ME591 Assignment 1

# Motion, Measurement and Estimation

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# **Introduction**

The purpose of this lab was to study three of fundamental components of autonomous robot, motion, measurement and estimation. First, a motion model of a three-wheeled omnidirectional model was derived. Next, sensor models for GPS and magnetometer were defined. Finally, Extending Kalman filter and multi-rate Kalman filter was used to combine the measurements from the sensors and measurements from the robot itself to estimate robot’s correct location.

# 1 Motion modeling of omnidirectional wheeled robot

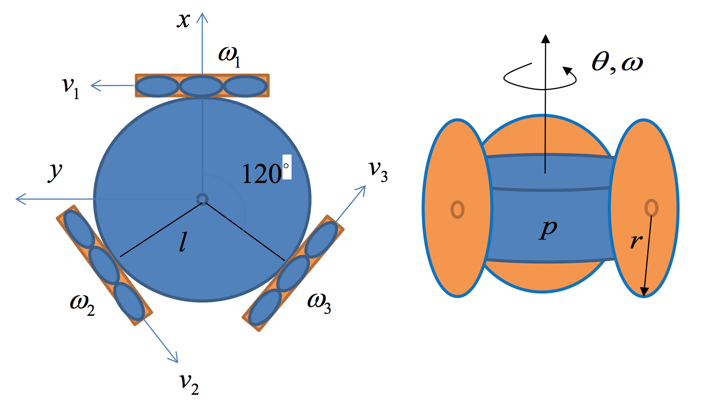


Figure 1 – Omnidirectional wheeled robot

The velocity for the robot can be expressed as:

To derive the motion model for the omnidirectional wheeled robot, we first look at the velocity decomposition of each wheel.

Next, the velocity found above is in the robot’s frame, thus, we need to convert it into the world frame.

# 2 Simulation of the Robot

Given the input , the following figure is what the output looks like over 15s with 10Hz update.

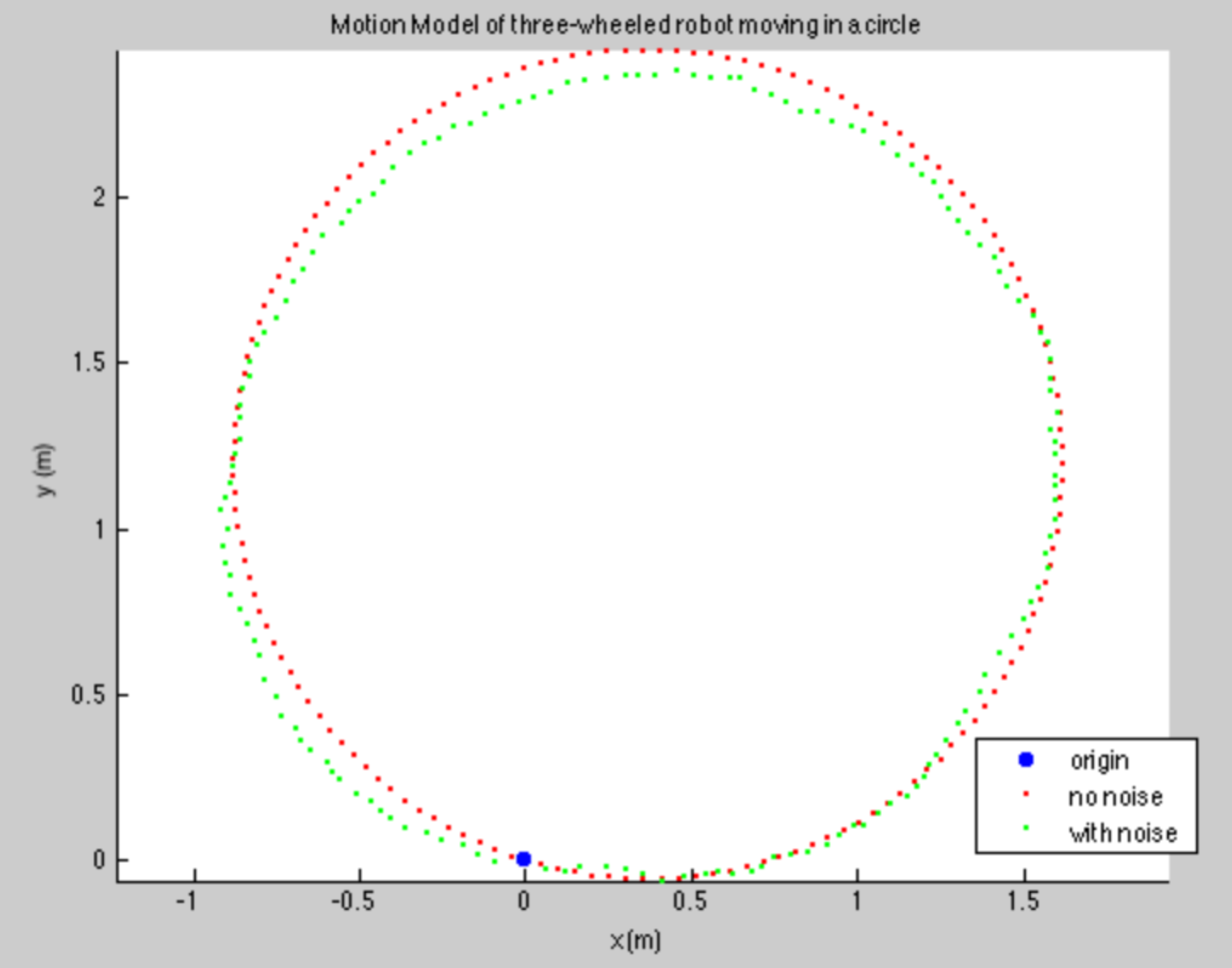


Figure 2 – Omnidirectional wheeled robot simulation given inputs

For the robot to move in a straight line, solve for the following

or

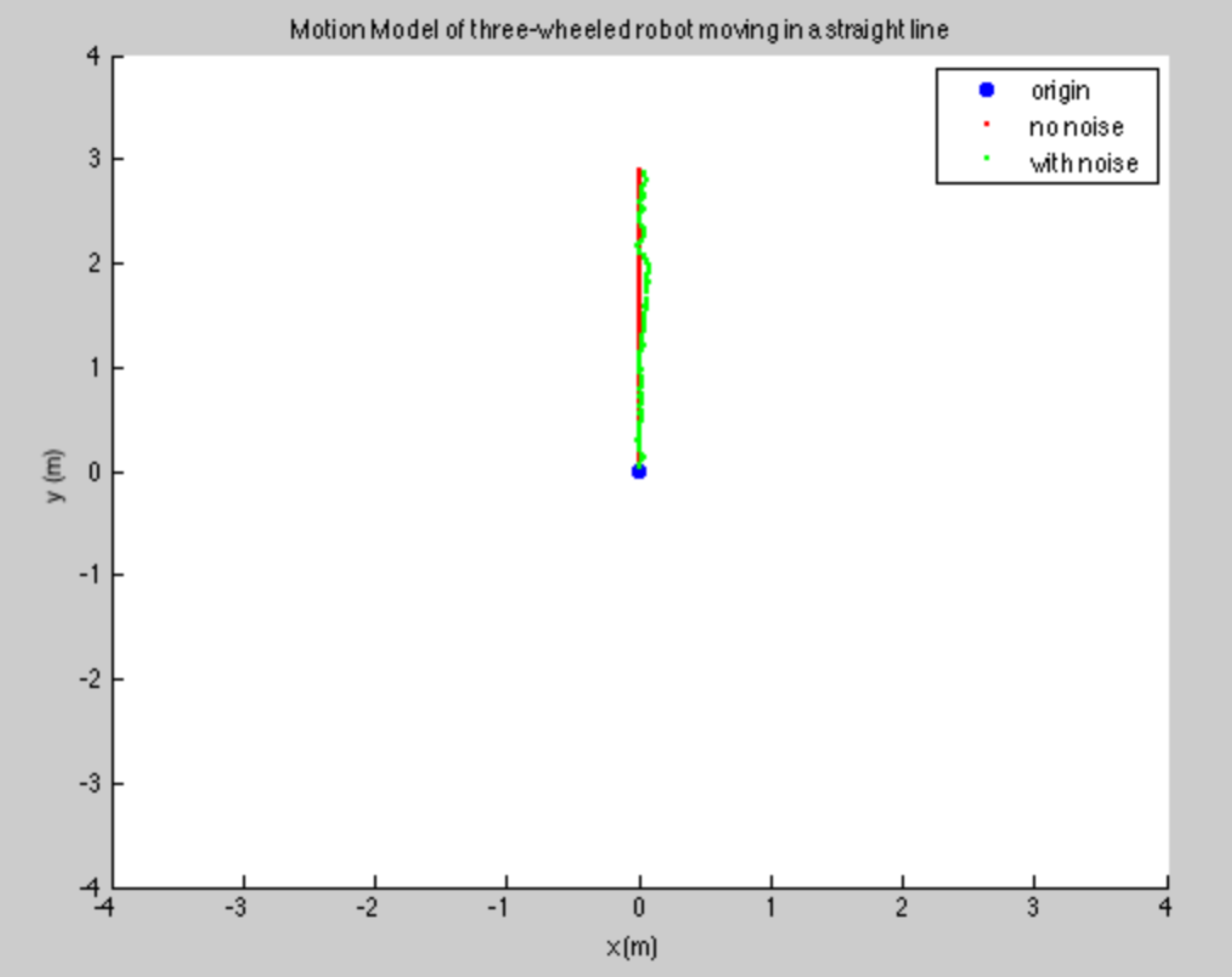
the result of solving these equation is

, to move in the x direction

or

, to move in the y direction

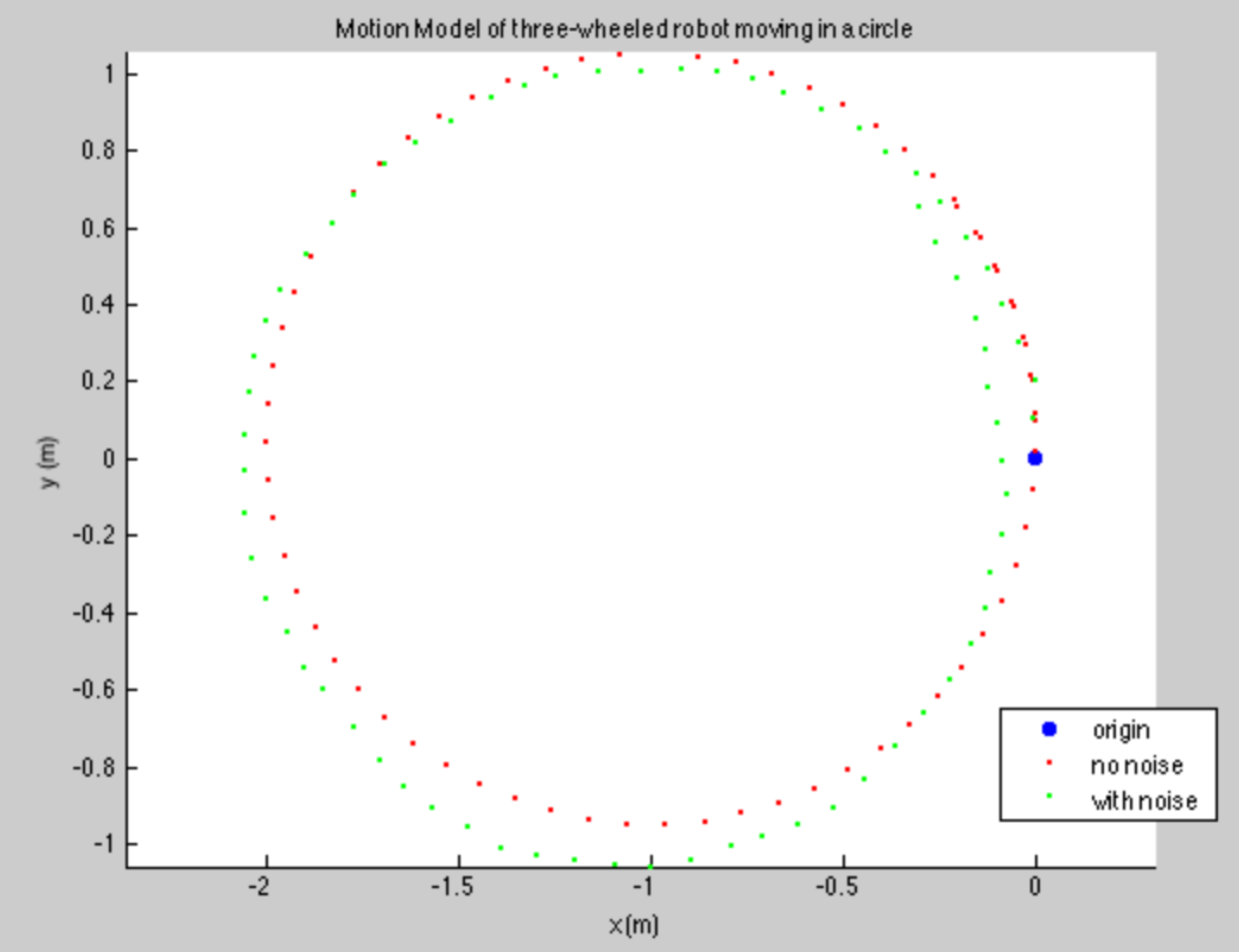
The result of this calculation is shown in the below figure



To move in a circle with radius of r,

For this specific question r = 1, for the sake of simplicity, set y = 0

The result is shown in the below figure



To move in a spiral, constant velocity for the wheels will not suffice. To solve for a spiral, fix angular velocity at one and keep y = 0 but set x to a function z = x\*t

The result is in the following figure