6 Evaluation and Conclusion

6.1 Evaluation

6.1.1 Characterization of Localisation Accuracy

To reliably evaluate the accuracy of the proposed indoor localisation algorithm, a walking model for the robot was designed, its measured track was collected through static UWB tag and corresponding X and Y coordinates are in 6.1:

Listing 6.1: Measured Ground Truth From UWB

```
1  xs: [5.799013605442178, 5.677136752136748, 5.70306106870229, 5.09885606060606,
       5.120082644628101, 4.572519379844961, 4.478495575221241, 2.03554054054054]
2  ys: [4.865020408163268, 4.234247863247866, 3.7864122137404563, 3.554515151515152,
        3.1047024793388442, 2.931767441860464, 2.4959646017699106,
       2.353558558558559]
```

It's a series of command of *move* and *rotate*:

Algorithm 1 Commands

1: **procedure** CONTROL
2:     *move forward 0.7m*
3:     *rotate counter-clockwise* 30°
4:     *move forward 0.5m*
5:     *rotate counter-clockwise* 30°
6:     *move forward 0.5m*
7:     *rotate clockwise* 150°
8:     *move forward 0.5m*
9:     *rotate counter-clockwise* 90°
10:     *move forward 0.5m*
11:     *rotate clockwise* 90°
12:     *move forward 0.6m*
13:     *rotate counter-clockwise* 90°
14:     *move forward 2.5m*

From the commands we can know, the robot has moved 5.8m in total in each experiment. We sample 50 data in each experiment, which is every 0.116m a point, and calculate *mean error* and *variance* based on the ten experiments and the result is:

`mean = 0.24249670463171374 m, variance = 0.033868014433167205 m²`

Assuming the initial pose [5.799013605442178, 4.865020408163268] is correct, based on the given commands we can also derive a theoretical track as bias correction, as shown in Figure 6.1:
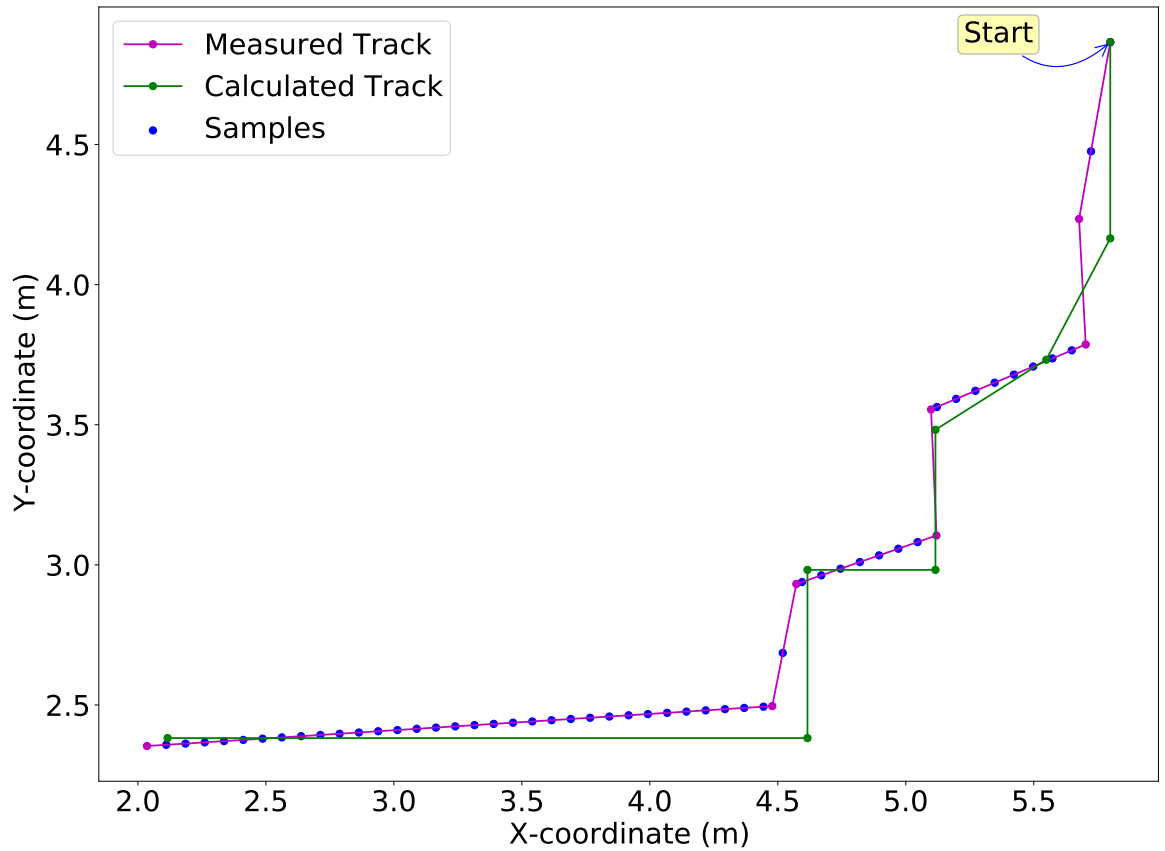

Figure 6.1: Measured vs. Calculated Ground Truth and sample points for measured track

By remote control, the filter result is as shown in Figure 6.2.

6.1.2 Observation

Compare different experiment results we can know, smoothing filter result heavily depends on the fluent remote control process, which is not always the case.
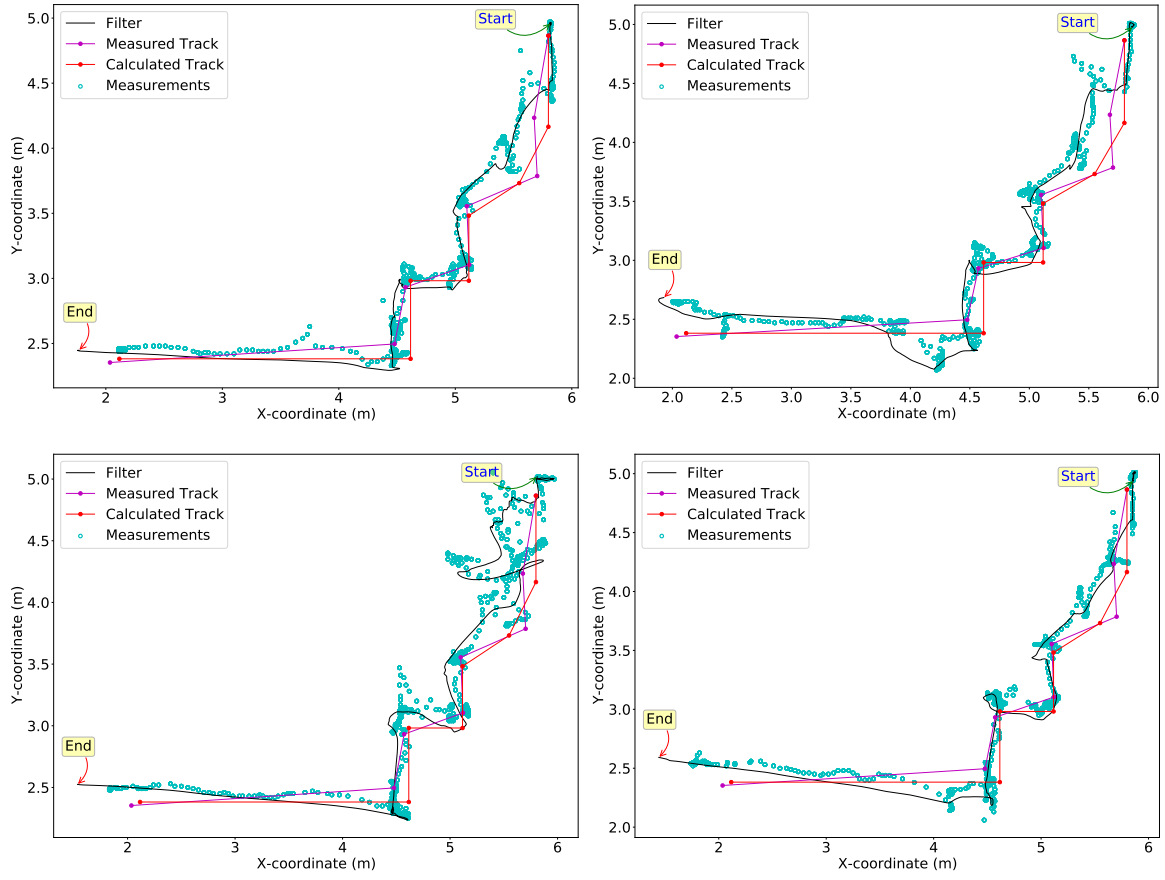
Figure 6.2: Plots of four repetitive experiments inside the energy lab

6.2 Conclusion

The model of sensors and model of the system can never be perfect and errors are always unavoidable, what we can do is just localising the mobile robot as accurate as possible. No doubt, robotics programming is a process which often involves a great deal of plain old trial-and-error. Sometimes in order to tune a single parameter it takes a few hours or even days.