Mobile Robotics Lab Report #3:

Kinematics of Differential Drive Robot

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# OBJECTIVES

* Create forward and inverse kinematics models of differential drive robot
* Use the differential drive robot model to drive the robot in specified paths within a simulation environment

# TASKS

## **Task One**: Simulink model for differential drive robot

1. Forward kinematics model
2. Forward kinematics model with wheel speeds given in rad/s
3. Inverse kinematics model

## **Task Two**: Drive the differential drive robot to follow a specified path

1. Drive the robot on a square path
2. Drive the robot on a figure-8 path

## **Task Three**: Draw a graph that traces the path your robot follows (extra credit)

# ANSWERS TO QUESTIONS

## **Question One**

* *Recorded value*: 3.51
* *Ideal value*: 3.5
* *The discrepancy is because the simulation (or a real robot) is discretized and can overshoot the exact value it is aiming for in the time between sampling its position.*

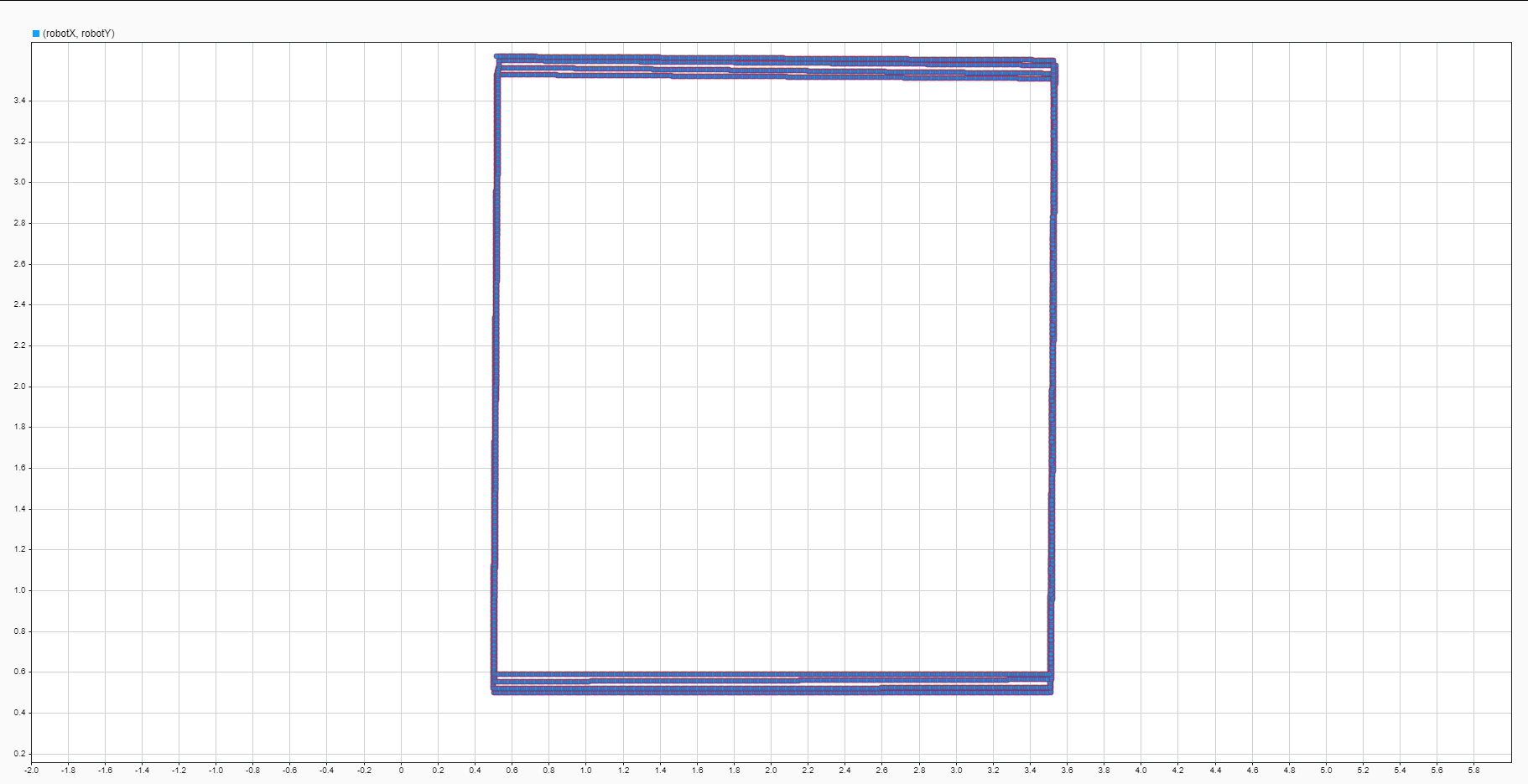
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## **Question Two**

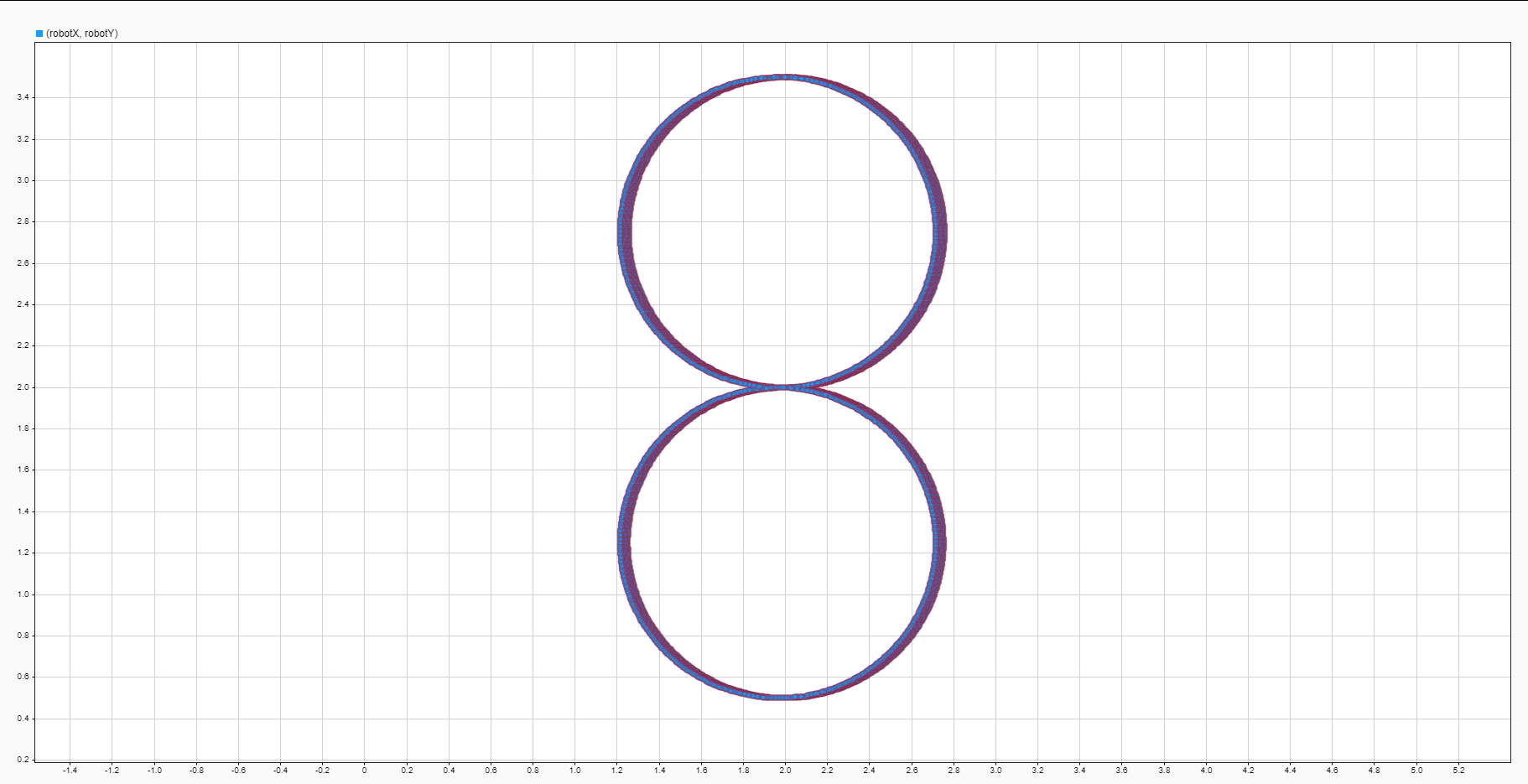
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## **Extra Credit**

### *Graph of Square Path*



### *Graph of Figure-8 Path*



# TABLES

## **Task One**

### **Part A**

| **w\_l\_rpm** | **w\_r\_rpm** | **V\_m/s** | **W\_rad/s** | **r** | **L** |
| --- | --- | --- | --- | --- | --- |
| 60 | 60 | 0.1885 | 0 | 0.03 | 0.1 |
| 60 | -60 | 0 | -3.77 |  |  |
| 60 | 30 | 0.1414 | -0.9425 |  |  |
| 60 | -30 | 0.04712 | -2.827 |  |  |
| -60 | 60 | 0 | 3.77 |  |  |
| -60 | -30 | -0.1414 | 0.9425 |  |  |
| -60 | -60 | -0.1885 | 0 |  |  |

### **Part B**

| **w\_l\_rad/s** | **w\_r\_rad/s** | **V\_m/s** | **W\_rad/s** | **r** | **L** |
| --- | --- | --- | --- | --- | --- |
| 6.283185 | 6.283185 | 0.1885 | 0 | 0.03 | 0.1 |
|  | 0 | 0.09425 | -1.885 |  |  |
|  |  | 0 | -3.77 |  |  |
| 0 |  | 0.1414 | 2.827 |  |  |
| 1 | 10 | 0.165 | 2.7 |  |  |
| 10 | 2 | 0.18 | -2.4 |  |  |
|  | 60 | 0.9471 | 17.06 |  |  |

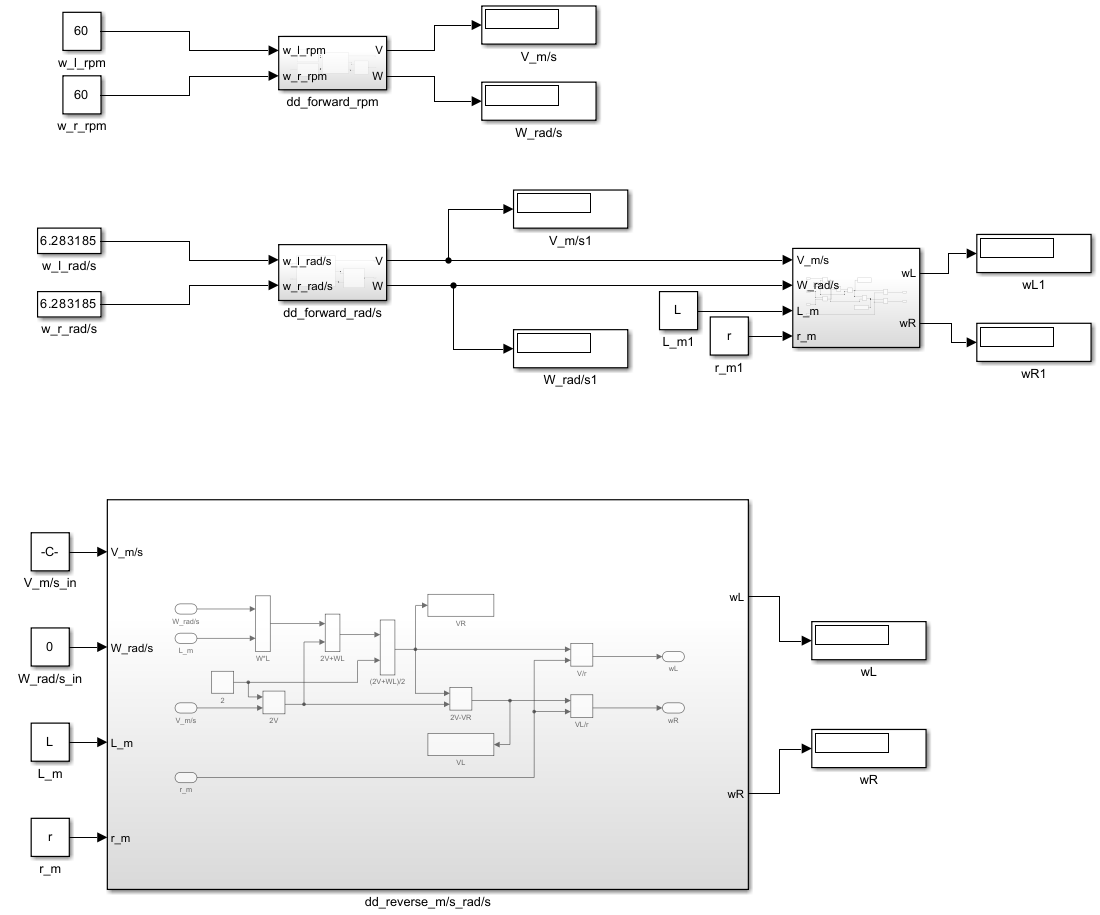
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### **Part C**

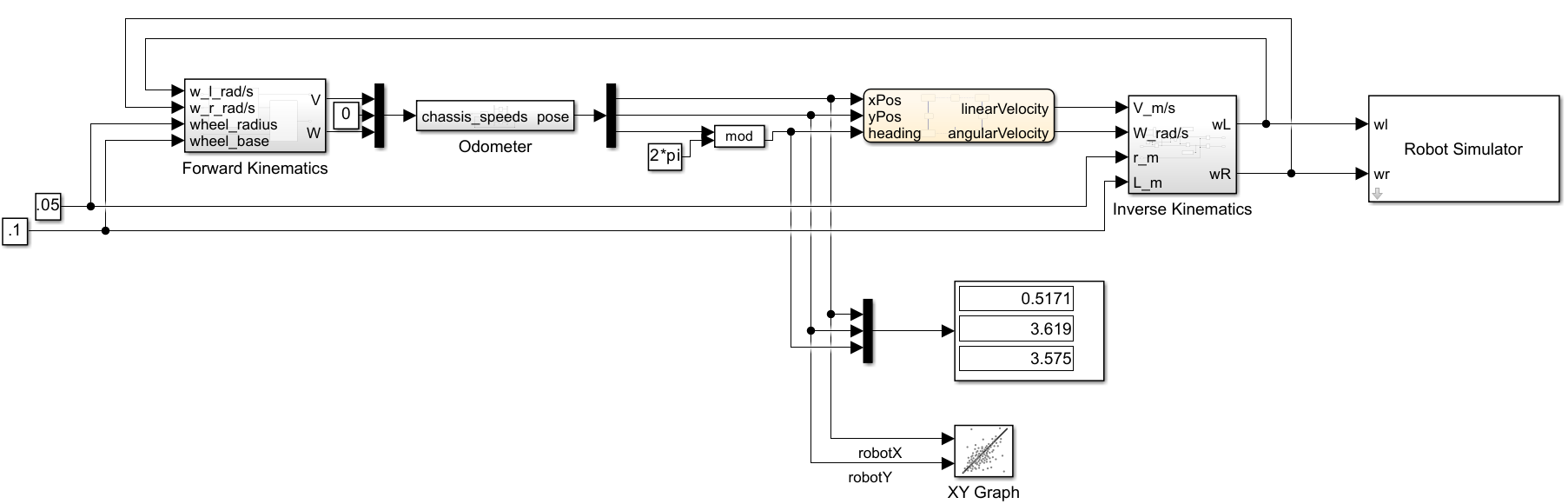
| **V\_m/s** | **W\_rad/s** | **w\_r\_rpm** | **w\_l\_rpm** | **r** | **L** |
| --- | --- | --- | --- | --- | --- |
| 0.1885 | 0 | 6.283 | 6.283 | 0.03 | 0.1 |
| 0 | 10 | 16.67 | -16.67 |  |  |
| -10 | 10 | -316.7 | -350 |  |  |
| 5 | 25 | 208.3 | 125 |  |  |
| 25 | 5 | 841.7 | 825 |  |  |
| 100 | 0 | 3333 | 3333 |  |  |
| 1 | 1 | 35 | 31.67 |  |  |

# SIMULINK MODELS & STATEFLOW DIAGRAMS

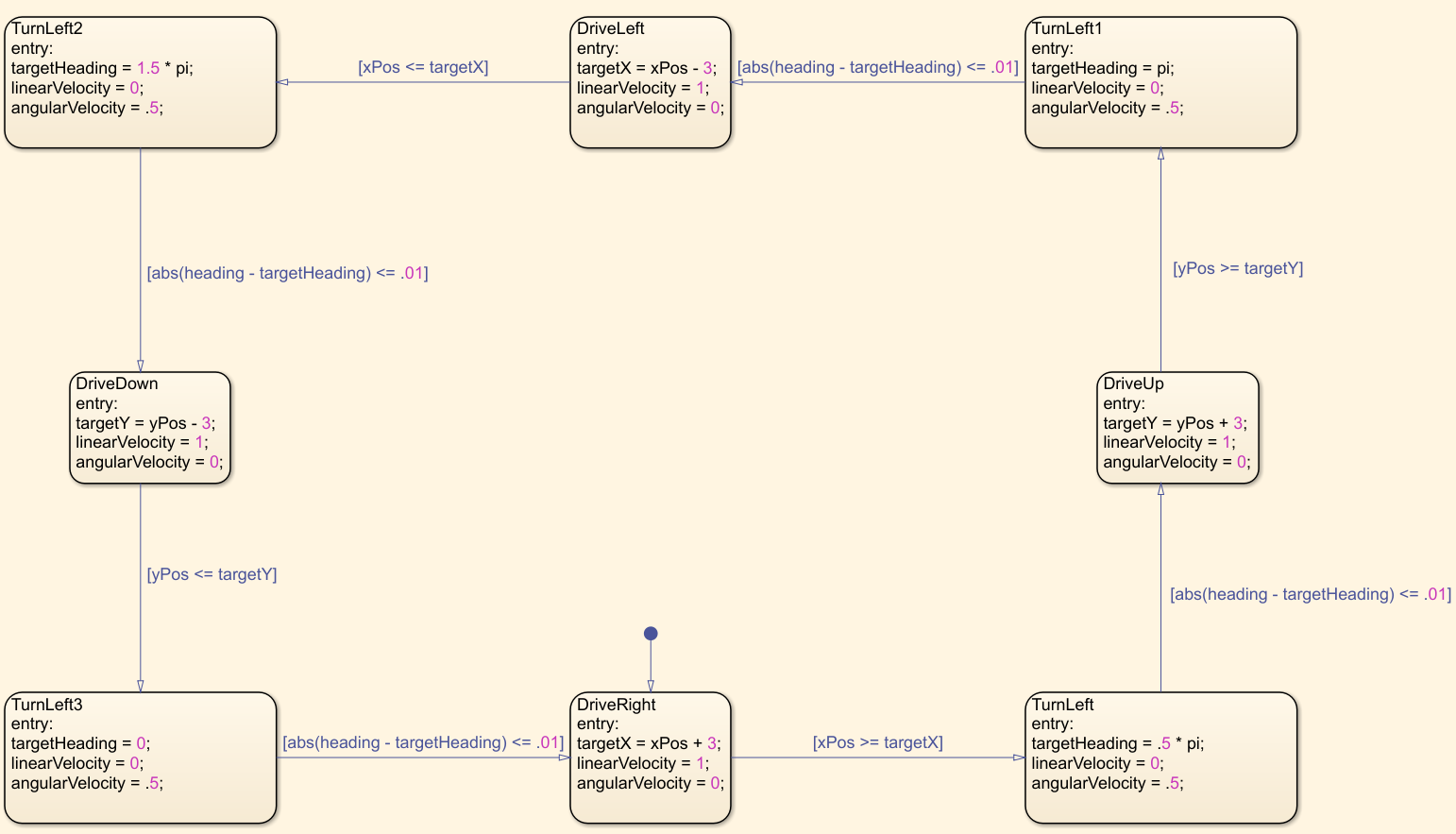
## *Kinematics Model*



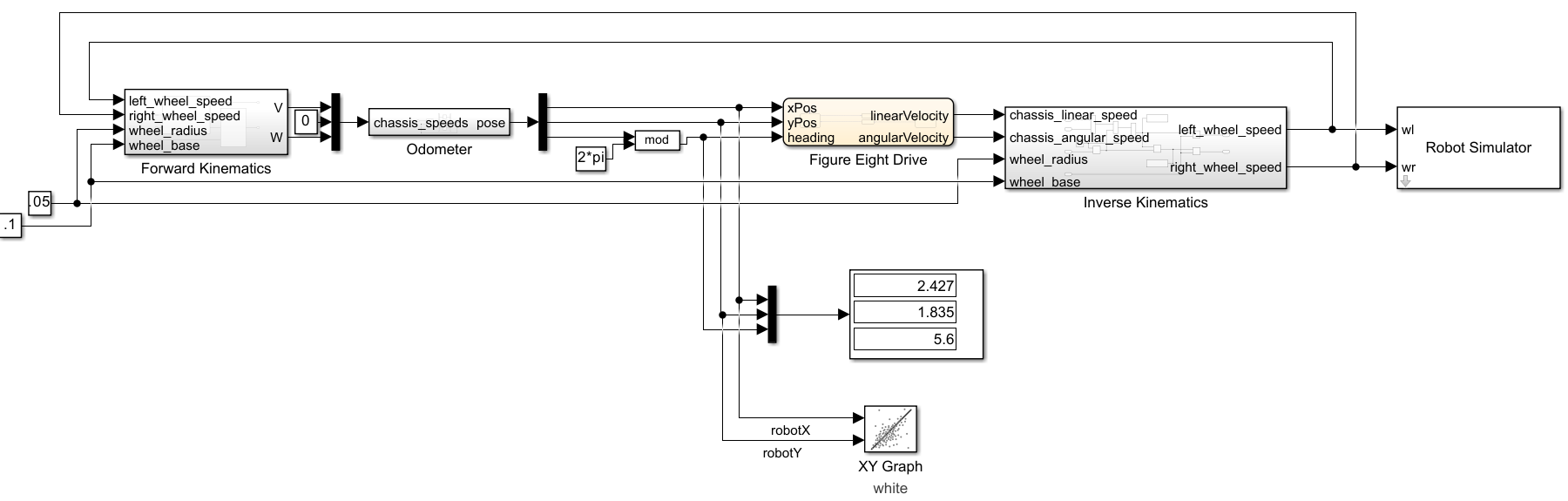
## *Square Model*



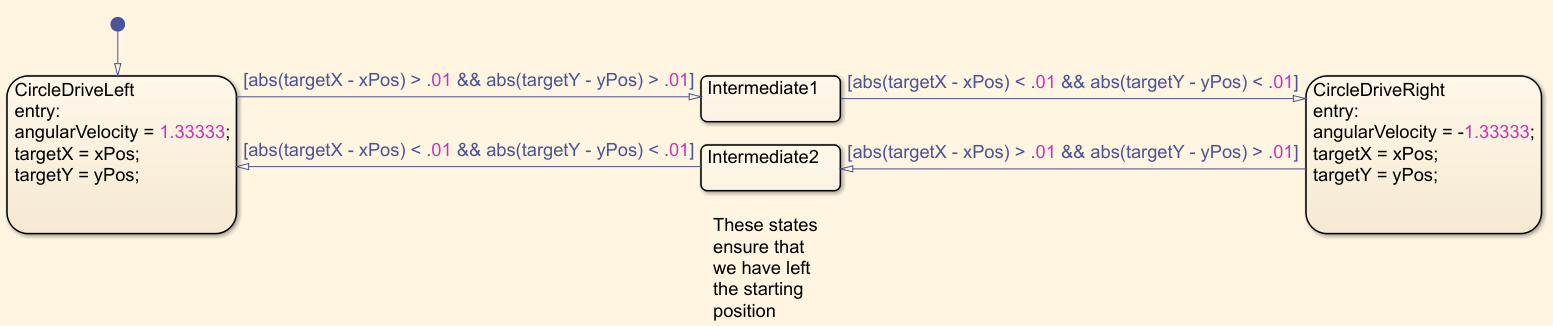
## *Square Model Drive Chart*



## *Figure-8 Model*



## *Figure-8 Drive Chart*



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