

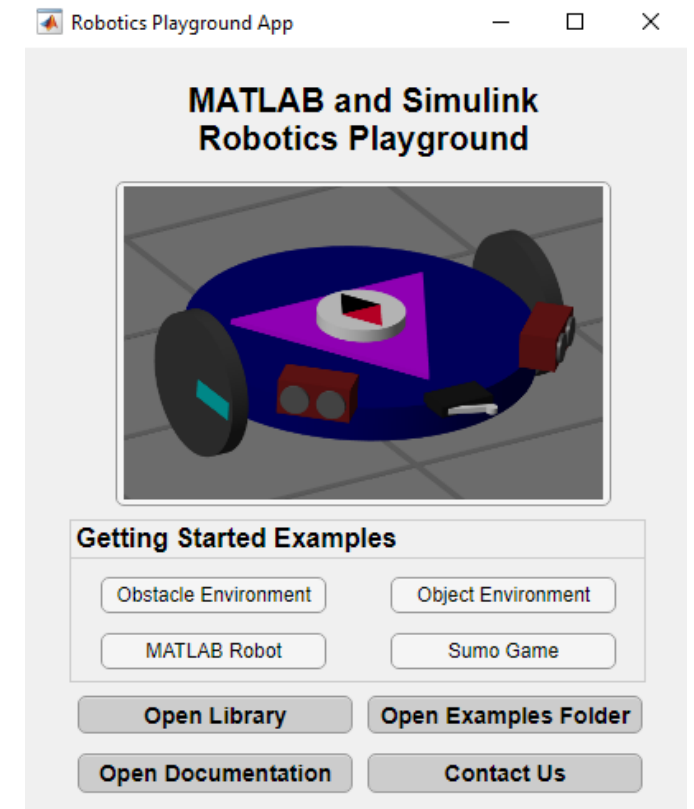
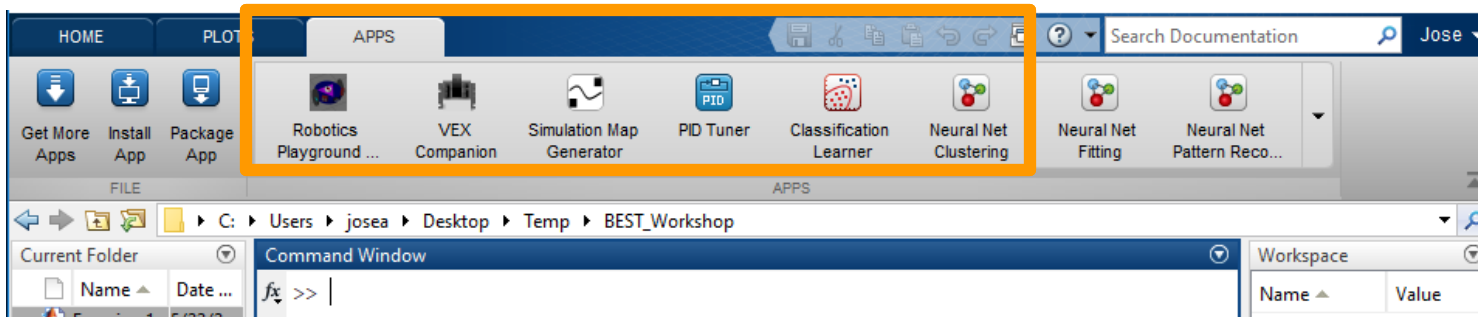
# Introduction to Mobile Robotics with MATLAB and Simulink

## Unit 4: Robot Controls

By MathWorks Student Competition team

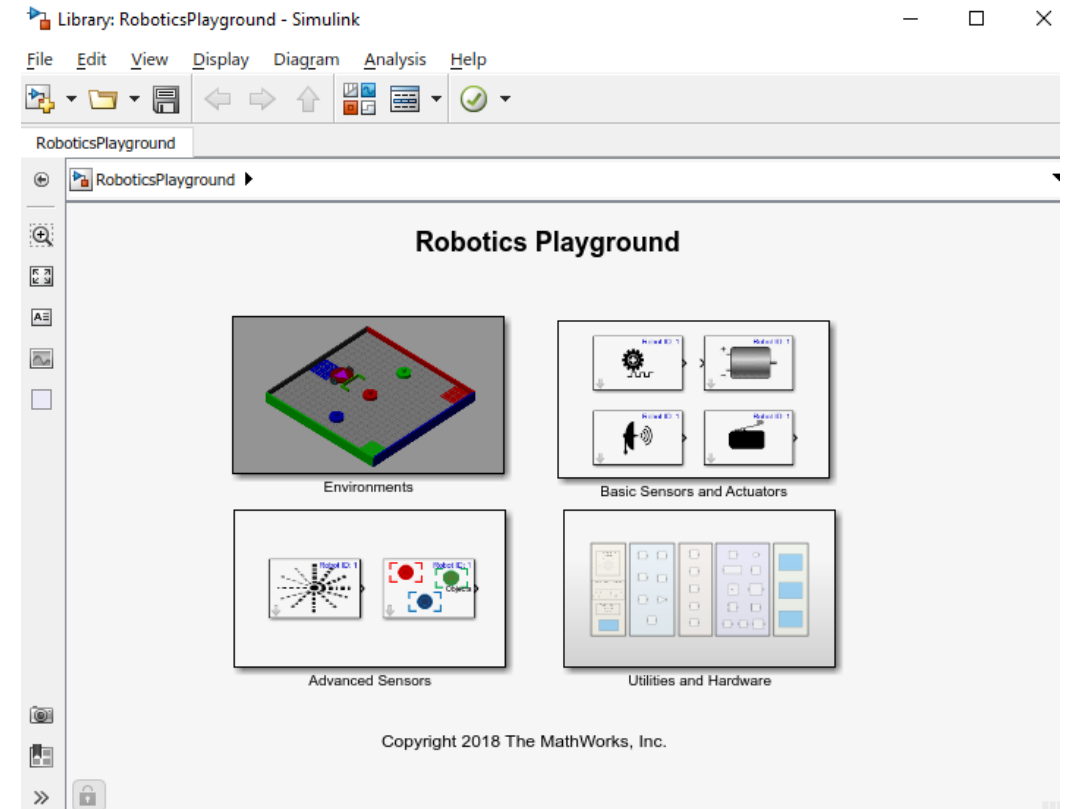
# Robotics Playground App

- To get started programming robot controls we will need to use a virtual environment in Simulink
1. Go to the “Apps” tab in MATLAB and find the Robotics Playground App
  2. Browse the examples
  3. Click the “Open Library” button



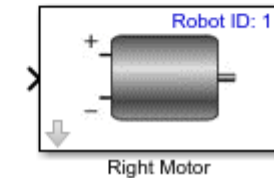
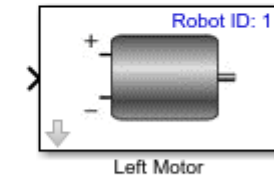
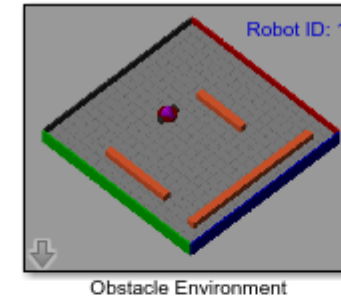
# Robotics Playground Library

- Double-click on this subsystems to show all the blocks for each category
- Commonly used Simulink blocks are available under the “**Utilities**” subsystem



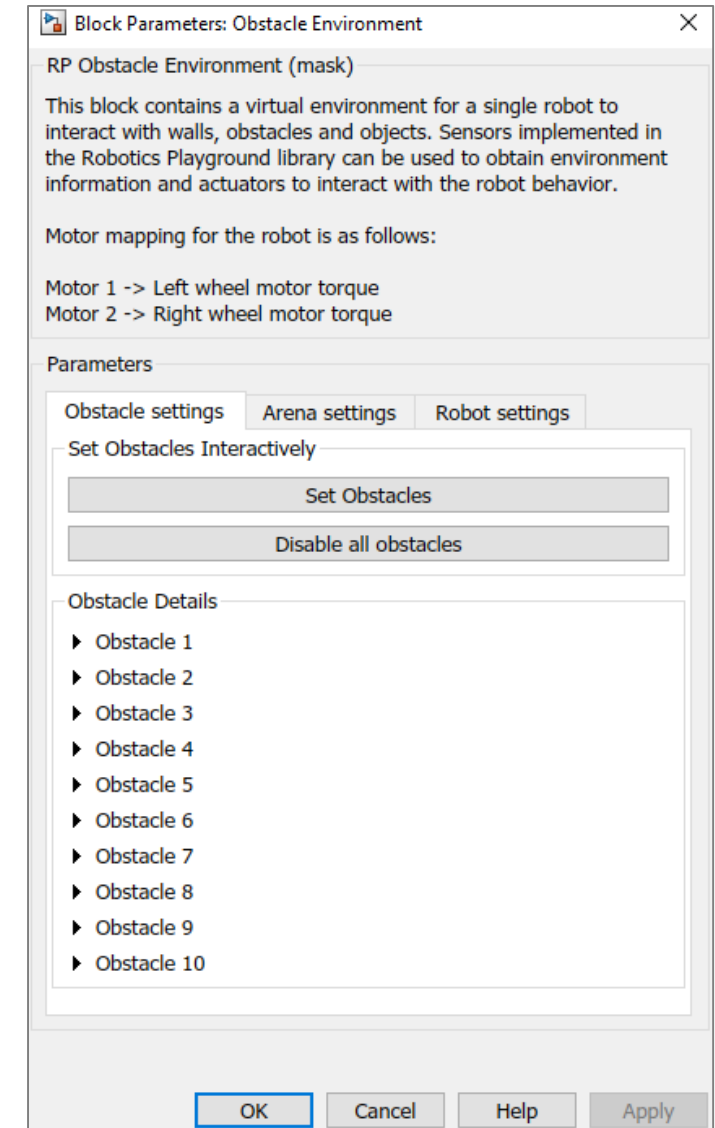
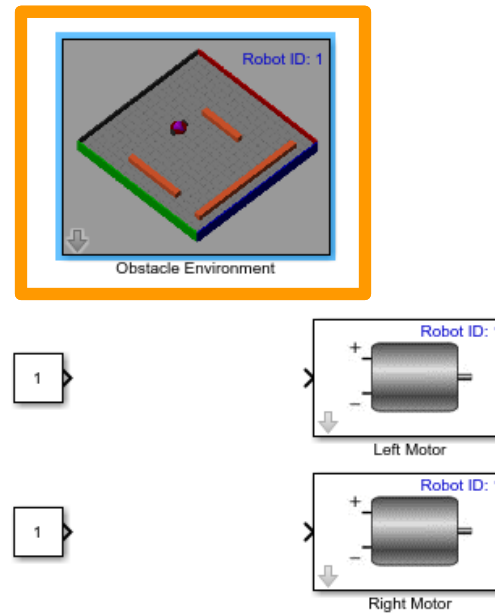
# Open a Model with a Virtual Environment

- You can drag blocks from the library to create your own model
- At least one environment is necessary
- For convenience you can open the “**MoveForward\_start.slx**” model to get started



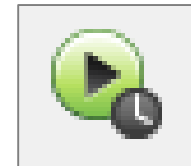
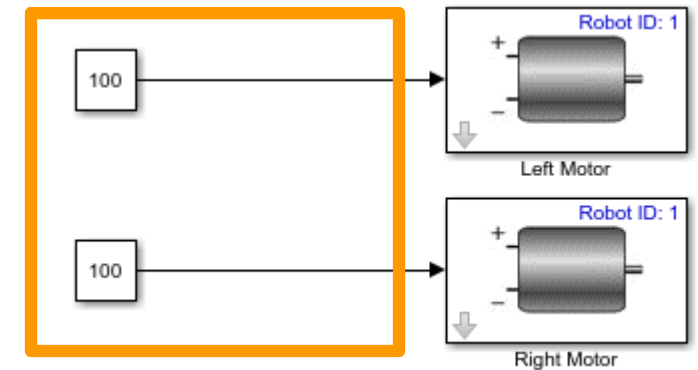
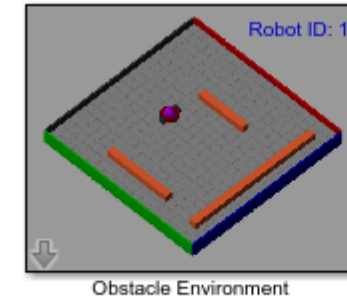
# Adjusting Environment Settings

- Double-click on the environment block to get access to all the available settings



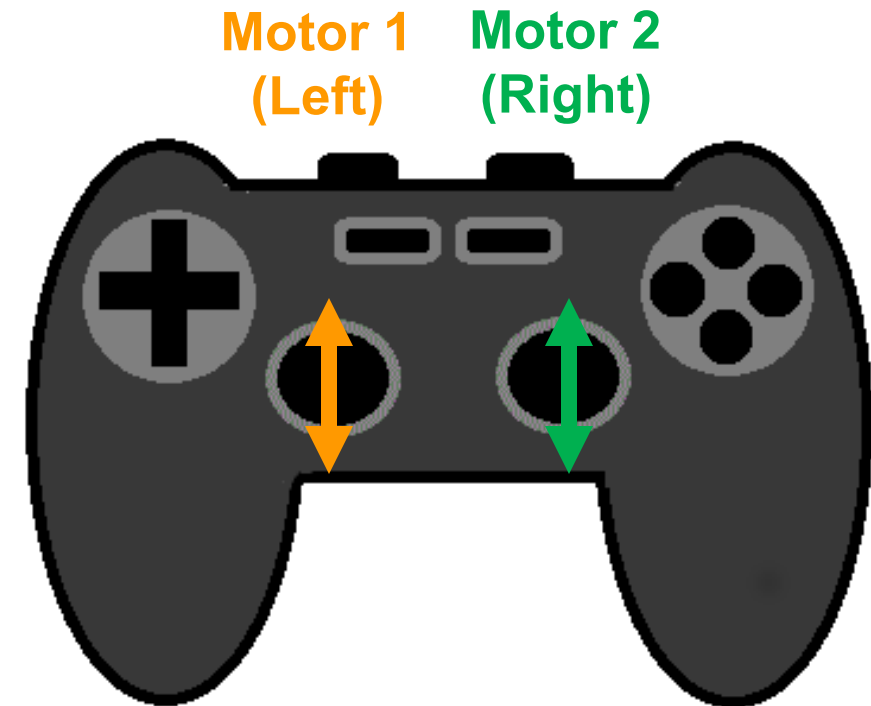
# Setting Motor Speeds

1. Connect the two constants independently to each motor and then run the model using the play button
2. Note that the input range for the motor blocks is -127 to 127 so might want to set a number that will make the robot move
3. Play with different positive and negative numbers to see how the robot reacts
4. Run the simulation using the play button on the Simulink toolbar



## Dashboard Controls – Tank Configuration

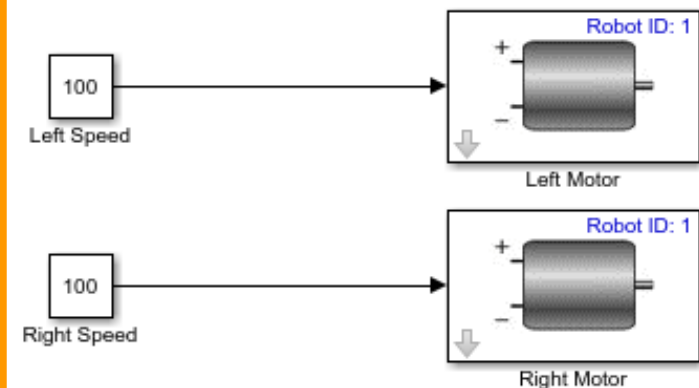
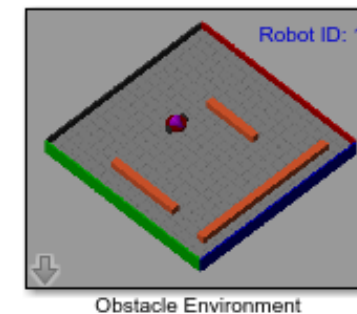
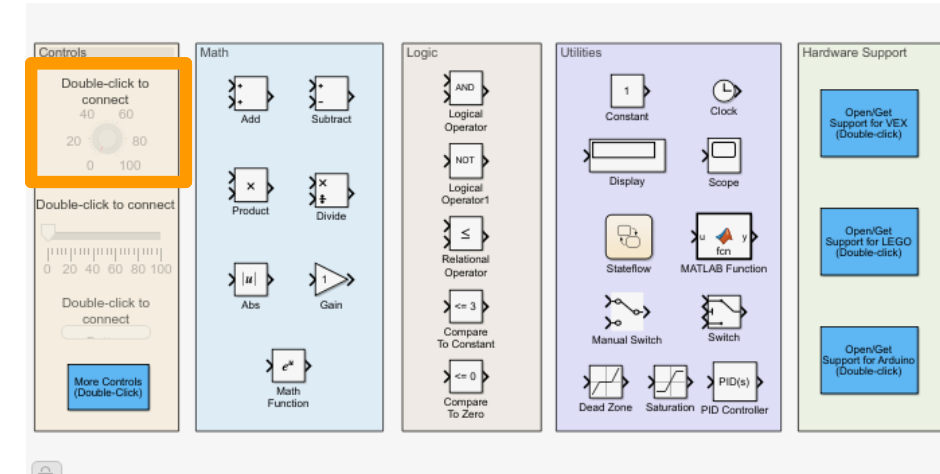
- Driving the left and right wheels of a robot through a pair of separate controls is called a “**Tank**” control configuration
- In a gamepad you will likely use two different joysticks



# Dashboard Controls – Tank Configuration

- Drive the robot in real-time using dashboard controls in a tank configuration

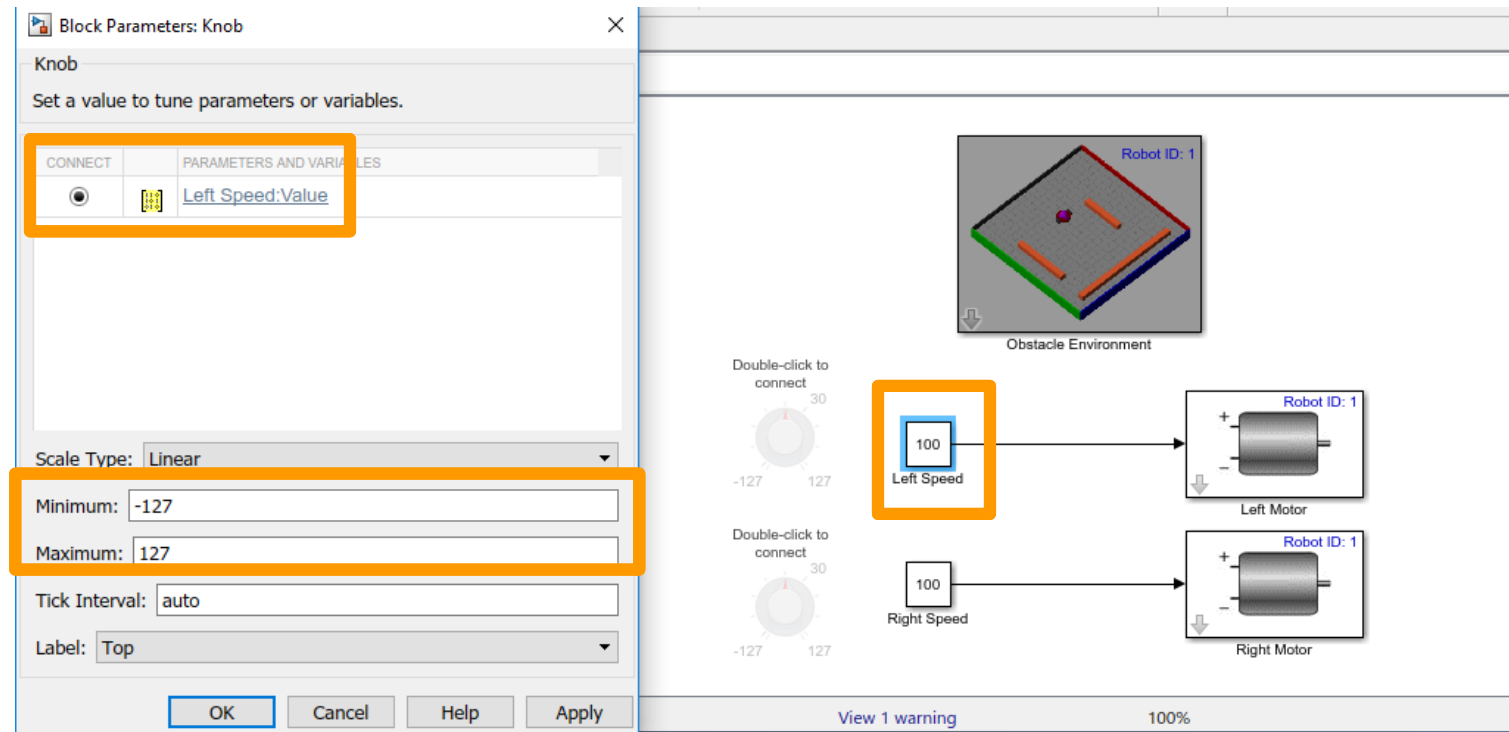
- Open the model  
“**TankControl\_start.slx**”
- Drag two knob controls from the “Utilities” library to you current model





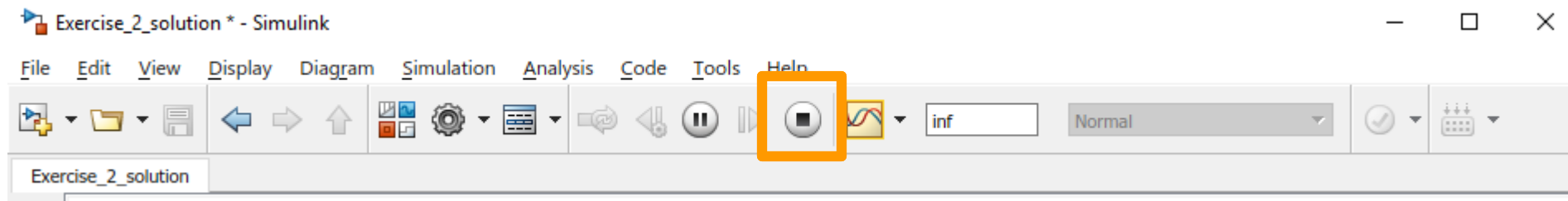
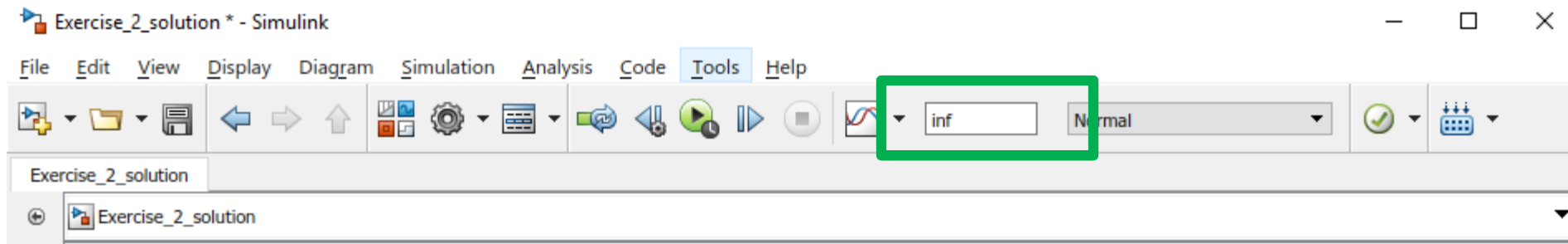
# Dashboard Controls – Tank Configuration

1. Double-click the knob control
2. Click on a constant block
3. Connect it to a constant block by checking the “Connect” checkbox
4. Set the Minimum and Maximum range of the knob to -127 and 127



# Dashboard Controls – Tank Configuration

1. Change the stop time in the toolbar to “inf”.
2. Run the model
3. Change the speeds of the motors by moving the control knobs
4. Stop the simulation using the “Stop” button



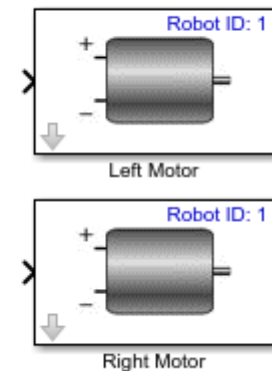
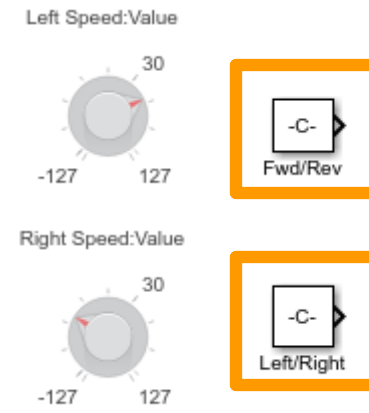
## Dashboard Controls – Arcade Configuration

- Controlling the robot using an “Arcade” configuration means you control forward speed and the rotation with two separate controls
- A gamepad joystick is used for the **left/right** turning while the other joystick is **forward/reverse**
- **Note:** Both directions of one joystick can also be used



# Dashboard Controls – Arcade Configuration

- For this we need to calculate the desired wheel speeds corresponding to Arcade inputs
1. Rename the constant blocks to **Fwd/Rev** and **Left/Right**
  2. Delete the signals that connect constants them to the motors
  3. Alternatively, open **“ArcadeControl\_start.slx”**



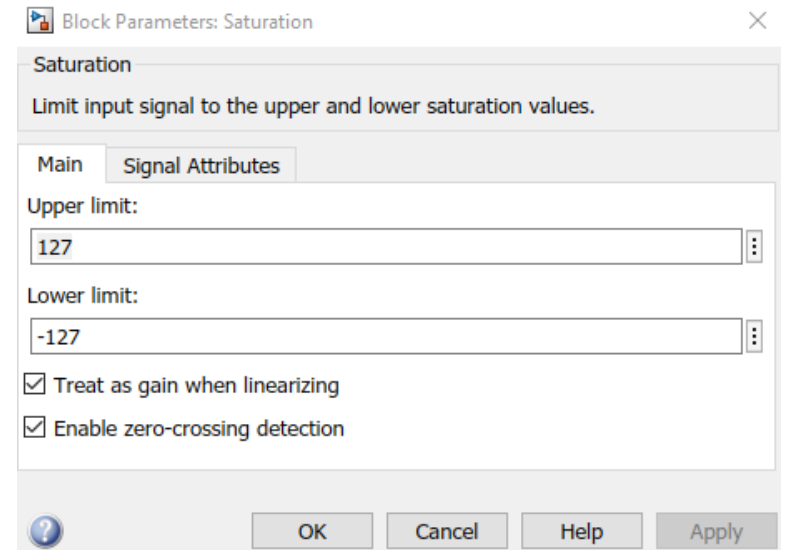
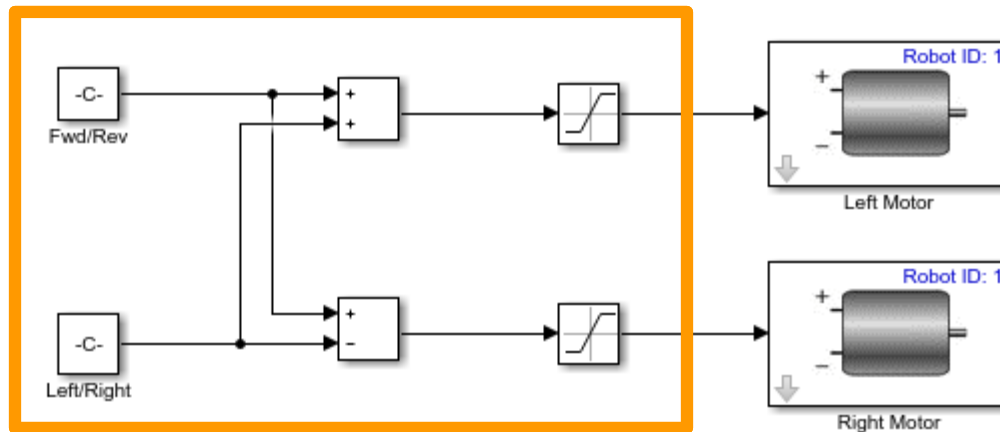
# Dashboard Controls – Arcade Configuration

1. Copy the diagram below using the corresponding Simulink blocks to calculate the motor speeds
2. Drag the “Saturation” block from the Utilities library
3. Set the limits of saturation blocks as shown
4. Run model
5. Use dashboard controls to drive robot

Fwd/Rev:Value



Left/Right:Value



## End of Unit 2: Robot Controls

- Congrats !
- Here are some learning outcomes from this unit
  - How to use virtual environments in Simulink
  - How to interact with robots using dashboard controls
  - How to program Tank and Arcade driving controls for gamepads