Robot Simulation Tutorial

Contents

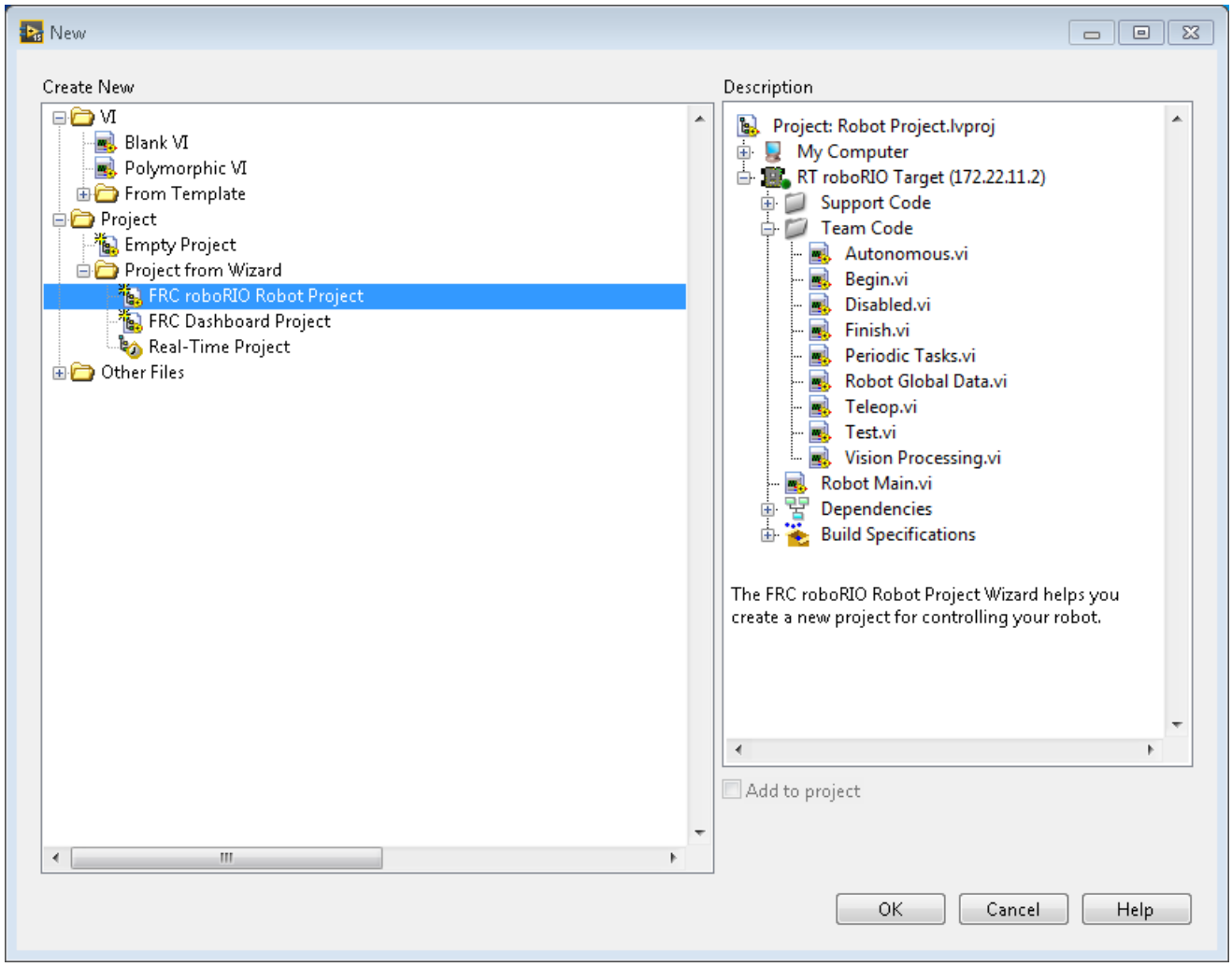
Introduction

Use the LabVIEW Robot Simulation to program a predefined robot without having an RT roboRIO Target. This allows multiple developers to concurrently create and test LabVIEW code without requiring each developer to have access to the hardware. Programming is the same, except only the predefined Actuators and Sensors on the simulated robot are currently supported. Robot code that has been developed and works in simulation mode can be moved to the RT roboRIO Target and run on a real robot.

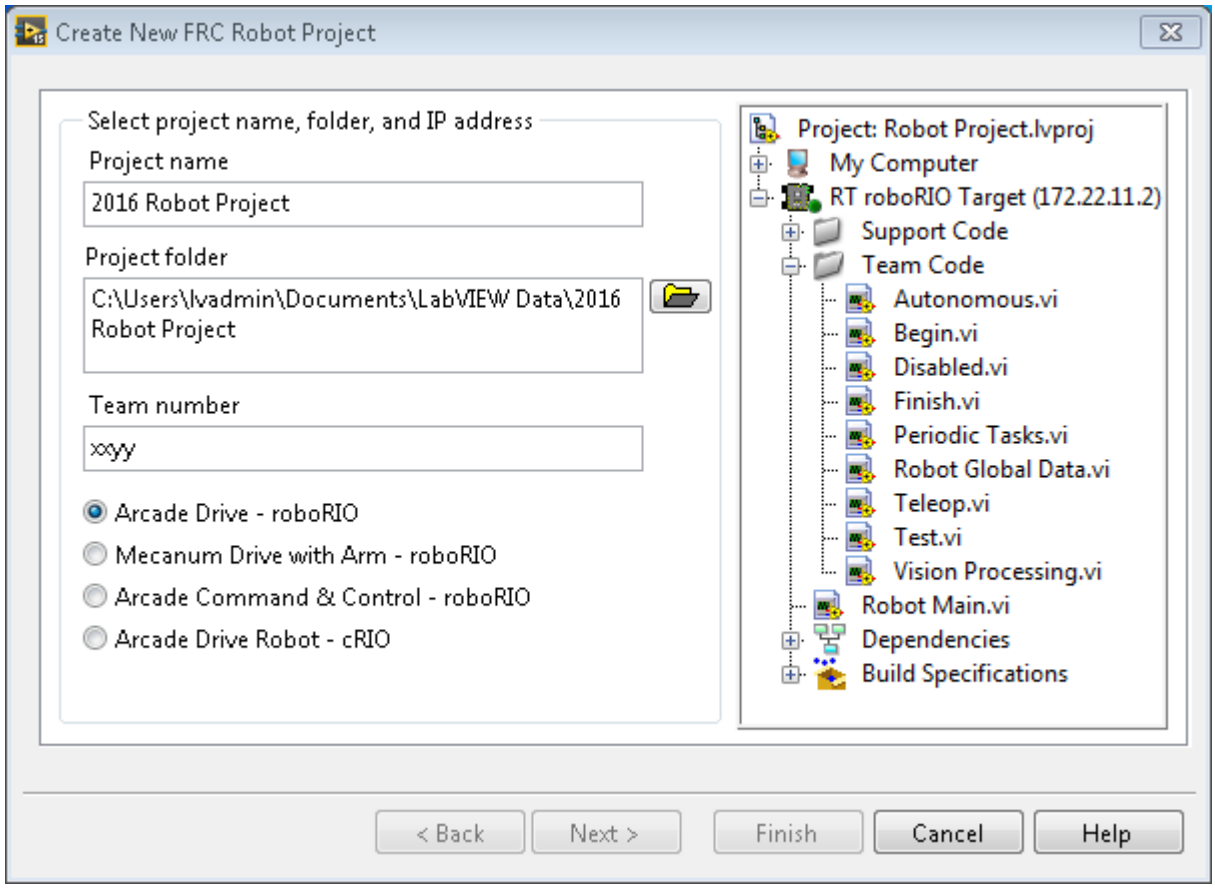
Opening the Robot Simulator

1. Start the **FRC Driver Station**. This is required for both real and simulated robots.

2. Open a New **FRC roboRIO Robot Project** either from the Getting Started window or by going to File»New…

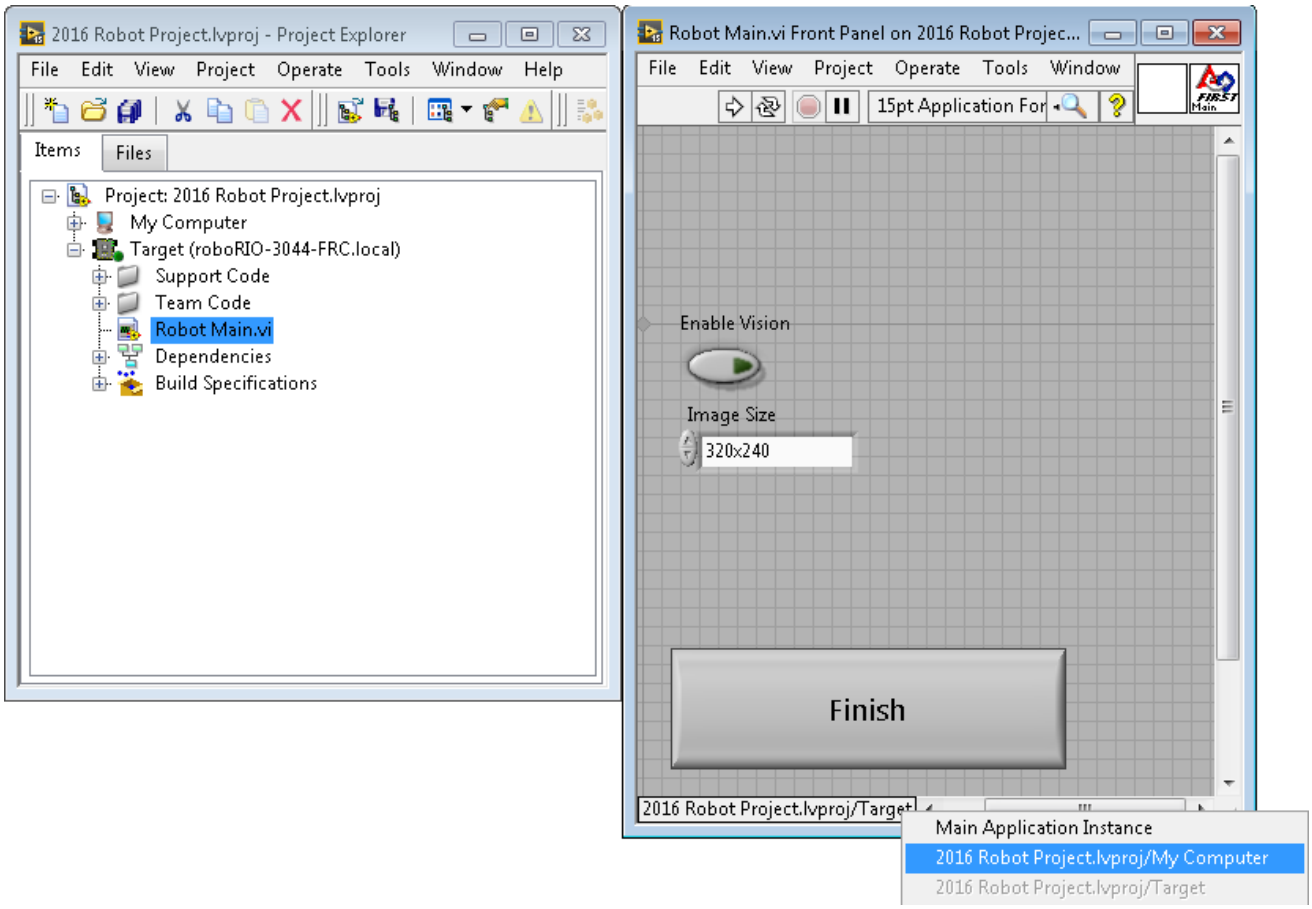


3. Update the **Team Number** by using your Team Number. This will automatically determine the IP for you. You can choose any of the roboRIO project options to access the simulator. The **Arcade Drive Robot – cRIO** does not support the simulator.

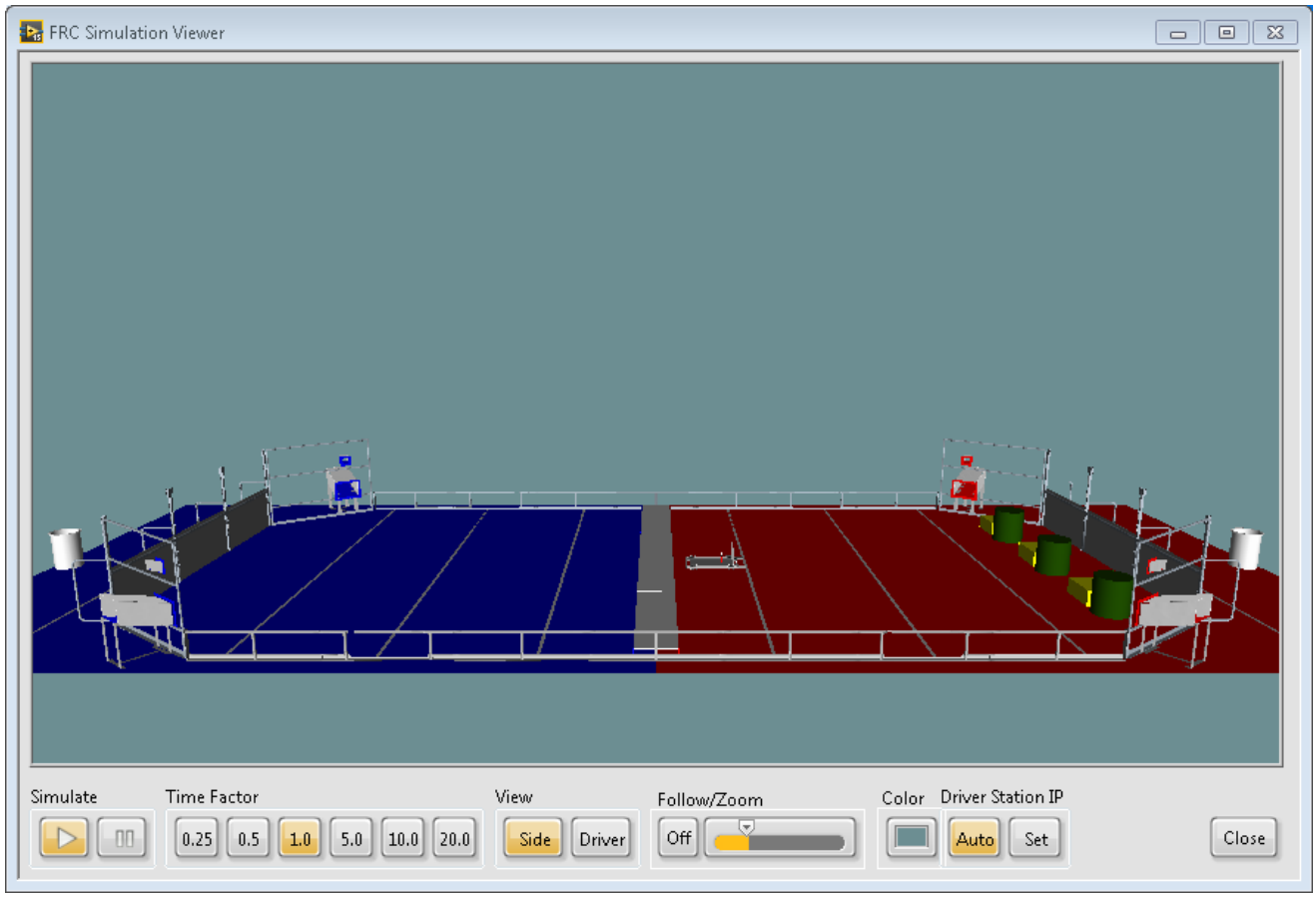


4. When the LabVIEW Project opens, select and open **Robot Main.vi**.

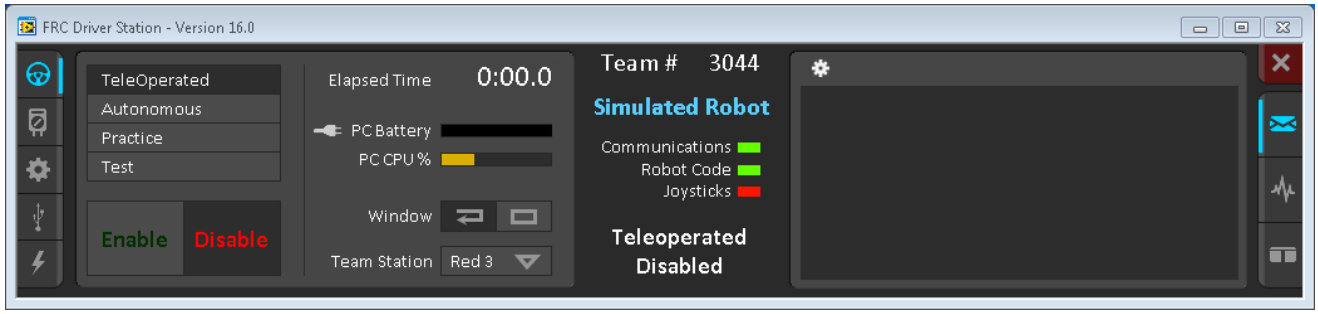
5. Right-click in the lower left corner of **Robot Main.vi** and choose **2016 Robot Project Tutorial.lvproj/My Computer**. Wait a moment while the subVIs reload. Be aware the name will match the name you chose for your project and may be different than the name used here.



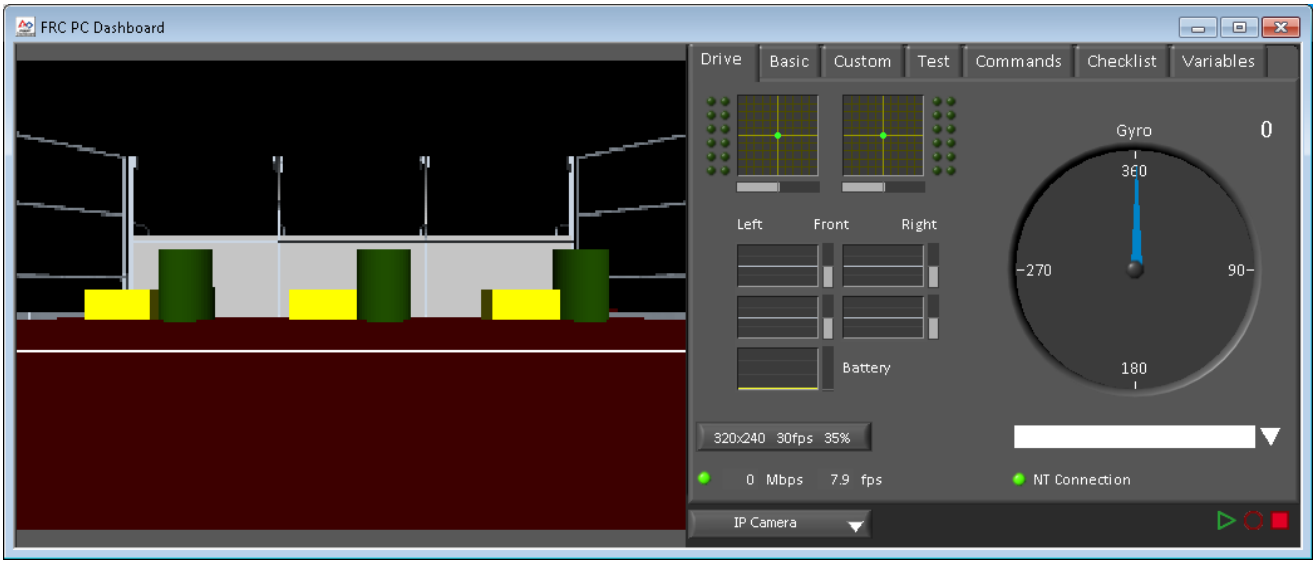
6. Run **Robot Main.vi** and the **FRC Simulation Viewer** opens.

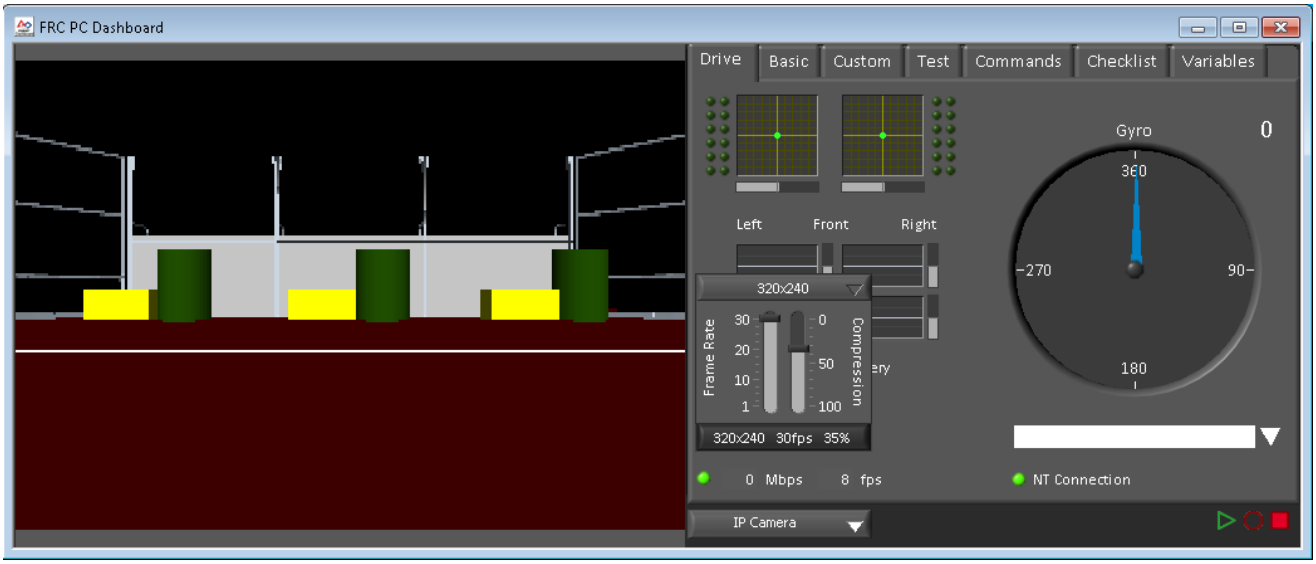


7. The **FRC Driver Station** should now show that you are in **Simulated Robot** Mode. Click **Enable** to place the robot in **Teleoperated Enabled** Mode.

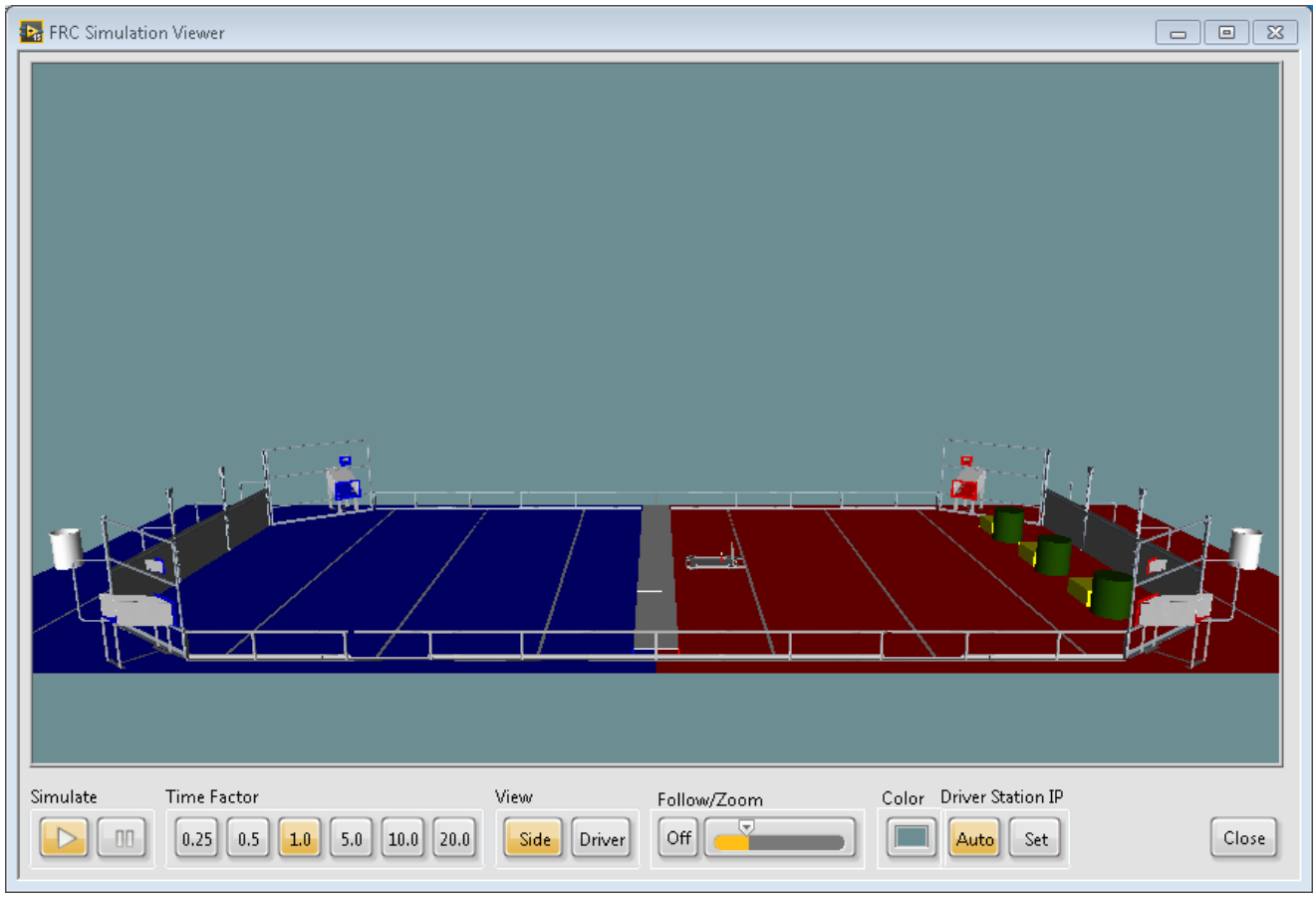


8. You should now be able to use a joystick to drive the robot in the **FRC Simulation Viewer**.
9. The camera image and **Drive** can be monitored in the **FRC PC Dashboard**. Change the Camera to **IP Camera** to view the camera. The camera can be changed using the dropdown menu at the bottom of the **Drive** tab in the center of the **FRC PC Dashboard** window. Left-click the resolution to change the **Frame Rate** and **Compression**. Changing to a lower frame rate will help performance on slower computers.





Using the FRC Simulator Viewer



Aside from Teleoperation of the simulated robot using the joystick, there are several options in the FRC Simulator Viewer to help customize your simulation environment:

Simulate – **Run** and **Pause** buttons are available.
Time Factor – Allows you to run the dynamic model of the system slower than real time (minimum 0.25) and faster than real time (maximum 20.0). A Time Factor of 1.0 will be representative of the system in real time.
View – Side or **Driver** enables you to default back to one of the two traditional points of view. If **Follow** is **Off**, left-clicking and panning in the Viewer window will allow you to choose a custom viewing angle.
Follow – If you turn Follow **On**, the Viewer will keep the robot centered in the screen from whichever **View** you have selected. If you turn Follow **Off**, left-clicking and panning in the Viewer window will allow you to choose a custom viewing angle, but zooming is no longer possible.
Color – Selects the background color.
Driver Station IP – Auto should be set to connect with the correct IP Address based on the RT roboRIO Target properties in the LabVIEW Project Explorer, but there is also an option to **Set** the IP address manually.
Close – Close the FRC Simulation Viewer and stop **Robot Main.vi**.

Programming a Simulated Robot

The simulated robots are predefined – they cannot be changed. However, they are the same as real robots in that they have sensors and actuators attached. By default, each project includes code to drive the robot. Beyond that, it is up to you to add code to make use of additional sensors and actuators included on each robot. For example, each simulated robot includes a gyro. By following **Tutorial 7 – Integrating Examples into Robot Code**, you can learn how to add gyro code for your simulated robot. Once you get that working in simulated mode, the same code can be built for a real robot.

In order to program each simulated robot, you need to know which sensors and actuators it has. You also need to know how each is wired – which module and channel each uses.

Remember that when you create an FRC Robot Project, you have three roboRIO options that will work with simulation. The simulated sensors and actuators are dependent on which project you choose. Below is a list for each project. You can also find this list within each project in **Robot Simulation Readme.html** under **My Computer**.

Supported Actuators and Sensors on the Simulated Robots

1. Arcade Drive Robot

Actuators on the simulated robot

1. Left Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 1
2. Right Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 2
3. Camera Servo
   Digital Module = Digital Module 1
   PWM Channel = PWM 5
   Angular Range = 170

Sensors on the simulated robot

1. Encoder on Right Motor
   Digital Module = Digital Module 1
   A Channel = DIO 3
   B Channel = DIO 4
2. Encoder on Left Motor

Digital Module = Digital Module 1
A Channel = DIO 5
B Channel = DIO 6

3. Gyro
   Analog Module = Analog Module 1
   Analog Channel = AI 1
4. Ultrasonic
   Ping Digital Module = Digital Module 1
   Ping DIO Channel = DIO 1
   Echo Digital Module = Digital Module 1
   Echo DIO Channel = DIO 2
5. AXIS M1011 Camera

2. Arcade Robot with Arm

Actuators on the simulated robot

1. Left Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 1
2. Right Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 2
3. Camera Servo
   Digital Module = Digital Module 1
   PWM Channel = PWM 5
   Angular Range = 170
4. Arm Servo
   Digital Module = Digital Module 1
   PWM Channel = PWM 6
   Angular Range = 170
5. Gripper Servo
   Digital Module = Digital Module 1
   PWM Channel = PWM 7
   Angular Range = 170

Sensors on the simulated robot

1. Encoder on Right Motor
   Digital Module = Digital Module 1
   A Channel = DIO 3
   B Channel = DIO 4
2. Encoder on Left Motor
   Digital Module = Digital Module 1
   A Channel = DIO 5
   B Channel = DIO 6
3. Gyro
   Analog Module = Analog Module 1

Analog Channel = AI 1

4. Ultrasonic
   Ping Digital Module = Digital Module 1
   Ping DIO Channel = DIO 1
   Echo Digital Module = Digital Module 1
   Echo DIO Channel = DIO 2
5. AXIS M1011 Camera

3. Mecanum Robot with Arm

Actuators on the simulated robot

1. Left Front Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 1
2. Right Front Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 2
3. Left Rear Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 3
4. Right Rear Motor
   Digital Module = Digital Module 1
   PWM Channel = PWM 4
5. Camera Servo
   Digital Module = Digital Module 1
   PWM Channel = PWM 5
   Angular Range = 170
6. Arm Servo
   Digital Module = Digital Module 1
   PWM Channel = PWM 6
   Angular Range = 170
7. Gripper Servo
   Digital Module = Digital Module 1
   PWM Channel = PWM 7
   Angular Range = 170

Sensors on the simulated robot

1. Encoder on Right Motor
   Digital Module = Digital Module 1
   A Channel = DIO 3
   B Channel = DIO 4
2. Encoder on Left Motor
   Digital Module = Digital Module 1
   A Channel = DIO 5
   B Channel = DIO 6
3. Gyro

Analog Module = Analog Module 1
Analog Channel = AI 1

4. Ultrasonic
   Ping Digital Module = Digital Module 1
   Ping DIO Channel = DIO 1
   Echo Digital Module = Digital Module 1
   Echo DIO Channel = DIO 2
5. AXIS M1011 Camera

Notes:

1. If you run a robot in simulation mode, but you have programmed it for I/O not supported in simulation mode, then errors will be generated that slow the simulation performance. You can check for errors under the **Diagnostics** tab of the FRC Driver Station.
2. The E-Stop (space bar) works in Simulation Mode. To reset it, simply wait five seconds and then reset **Robot Main.vi**.
3. To change the **Robot Main.vi** to be able to run on the target again, you will need to right click in the lower left corner of **Robot Main.vi** and choose **2016 Robot Project Tutorial.lvproj/Target**. Wait a moment while the subVIs reload.