# Lab 01 Worksheet

# Getting to Know Your Robot – Let’s Get Moving!

Robot Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team Member Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team Member name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Purpose

In your own words, state the purpose of lab 01 in the following space.

In your own words, what is odometry error?

## Inventory

Check to confirm all parts received or list missing parts in the following space.

## Part 1 – Software Installation

What IDE will you use to program the robot? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Check to confirm “RobotIntro.ino” downloaded and all libraries installed

## Part 2 – Robot Motion

How does varying the stepTime variable change the robot behavior?

Describe what the following functions do in the following space.

* move1()
* move2()
* move3()
* move4()
* move5()

Describe what the following functions do in the following space.

* move()
* moveTo()
* stop()
* run()
* runSped()
* runToPosition()
* runToNewPosition()
* runSpeedToPosition()

## Part 3 – AccelStepper Library

Review the library documentation and explain what the following functions do.

* + Blocking
  + Bounce
  + ConstantSpeed
  + MultipleSteppers
  + MultiStepper
  + Overshoot
  + ProportionalControl
  + Quickstop
  + Random

## Part 4 – Encoders

Left encoder ticks for quarter turn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Left encoder ticks for half turn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Left encoder ticks for full turn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Left encoder ticks for two turns \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Right encoder ticks for quarter turn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Right encoder ticks for half turn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Right encoder ticks for full turn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Right encoder ticks for two turns \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Are these values consistent for each motor? Why or why not?

Are these values consistent between motors? Why or why not?

How could you use this information to correct for odometry error?

Compare the accuracy between encoder ticks and steps for a given distance (i.e. 2 feet). How many ticks/step or steps/tick?

Describe how you can use a proportional controller to move the robot a given distance and correct for odometry error. Hint: You will need sensor feedback where the input is steps or distance.

## Part 5 –IMU – Gyro and Accelerometer

In the following space describe how the gyroscope and accelerometer values change as you move the robot around.

What are the units for the gyroscope?

What are the units for the accelerometer?

How could you use this information to correct for odometry error?

## Part 6 – Motion Functions

How can you distinguish the anode and cathode on an LED?

Why do we put a resistor in series with an LED?

How many steps does it take to move your robot **forward** 2 feet? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the error between the desired distance and the actual distance? \_\_\_\_\_\_\_\_\_\_\_\_\_

How many steps does it take to move your robot **backward** 2 feet? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Are the forward and reverse steps the same? If not, why do you think that happens?

How many steps does it take to **spin** the robot clockwise ninety degrees?\_\_\_\_\_\_\_\_\_\_\_\_

How many steps does it take to **spin** the robot counterclockwise ninety degrees?\_\_\_\_\_\_\_\_\_\_\_\_

Are the clockwise and counterclockwise steps consistent? If not, why do you think that happens?

How many steps does it take to **pivot** the robot clockwise ninety degrees?\_\_\_\_\_\_\_\_\_\_\_\_

How many steps does it take to **pivot** the robot counterclockwise ninety degrees?\_\_\_\_\_\_\_\_\_\_\_\_

Are the clockwise and counterclockwise steps consistent? If not, why do you think that happens?

What is the diameter and circumference of the robot wheels? How did you use these in a formula to design the circle or turn function?

How many inches or feet can the robot move in a quarter, half, full, and two rotations?

How did you calculate the turn angle for the robot? Explain and show formula in memo.

## Part 7 – Circle and Figure 8

In the following space, describe how you designed the moveCircle() function with the flexibility of adjusting movement based upon the desired diameter.

How did you modify the function to work for the figure eight?

## Part 8 – GoToAngle Behavior

In the following space, describe how you designed the GoToAngle() function with the flexibility of adjusting movement based upon the desired angle.

What type of accuracy/error did you have in the go-to-angle behavior?

## Part 9 – GoToGoal Behavior

In the following space, describe how you designed the GoToGoal() function with the flexibility of adjusting movement based upon the desired x and y position.

How did you calculate the move distance given the x and y position? Explain and show formula in memo?

What type of accuracy/error did you have in the go-to-goal behavior?

What could you do to improve the accuracy of the behaviors?

Did your team use the turn then forward approach for go-to-goal or move and turn at the same time? If so, what were the pros and cons of using your approach versus the other one?

## Part 10 – Square Path

In the following space, describe how you designed the moveSquare() function with the flexibility of adjusting movement based upon the desired diameter.

## Part 11 – Wireless Communication

In the following space, describe how you got the Bluetooth to work wirelessly with your robot?

## Part 12 – Wireless Programming (Optional)

In the following space, if you were able to get wireless programming using Bluetooth working on the robot, describe how you implemented it in this space.

## Conclusions.

What are some sources of the odometry error?

How could you correct for this error?

How could you improve the three motions (move*Square, moveCircle, moveFigure8*) functions?

Describe the method, pseudocode, flow chart, or state diagram. Discuss the reality with the theory and software design plan. What was similar? What was different?

What is your robot’s name? Write 2 or 3 sentences to describe how your robot’s name relates to some historical figure, robot, or theory in robotics. Make sure to use proper citations and referencing.