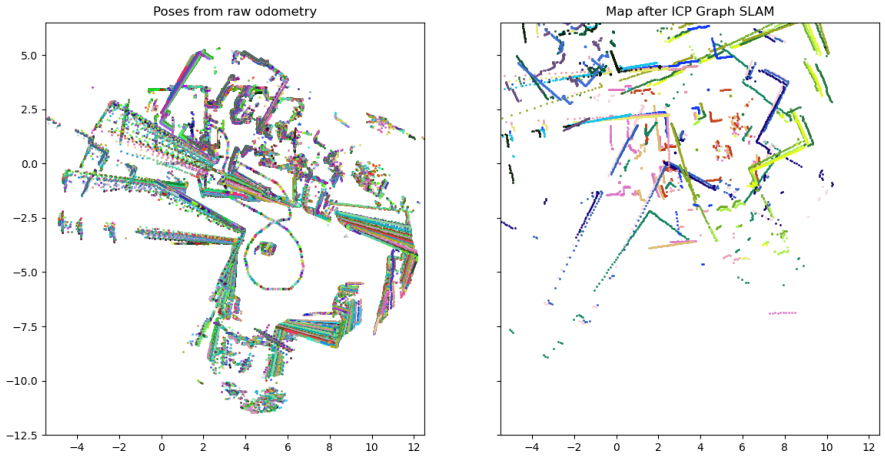

Figure 5: result of distThresholdAdd ¿ distThresholdMatch

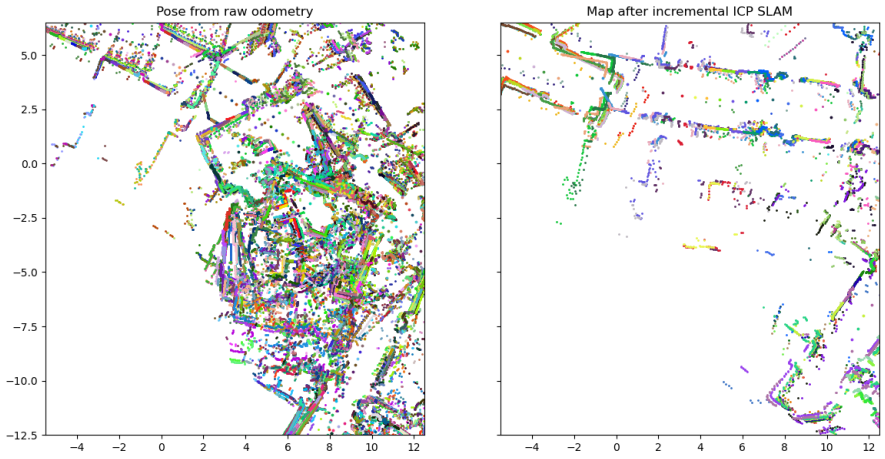

Figure 6: Incremental SLAM in FR79 Data Set

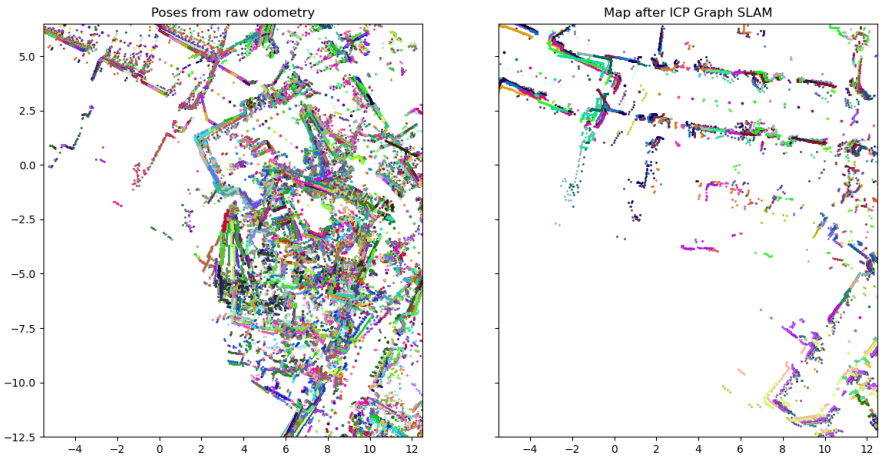

Figure 7: Graph SLAM in FR79 Data Set