# ME 132b - Odometry

In part b of the first lab for ME 132B you will be writing a script to command a TurtleBot (Fig. 1) to trace out a simple shape and return to its starting position. During the test the TurtleBot will be logging readings from the encoders on each of its wheels, which you will convert into Cartesian position using the differential vehicle equations and compare with the path you intended it to follow. At the end of the test we will physically measure the error in the TurtleBot's position in order to gauge the accuracy of the odometry.

## Lab Preparation

Appointments for the hardware demonstration can be made via the doodle poll that will be sent out via email and under announcements on the course website. Before your scheduled demo time you will need to add code to a script to make the TurtleBot trace a simple pattern that brings it back to rest in the same location as it started within 20 seconds. The template for this script can be downloaded here. Try to keep the TurtleBot from venturing more than 1m away from the starting point, along with linear motion $\leq 0.3$ m/s and angular $\leq \pi/2$ rad/s.



Figure 1: TurtleBot 2 based on the Kobuki platform

## Hardware demonstration

Show up to your scheduled time slot with your modified python script ready to be transferred to the TurtleBot's notebook. The TurtleBot will be placed on a marked starting position and then your script will be run, moving through whatever pattern you designed.

After the program finishes, we will measure the X and Y offset of the TurtleBot from its initial position for you to compare to your odometry results. You will take a copy of the csv file on the

TurtleBot notebook which contains encoder readings from the two wheels over the course of the program.

## Odometry Data processing

Use the kinematic equations from the class handout on differential drive vehicles to calculate the XY position and orientation of the TurtleBot over the course of your program, and plot the results as you did in lab 1a.

Parameters in the equations include:

Wheel base - 23cm

Encoders - 2578.33 ticks/wheel rev or 11.7 ticks/mm travel

Encoder sensor read rate - 50Hz (so use 20ms as $\Delta t$ in the integration)

## Homework Deliverables

Submit plots of the XY position and orientation of the TurtleBot along with the code/equations you use to calculate them. Comment on how the path plotted by the odometry compares with the path the TurtleBot actually traced out, and the accuracy of the position measured at the end of the program.