The background is a dark blue gradient with faint, light blue geometric patterns. On the left side, there are several concentric circles and arcs, some with degree markings ranging from 140 to 260. There are also dashed lines and arrows indicating movement or rotation. The overall aesthetic is technical and futuristic.

# FRC SIMULATED ROBOT DRIVING PRACTICE USING AUTODESK BXD SYNTHESIS V4.0

SEPTEMBER 2017

# ABOUT

The better an FRC team's driving is, the better they will be able to maximize the performance of their robot on the field. It takes a significant investment of time for a person to develop robot driving skills, and the actual amount of time a driver has with the robot is often much less than would be ideal.

Simulations are not perfect. The real robot in the real world will absolutely behave differently than a simulated robot on a computer screen. That said, a simulation does offer a major advantage: unlimited practice time.

The latest version of Autodesk's "BXD Synthesis" (v4.0), which runs on Windows only unfortunately, seems quite good for simulated FRC driving practice. Various kinds of simulated robots are available, and simulated FRC fields back to 2010 can be loaded within the environment. Also, a wide range of controllers can be set up in different configurations, including flight stick controllers like the Logitech Extreme 3D Pro and PC-compatible game controllers like the Xbox One controller.

This document provides instructions for how to install and use BXD Synthesis for driving practice. It does not cover every feature of the application, and the approach described may not be the best approach for you in the long run, but it should get you started. Good luck driving & have fun!

# STEP 1: INSTALL BXD SYNTHESIS

Go

to <http://bxd.autodesk.com/>

Click

“Download It Here!”

Follow

Installation Instructions

## STEP 2: RUN THE BXD SYNTHESIS APPLICATION

Click

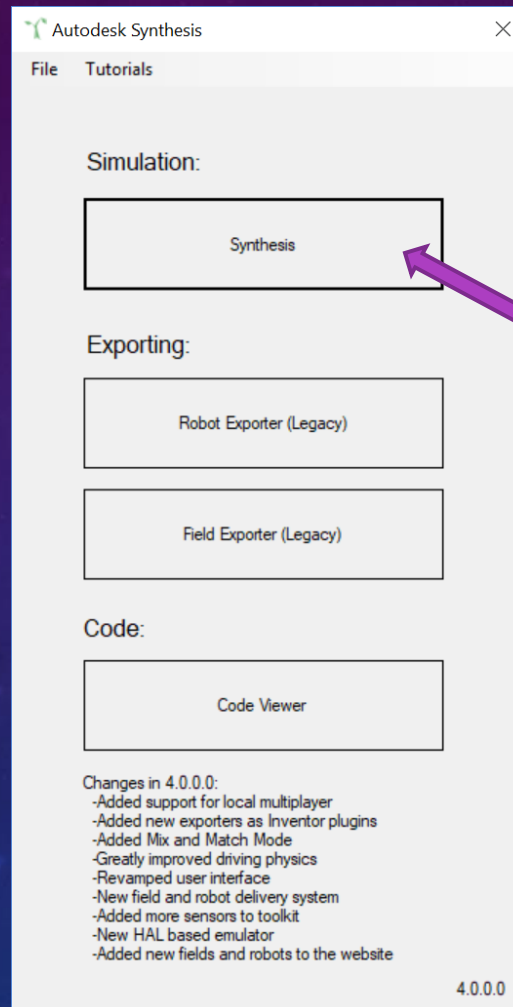
the Desktop or Toolbar shortcut to  
Synthesis

Or  
Search

for Synthesis using the menu or search  
function near bottom left in Windows,  
and start up that way



# STEP 3: START THE SIMULATION APPLICATION



CLICK HERE

STEP 3  
(CONTINUED)

YOU WILL  
ARRIVE HERE



## STEP 4: PLUG IN A CONTROLLER

### Tested So Far

Xbox One Controller (with USB cord)

Xbox 360 Controller for PC

Logitech Extreme 3D Pro Flight Stick

Playstation-style Saitek P990 handheld controller

# STEP 5: SELECT CONTROLLER OPTIONS – XBOX CONTROLLER

(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A FLIGHT  
STICK OR NON-XBOX  
GAME CONTROLLER)

Click

“Options” at top of screen

Decide

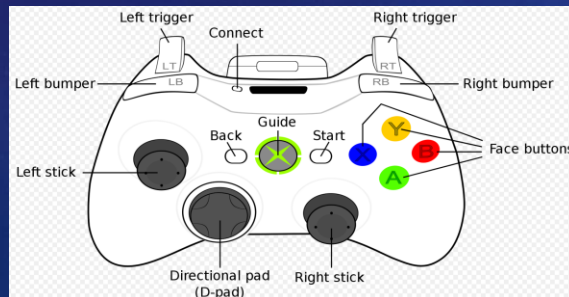
Option 1: Defaults. The default settings are the most common Xbox controller configuration used by FRC teams, sometimes called “Modified Arcade Drive”. The left joystick controls forward / backward and the right joystick controls left / right steering. This is a good place to start, but be sure to try option 2 as well for comparison.

Option 2: Triggers. Go to Next Page



# STEP 5: SELECT CONTROLLER OPTIONS – XBOX CONTROLLER

(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A FLIGHT  
STICK OR NON-XBOX  
GAME CONTROLLER)

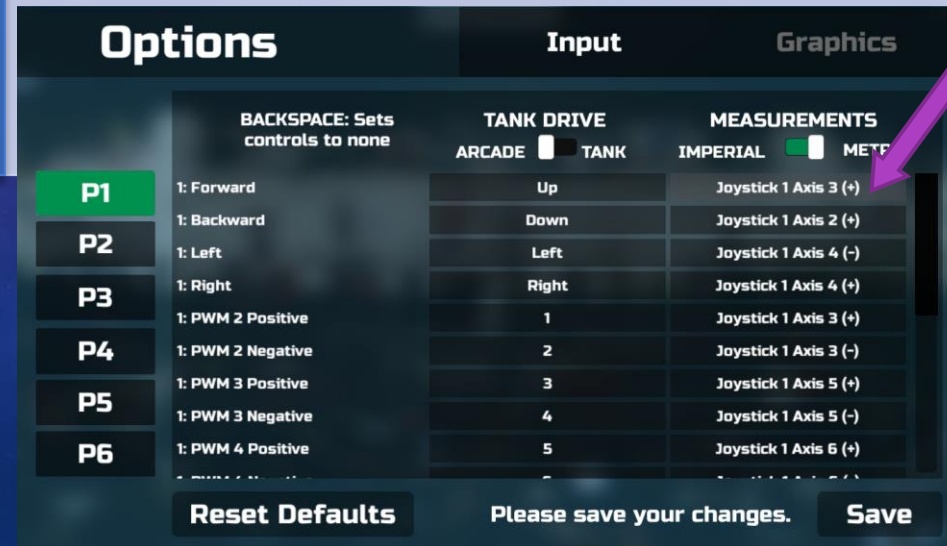


Decide  
(continued)

Option 2: Triggers. Use the left and right triggers for Forward / Backward control instead of the left joystick.

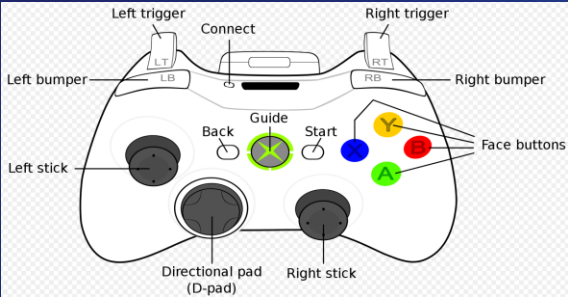
Setup Instructions:

1. On the Options-Input screen, click the box to the right of the “Up” box as indicated below.
2. Press the left trigger on the controller



# STEP 5: SELECT CONTROLLER OPTIONS – XBOX CONTROLLER

(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A FLIGHT  
STICK OR NON-XBOX  
GAME CONTROLLER)



Decide  
(continued)

Option 2: Triggers. Use the left and right triggers for Forward / Backward control instead of the left joystick.

Setup Instructions (continued):

3. Click the box to the right of the “Down” box as indicated below.

4. Press the right trigger on the controller

Options

Input

Graphics

	BACKSPACE: Sets controls to none	TANK DRIVE ARCADE <input type="checkbox"/> TANK <input checked="" type="checkbox"/>	MEASUREMENTS IMPERIAL <input checked="" type="checkbox"/> METRIC <input type="checkbox"/>
P1	1: Forward	Up	Joystick 1 Axis 3 (+)
P2	1: Backward	Down	Joystick 1 Axis 3 (-)
P3	1: Left	Left	Joystick 1 Axis 4 (-)
P4	1: Right	Right	Joystick 1 Axis 4 (+)
P5	1: PWM 2 Positive	1	Joystick 1 Axis 3 (+)
P6	1: PWM 2 Negative	2	Joystick 1 Axis 3 (-)
	1: PWM 3 Positive	3	Joystick 1 Axis 5 (+)
	1: PWM 3 Negative	4	Joystick 1 Axis 5 (-)
	1: PWM 4 Positive	5	Joystick 1 Axis 6 (+)

Reset Defaults

Please save your changes.

Save



# STEP 5: SELECT CONTROLLER OPTIONS – XBOX CONTROLLER

(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A FLIGHT  
STICK OR NON-XBOX  
GAME CONTROLLER)

Decide  
(continued)

Option 2: Triggers. Use the left and right triggers for Forward / Backward control instead of the left joystick.

Setup Instructions (continued):

5. The original default mappings of the triggers need to be removed. Click the box to the right of “1” and then press the controller’s “A” button. Do the same for the box to the right of “2” and the “B” button.





## STEP 5: SELECT CONTROLLER OPTIONS – FLIGHT STICK

(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A GAME  
CONTROLLER THAT IS  
NEITHER XBOX NOR  
FLIGHT STICK)

Click

“Options” at top of screen

Decide

The default settings will not work with a flight stick – try one or both of the options below.

Option 1: Arcade Drive – stick only

→Go to next page for instructions

Option 2: Modified Arcade Drive using throttle

→Skip forward a few pages

# STEP 5: SELECT CONTROLLER OPTIONS – FLIGHT STICK

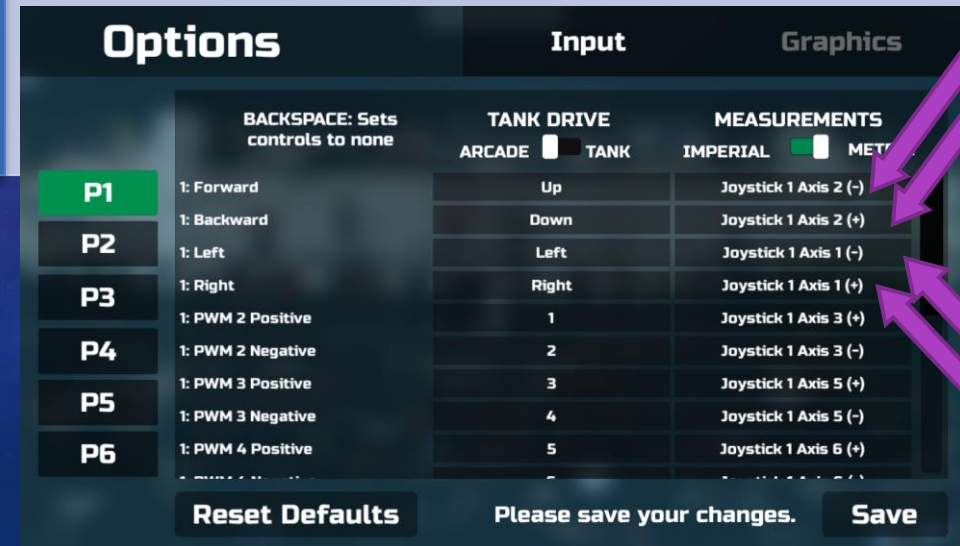
(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A GAME  
CONTROLLER THAT IS  
NEITHER XBOX NOR  
FLIGHT STICK)

Decide  
(continued)

Option 1: Arcade Drive – stick only

Setup Instructions:

1. While on the Options-Input screen, push and hold the joystick all the way up/forward
2. Click the box to the right of the “Up” box as shown below
3. Repeat the above to set up the Down/Backward, Left, and Right directions





# STEP 5: SELECT CONTROLLER OPTIONS – FLIGHT STICK

(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A GAME  
CONTROLLER THAT IS  
NEITHER XBOX NOR  
FLIGHT STICK)



Decide  
(continued)

## Option 2: Modified Arcade Drive using throttle

Setup Instructions:

- 1. While on the Options-Input screen, push the throttle all the way up/forward
- 2. Click the box to the right of the “Up” box as shown below
- 3. Similarly push the throttle all the way down, and click the box to the right of the “Down” box

Options

Input

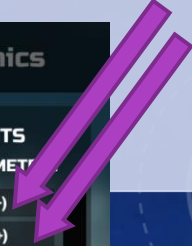
Graphics

	BACKSPACE: Sets controls to none	TANK DRIVE ARCADE <input type="checkbox"/> TANK <input type="checkbox"/>	MEASUREMENTS IMPERIAL <input type="checkbox"/> METRIC <input type="checkbox"/>
P1	1: Forward	Up	Joystick 1 Axis 2 (-)
P2	1: Backward	Down	Joystick 1 Axis 2 (+)
P3	1: Left	Left	Joystick 1 Axis 1 (-)
P4	1: Right	Right	Joystick 1 Axis 1 (+)
P5	1: PWM 2 Positive	1	Joystick 1 Axis 3 (+)
P6	1: PWM 2 Negative	2	Joystick 1 Axis 3 (-)
	1: PWM 3 Positive	3	Joystick 1 Axis 5 (+)
	1: PWM 3 Negative	4	Joystick 1 Axis 5 (-)
	1: PWM 4 Positive	5	Joystick 1 Axis 6 (+)

Reset Defaults

Please save your changes.

Save



# STEP 5: SELECT CONTROLLER OPTIONS – FLIGHT STICK

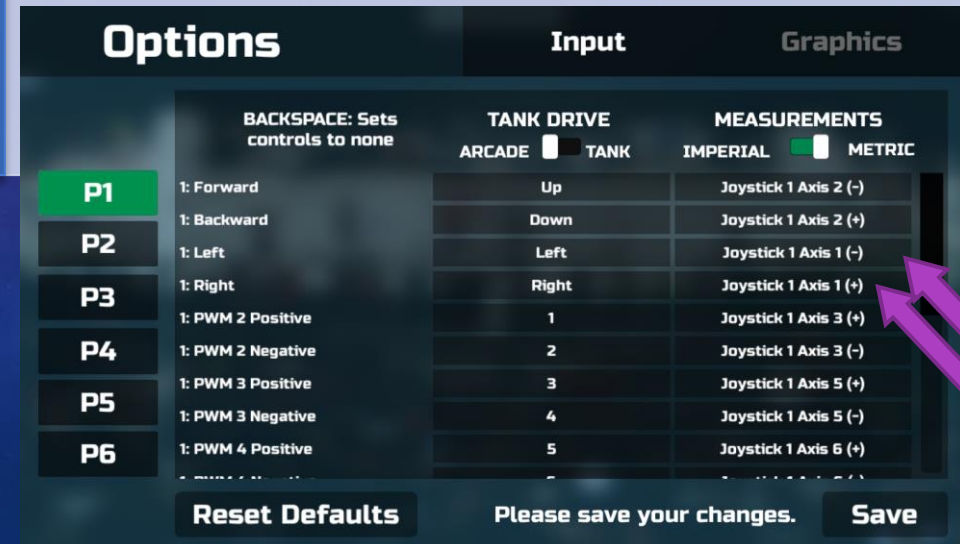
(SKIP FORWARD IN  
THESE INSTRUCTIONS IF  
YOU HAVE A GAME  
CONTROLLER THAT IS  
NEITHER XBOX NOR  
FLIGHT STICK)

Decide  
(continued)

Option 2: Modified Arcade Drive using throttle

Setup Instructions:

4. Push and hold the joystick all the way to the left
5. Click the box to the right of the “Left” box as shown below
6. Repeat the above to set up the Right direction

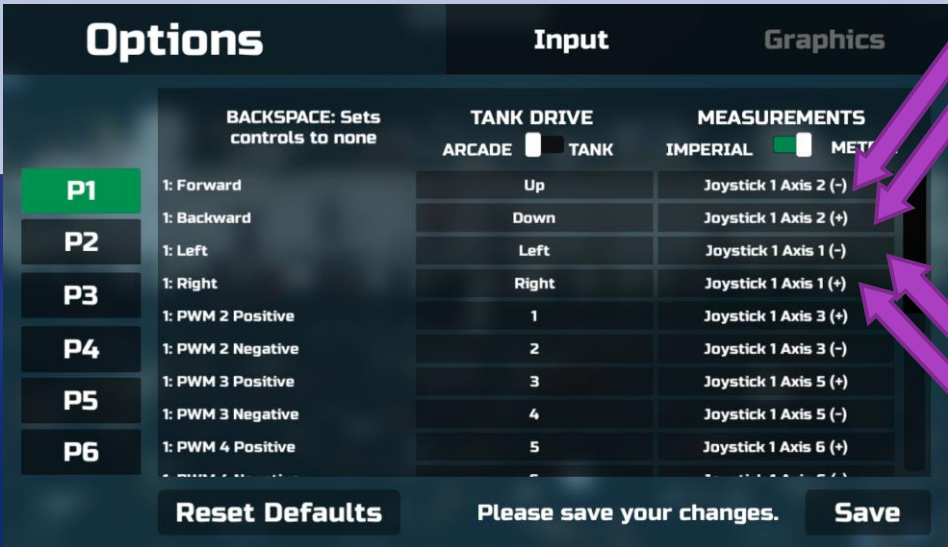


STEP 5: SELECT  
CONTROLLER  
OPTIONS –  
OTHER  
CONTROLLER

Decide  
(continued)

Since there are many types of controllers, specific instructions covering them all cannot be provided. The default settings worked fine with a Playstation-like Saitek controller for Modified Arcade Drive.

If that doesn't work or if you wish to experiment, then similar Up, Down, Left, and Right mapping actions to those described for Xbox controller and flight stick will be needed.



## STEP 6: SELECT GRAPHICS SETTINGS

Click

“Options” at top of screen, then “Graphics”

Decide

I picked Full Screen and Medium, but you may wish (or need) to use other settings depending on your computer.



## STEP 6: SELECT ROBOT AND FIELD

### Click

“Select” at top of screen, then click on “Main Simulator”. (Feel free to try Mix and Match as well later.)

### Decide

I recommend starting with Field = “2013 Ultimate Ascent” and Robot = “Sample Robot” because both are fairly simple, fast to load, etc.

After you have done some driving practice, then you can try some other fields, including “2017 Steamworks”. And you can try some other robots to see how they behave differently.



# STEP 7: START SIMULATION & SELECT VIEW -- FREEROAM

## Click

Once you pick your field and robot, click “START!”. Then pick a View option (see below).

## Decide

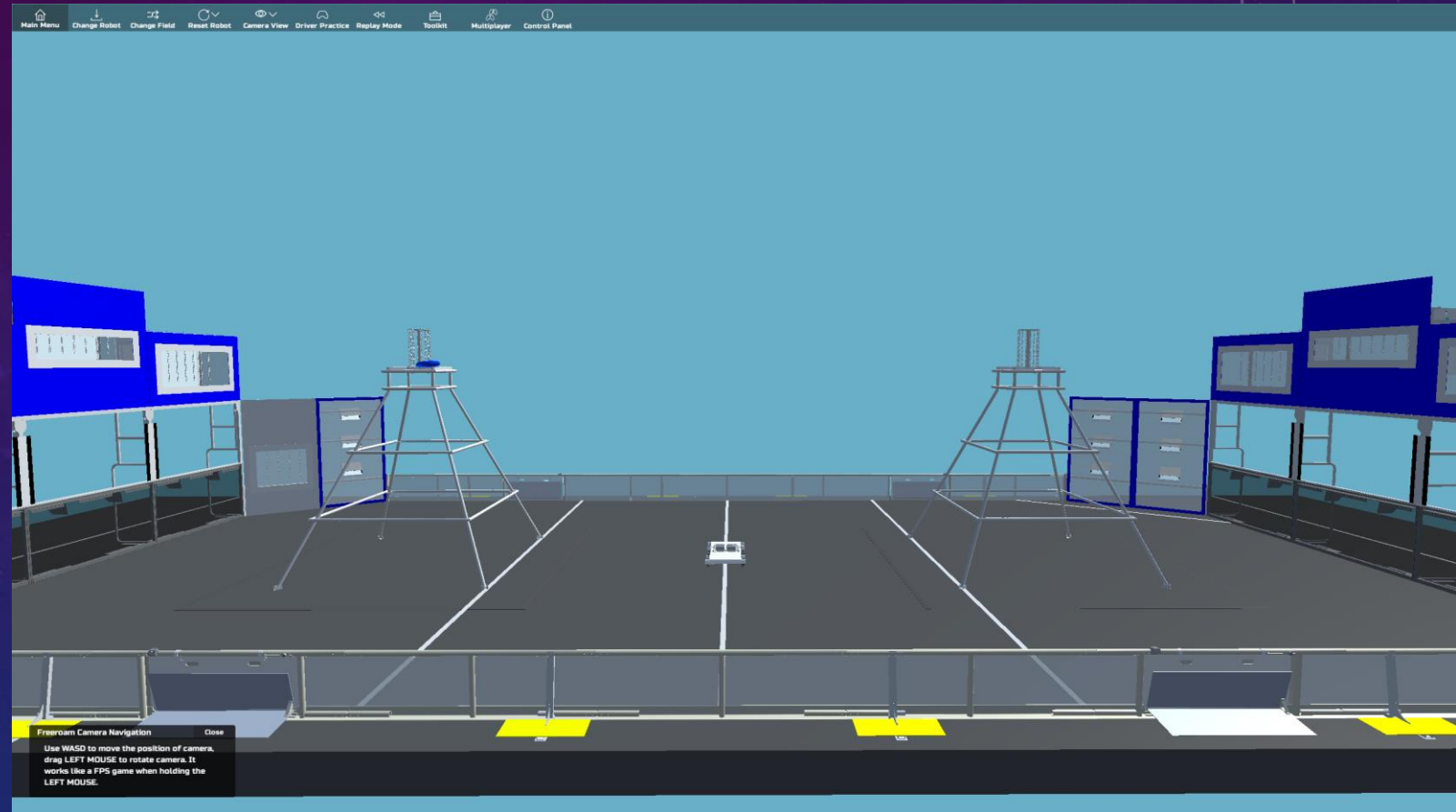
The default camera view is easy to use but unrealistic. It simulates a camera following behind the robot as it moves, like a video game. You can start with it if you like, but I recommend switching over to one of the following two more realistic views:

**Freeroam:** You pick a fixed position for the camera. I like a side audience view for beginner driver practice. Set that up as follows:

1. Click “Camera View” at top, and choose Freeroam
2. Hold down your left mouse button and move the mouse to the right until the camera is facing the long side of the field (it’s a 90-degree shift)
3. Press the “S” key on your computer keyboard to back the camera up so you can see the whole field. See next page for what it should look like.

**Driver Station view:** Move forward two pages

STEP 7:  
START  
SIMULATION  
& SELECT  
VIEW --  
FREEROAM



# STEP 7: START SIMULATION & SELECT VIEW -- DRIVER STATION

## Click

Once you pick your field and robot, click “START!”. Then pick a View option (see below).

## Decide

### Second realistic view option

**Driver Station:** Camera position is closest to game-like. You can adjust the view to simulate any of the 6 driver station positions on the field. Here’s how to set it up.

1. Click “Camera View” at top, and choose “Driver Station”
2. Use on-screen instructions at bottom left to select which driver station view is simulated.
3. With a game like Steamworks that has poor sight lines, you’ll want to also turn on the robot camera.

--- Click “Toolkit”, then “Camera” using the menus at the top of the screen.

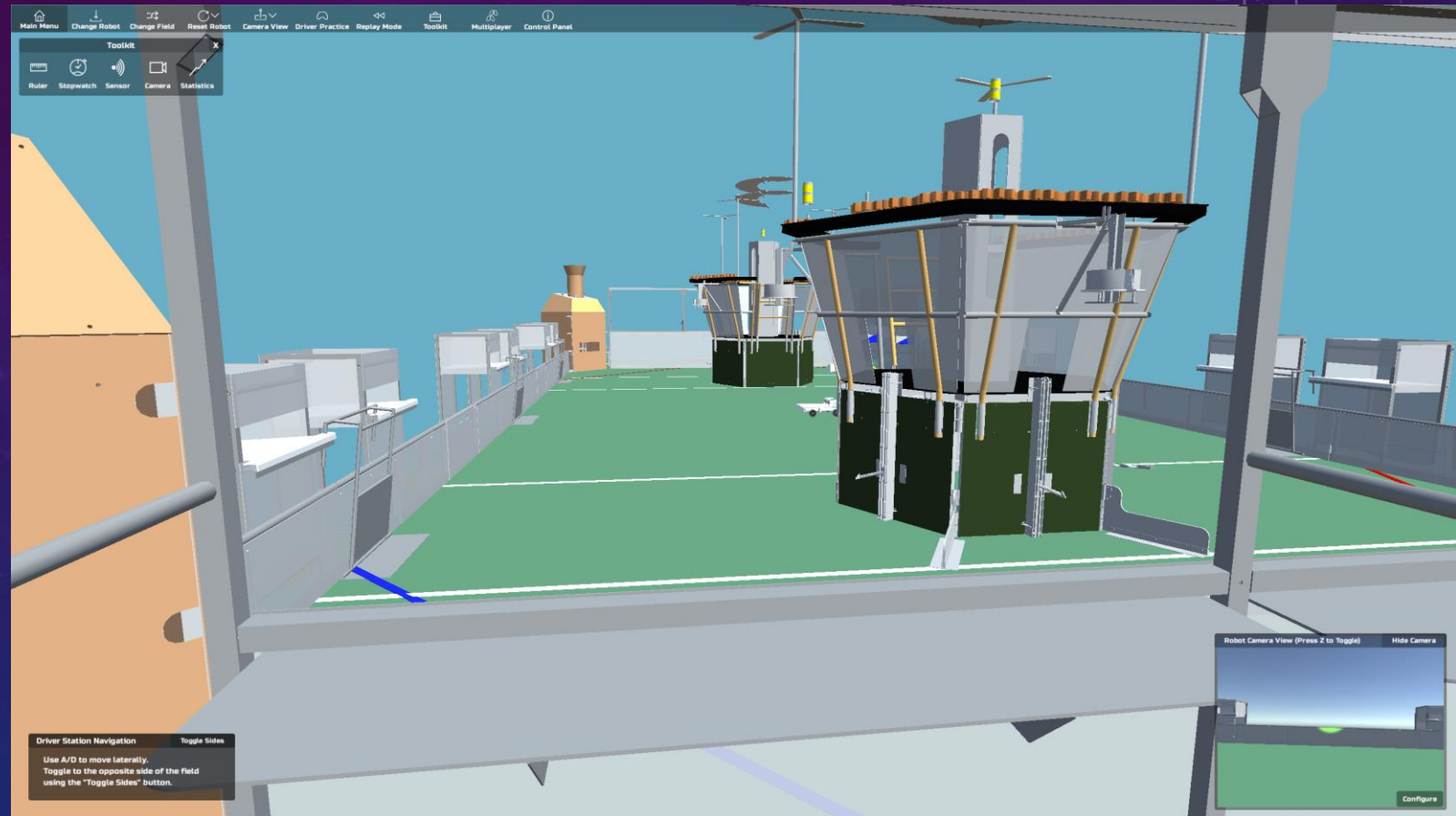
--- For some reason, the default camera direction is sideways (at least on the Sample Robot), so you’ll need to fix that. Click “Show Camera” in the camera view, then “Configure” in the camera view at bottom right.

--- Click “Show/Edit Camera Angle” in the Camera Config panel at bottom left.

--- Press the “D” keyboard key to rotate the camera until it is facing forward (yes, this is a pain). If you go too far, press “A” to rotate back the other direction.

--- The camera view is actually good once you get it set up... unrealistically good. In real life, latency and frame rates are often quite poor. So I recommend only using the camera view when you don’t have a direct sight line.

STEP 7:  
START  
SIMULATION  
& SELECT  
VIEW --  
DRIVER  
STATION





FINAL STEP: PRACTICE AND HAVE FUN!