# Robotics Systems

# Courework 2 Report on Baseline Experiment


Jasmeet Khalsa
lu18275@bristol.ac.uk

Samia Mohinta
dc18393@bristol.ac.uk

Tushar Bhatnagar
wq18309@bristol.ac.uk

Tanya Sharma
ts15606@bristol.ac.uk


**Hypothesis:**

We hypothesise that cumulative error in the odometry system over time will compromise the precision/accuracy of the map made. Therefore, by improving the odometry subsystem we expect to encode a better map.

**Objective:**

The objective of the experiment was to determine the error accumulated over time using "random walk" over 3 specified time periods.

**Methodology:**

Time Period: 10 seconds, 20 seconds and 30 seconds

Cause of errors: Error could be due to the drift, slip or a sticky robot wheel, and the disparity between the encoder counts and PID tuning for the speed controllers.

The experiment starts by placing the robot at the origin. In our case, the origin (x,y) is (900,900). The robot starts by moving randomly over the designated map. This is done by providing a left/right turn bias based on a gaussian distribution with a zero mean and a standard deviation of 5. The robot is made to rotate by an angle of 180 degrees once it reaches either of the 4 map boundaries and continue its random movement.

The robot is made to move randomly until the elapsed time period reaches the predefined time. After this, the robot orients itself towards the perceived origin and moves towards this origin in a straight line. Once the robot stops at its perceived origin, we find the displacement error between the perceived origin and the actual starting point using a measuring tape. The displacement is calculated from the centre of the robot to the true origin. Given the manual measurement of displacements, these observations are prone to human error and hence, to reduce the error, multiple trials (4 trials) are conducted for each of the successive time periods of 10 seconds, 20 seconds and 30 seconds respectively.

**Results and Discussion:**

From Figure 1 and Figure 2 (below), we can visualize that the displacement error is increasing as we increase the time period for the random walk. Thus, it is understood that as the odometry (currently based on only encoder counts) error grows over time, we shall get a degraded version of the map encoded. We believe we can improve the map encoding by implementing sensor fusion. We plan to fuse the Magnetometer and the IMU in order to improve the odometry subsystem and encode a better map.

We shall validate any improvements in the subsystem performance in the next experiment day. In addition to testing sensor fusion, we shall also conduct mini-experiments to better understand the error accumulation when we vary the parameters in our baseline experiment. It is essential to understand how the subsystem performs if we change the total wheel speed or distance or implement spiral walk instead of random walk. We shall isolate these conditions as separate mini-experiments and collect the error data from kinematics before we go onto integrate sensor fusion with odometry. Eventually, we believe that sensor fusion will improve the positional accuracy of the robot (romi) on the map and in consequence, we enable us to encode the map with more precision. As we proceed with a step by step approach towards refining the subsystem, we shall note and evaluate all exceptional scenarios that may occur in terms of performance.

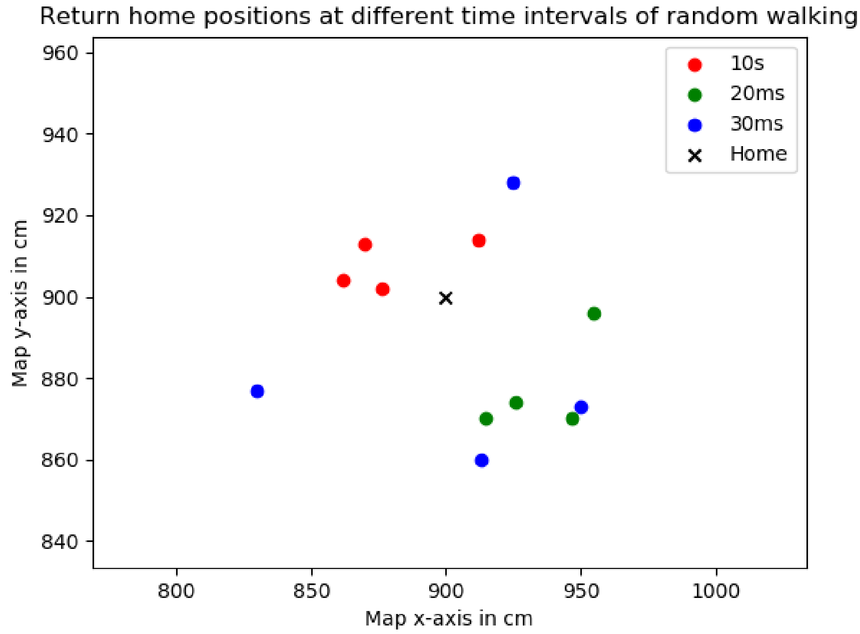


*Figure 1: Scatter plot showing return home positions at 3 different time periods of random walking*

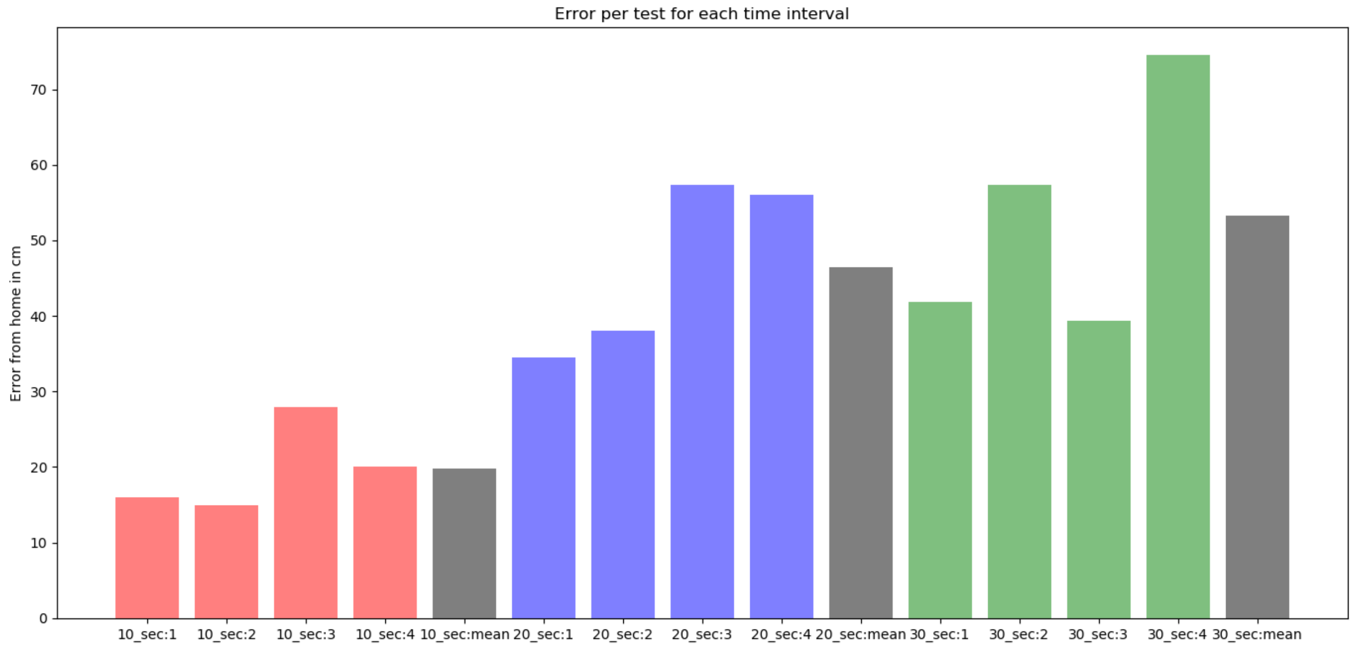


*Figure 2: Bar plot depicting individual displacement error for each trial (red, green, blue) and mean displacement error for each time period across 4 trials (grey).*