



Outbreak ♦ Online
Autonomous Programming Challenge
Time Trials Guide
13 November 2020

This document is intended to provide guidance to teams regarding execution of the Outbreak Online Competition Autonomous time trials. It outlines the general rules, methods and procedures related to execution of the time trials.

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Section 1 General Rules

1. The Outbreak Autonomous Programming Challenge will be executed as time trials on a virtual game field using a virtual robot that is programmed by the team.
2. The objectives of this challenge will be to score as many points as possible in each time trial, based on the rules described in Section 3.9. of the BEST Competition Rules.
3. Physical collisions between the robot and cells, isolation frames, and isolation platforms are not modeled in the virtual game field.
4. A minimum of 3 time-trials will be run by each team. The maximum number of time trials each team will run in the Autonomous Programming Challenge will be determined by the hub.
5. Autonomous Time Trials will be judged and scored through scheduled online meeting(s) and video streaming. Each team must have appropriate internet access as described in section 1.1 .
6. Autonomous Time Trials will not influence any other awards.

1.1 Prerequisites

To participate in the Outbreak Online Autonomous Programming Challenge, teams must have

- Computer with internet access.
- Ability to participate in online meetings and load any specified online meeting software, as determined by the hub meeting platform(s).

The Autonomous Programming Challenge uses Mathworks MATLAB/Simulink tools, provided free to all participating teams. Request the software at <http://www.mathworks.com/best-robotics>. The team may install the software on as many computers as necessary (school computers, individual student computers, etc.).

The team must provide a computer sufficient to execute these tools. This requires a windows, mac or unix computer meeting the minimum [MathWorks system requirements](#). We recommend at least 25GB of free disk space.

All robot programming will be accomplished in MATLAB/Simulink. No other programming languages will work with the virtual environment being used for this challenge.

1.1.1 Alternative Computing Resources

In the case that students are not able to satisfy the computing resources prerequisites, the following possibilities exist.

- 1) MATLAB/Simulink Online
 - a. Available to all students via their free MathWorks Account.
 - b. Can be used for autonomous mode visualization on Robotics Playground BUT not in real-time; a video of the simulation is created for playback. We've added buttons to the BEST Autonomous challenge Simulink template to "create video" for 2 camera views and to "replay video".
- 2) Remote Desktop
 - a. A 3rd party (hub, teacher/school, etc.) provides remote desktop sharing to computer(s) running MATLAB/Simulink (e.g., a university computer lab, individual hub computers, school computers, etc.). This is NOT the same as a network install. The Mathworks license does not allow execution on a network.
 - b. Joysticks will not work with remote desktop sharing; keyboard control should work but it may be slower based on remote desktop software and internet connection.
- 3) AWS option (or other virtual machine option)
 - a. Any remote virtual machine option should work so long as keyboard input works. This option may be no better than using the MATLAB/Simulink Online option.
 - b. Any virtual machine option MUST have students activate the installation (ideal), or at minimum have the teacher activate the installation. The hub should not activate the installation; the Mathworks license requires that each user (at least the team leader) activates the license for tracking purposes.
- 4) Hub loans laptops to teams
 - a. Check with your hub to see if this is a possibility.

1.1.2 MathWorks License Activation Requirements

No matter what the platform is running the MATLAB/Simulink software (home desktop, remote desktop, virtual machine), the software must be activated by 1) the student or 2) the teacher. This is for tracking purposes. The desire is for each individual student to activate with the fallback to at least the teacher. Hubs are not allowed to install/activate the software with a hub account and then share the resources with teams. Such usage would require special approval.

1.2 Time Trials Preparation

The following activities should be accomplished prior to the scheduled competition Time Trials.

1. Teams can download the Robotics Playground Add-on for MATLAB/Simulink and use any of the available practice configuration files.

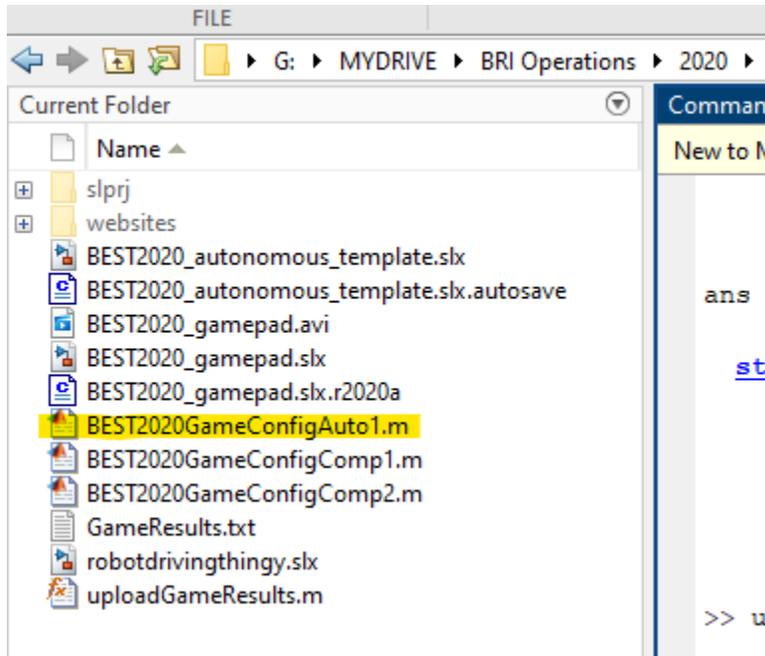
See how to install Robotics Playground by watching the first 3 minutes of this video:

<https://www.mathworks.com/videos/matlab-and-simulink-pass-competitions-hub-getting-started-with-robotics-playground-virtual-worlds-1533569380647.html>

- From MATLAB window, select Add-Ons > Get Add-Ons
 - In the Add-On Explorer window, type “Robotics Playground” in the search window and click on the search icon (magnifying glass)
 - Find the Robotics Playground in the list and click to begin installation (if it is not already installed)
 - An Autonomous Programming template model will be provided with the Robotics Playground download. This template is a Simulink model that contains the virtual game field and a few special buttons useful during the autonomous time trials. DO NOT MODIFY the virtual game field block. It is best to copy the template file to begin editing so that you can always go back to the original file.
 - If you have already installed the Robotics Playground previously, go to the MATLAB window, Add-Ons > Add-On Manager, search for “Robotics Playground”, then uninstall and re-install it to get the BEST Robotics templates. The BEST Robotics templates will become available hubs’ kickoff (September).
2. Up to 8 unique autonomous field configuration file(s) will be provided by the hub for the Autonomous Programming Challenge. These configuration files will become available to the team via their BEST National Registry Team Workflow at the hub Kickoff. The files will be named BEST2020GameConfigAuto#.m, where # is a number from 1 to 8. The filename MUST NOT be changed.
 3. The Autonomous Challenge configuration files will provide the team with starting positions of the cells on the field (exact location in each grid space) and a random order for the cell types. The starting positions will not change.
 4. A new set of Autonomous Challenge configuration files will be provided by the hub just prior to the team’s time trials. The new configuration files will have a different randomization of the cell types on the field, but the starting locations will not change.

Files shared by your Hub				
	NAME	DESCRIPTION	DATE UPLOADED	PERMISSION
	Gameday	Game Day Information	4/28/2020 3:56pm	public
	Kickoff	Kickoff Information	4/28/2020 3:55pm	public
	Logo	Hub Logo 2020	4/23/2020 6:56pm	public
	Teams	Virtual Field Competition Config File 1	7/11/2020 6:40pm	confidential
	Teams	Virtual Field Competition Config File 2	7/11/2020 6:41pm	confidential

5. These configuration files must be stored under the same folder as your Simulink model (.slx file) that you created from the initial template file.



6. Teams must download the configuration file(s) and copy them into the same directory where their Simulink model resides. For example, after downloading and install the Robotics Playground, the template files can be moved to any user-defined directory for editing. The competition configuration files must be stored in the same folder as the Simulink model for the simulation to find them.
7. Additionally, teams must download the “uploadGameResults.m” script and place it into the same directory with their Simulink Model. This script is used in the automated scoring.
8. The autonomous time trials will occur at a scheduled time. Teams should check their Team Workflow for the exact time the trials will occur.
9. Students and referees will join an online meeting at the scheduled time. The URL link to join the meeting will be available in the Team Workflow with the details of the time trials scheduled activity.

Scheduled Activities				
REQD	ACTIVITY	AVAILABLE DATE & TIME	DESCRIPTION	REGISTERED TIMES
<input checked="" type="checkbox"/>	Marketing Presentation Registration	6/26/2020 1:00pm 6/26/2020 4:00pm	Team present to judges (Register by 6/13/2020 12:00am)	Virtual Room 303 6/26/2020 1:30pm
<input checked="" type="checkbox"/>	Critical Design Review	7/1/2020 1:00pm 7/3/2020 5:00pm	Formal design review with judges covering the robot design (Register by 6/22/2020 12:00pm)	No reservation
<input checked="" type="checkbox"/>	Virtual Exhibit Interviews	7/6/2020 8:00am 7/7/2020 5:00pm	Judges will interview students at the virtual exhibit (Register by 6/26/2020 12:00pm)	online meeting 7/6/2020 9:30am
<input checked="" type="checkbox"/>	Programming Challenge	7/13/2020 9:00am 7/15/2020 5:00pm	Streaming time trials for programming challenge (Register by 7/12/2020 12:00am)	Virtual Stream 7/13/2020 9:00am

Your team can register for 1 times. Close

VIRTUAL STREAM
[HTTPS://MEET.GOOGLE.COM](https://meet.google.com)

Release 7/13/2020 9:00am
Bogus High School

Signup 7/13/2020 10:00am

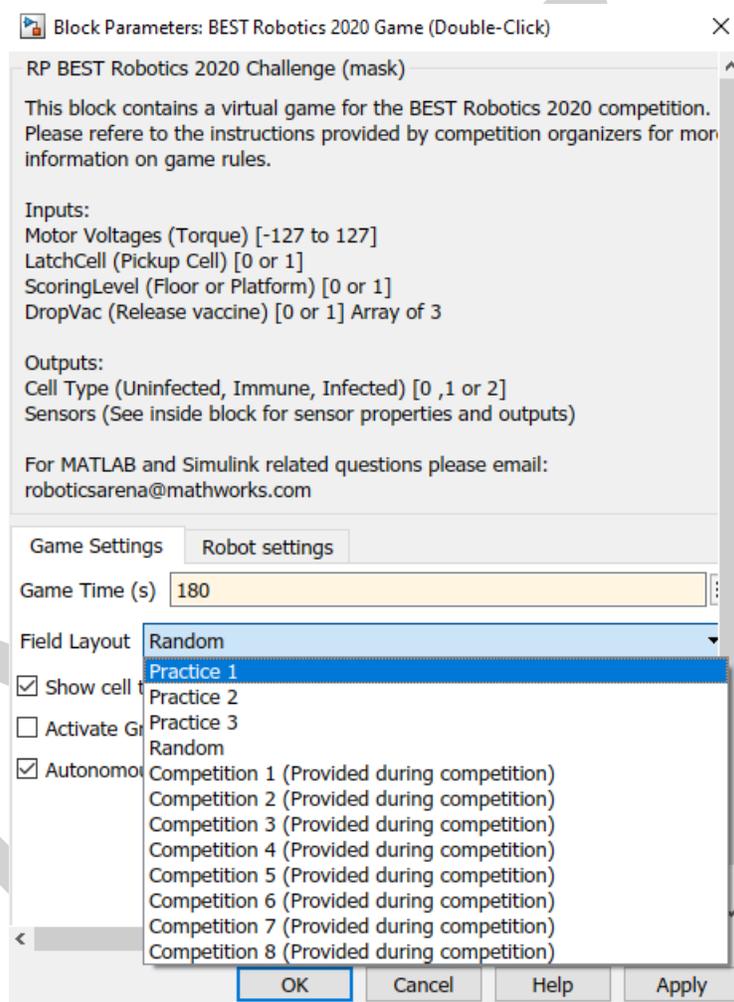
7/13/2020 11:00am

10. Teams should be sure to coordinate with their hub PRIOR to their scheduled time trials and know what online meeting software is required. Typically, any software needed will be downloaded/installed when the meeting is joined if it has not been installed prior. This might be an issue for school computers so make sure that you have successfully joined a meeting using the online meeting platform to be used, on the computer that you will be using for the time trials.

1.3 Practicing

1. Teams can practice on the field using any of the available Practice field configurations. These configuration files come with the Robotics Playground and are always available. Double-click on the BEST Robotics 2020 Game Field block to select the field configuration. You MUST have the "Autonomous Configuration" checkbox checked or the proper configuration file will not be used.
2. A Random field configuration file is always available; use this configuration to get a random field setup on each run. Double-click on the BEST Robotics 2020 Game Field block to select the field configuration.

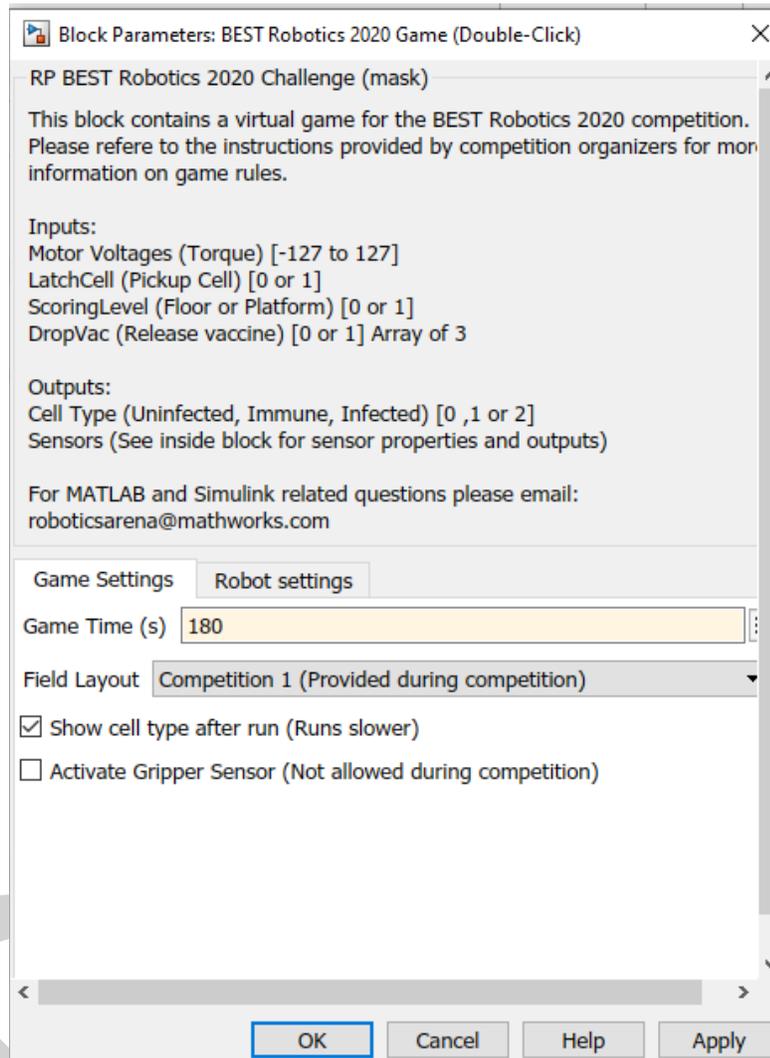
3. After running a practice trial, teams can save the game field results locally to a text file and load it into the Outbreak Infection Analysis Tool XLS for calculating the score for that time trial.
 - a. The student running MATLAB/Simulink can enter the following command in the MATLAB command window to save the results into a file.
`save("filename.txt","GameResults","-ascii","-tabs")`
 - b. Open the Outbreak Infection Analysis Tool XLS, and enable macros at the prompt.
 - c. Click on the “**Import and Score (Autonomous)**” button.
 - d. Results will be imported and score for Autonomous trial will be shown.



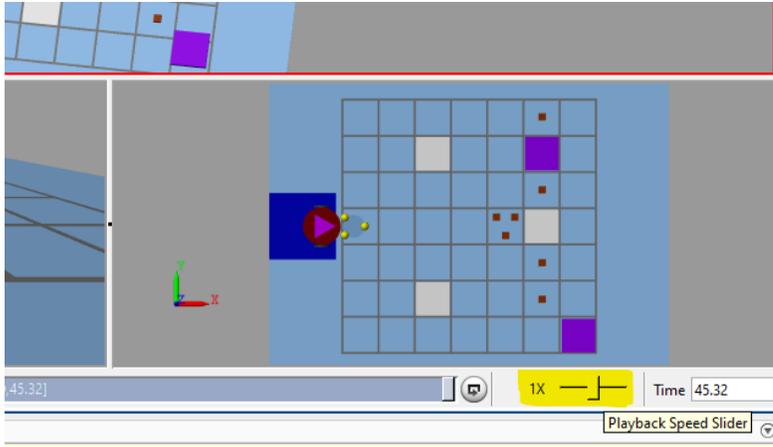
1.4 Setting up the Virtual Field

1. During the time trial, a head referee will be online and communicating with a designated agent of the team; typically, this will be the student running the simulations.
2. The team should configure the simulation for the time trial.
 - a. Double-click on Game Field block

- b. Set time to 180 (seconds).
- c. Check the box next to “Show cell type after run”, if desired.



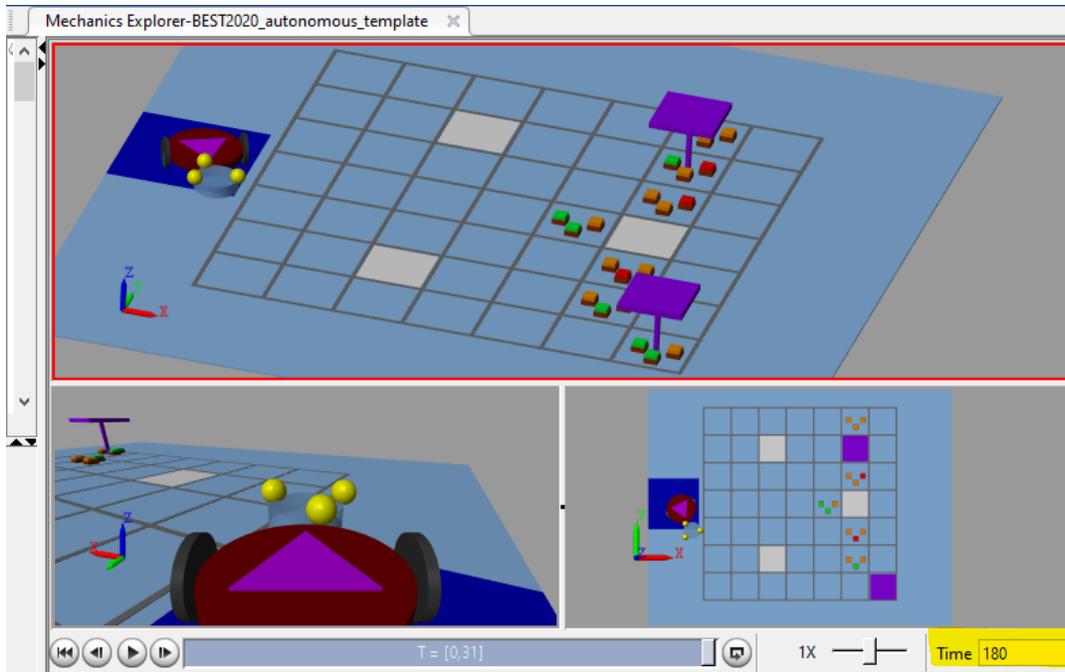
- d. Click OK to accept the configuration.
- e. Press Ctrl-D to update the diagram, compile the model and open Simscape (3D view).
- f. In simscape (3D view) window, keep the “Playback Speed” set to 1X.



3. Prior to the time trial, the team will share their ENTIRE SCREEN on the computer running the MATLAB/Simulink robotics playground simulation. Refer to section 1.5 for details on how teams should setup their MATLAB/Simulink screens on the computer running the simulations.
4. Start the simulation by pressing the Start Simulation button  along the top menu of the Mechanics Explorer window.



5. When the simulation is activated, the Mechanics Explorer view should be visible for all participants in the online meeting to view (referees and students).

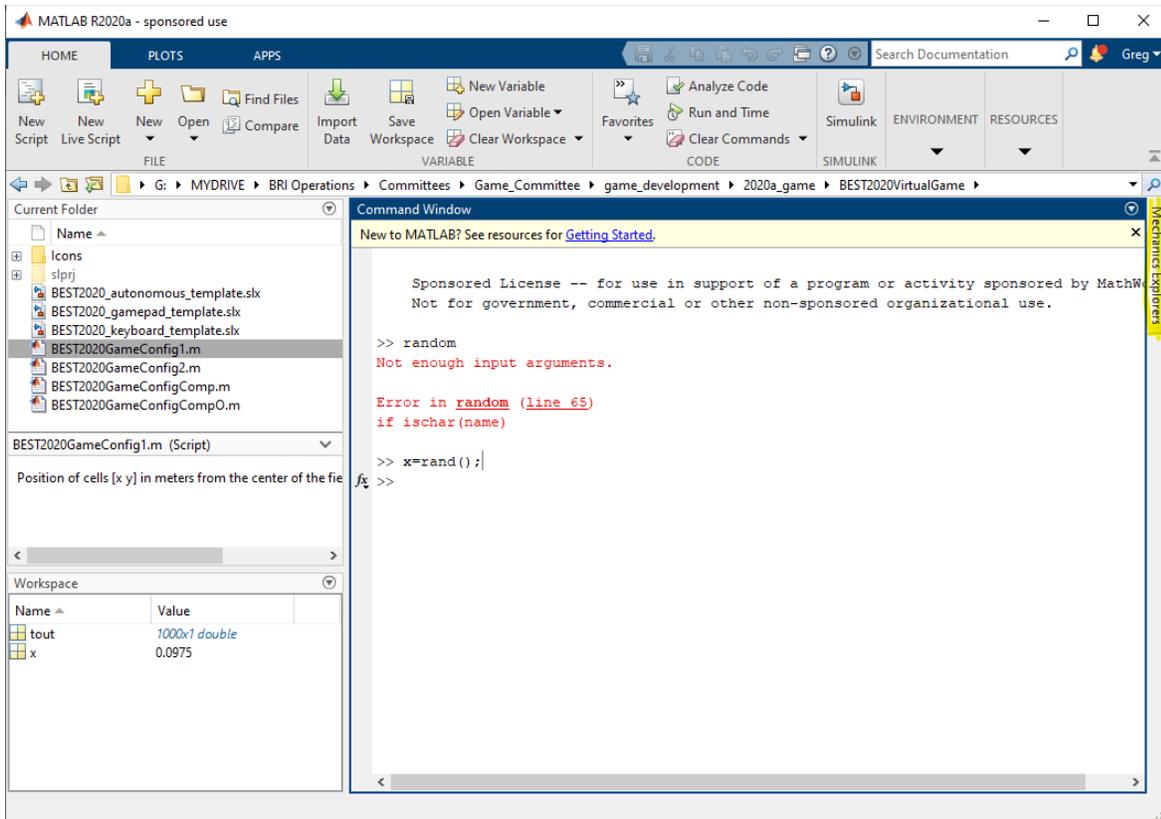


- The timer in the lower right corner of the MATLAB window will show the time elapsed during the time trial (simulation). This counter will increment to 180 seconds and the simulation will stop. All inputs to the simulation will be ignored after that point.

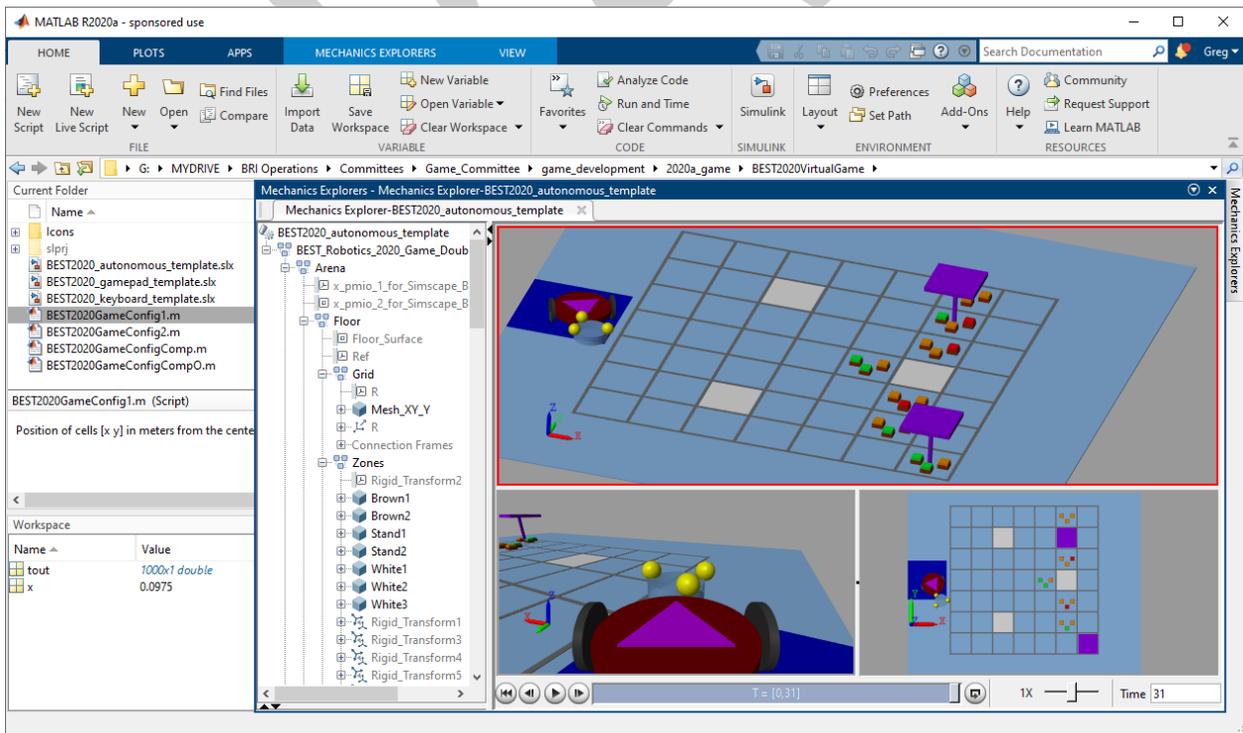
1.5 Setting Up MATLAB/Simulink Windows for Time Trials

Put the Autonomous Configuration Files provided by your hub in the same directory as the Simulink model, or in the FieldConfigs sub-folder, as shown in section 1.2

If the Mechanics Explorer is not visible, it may be minimized on the right side of the screen. Just click to reopen it.

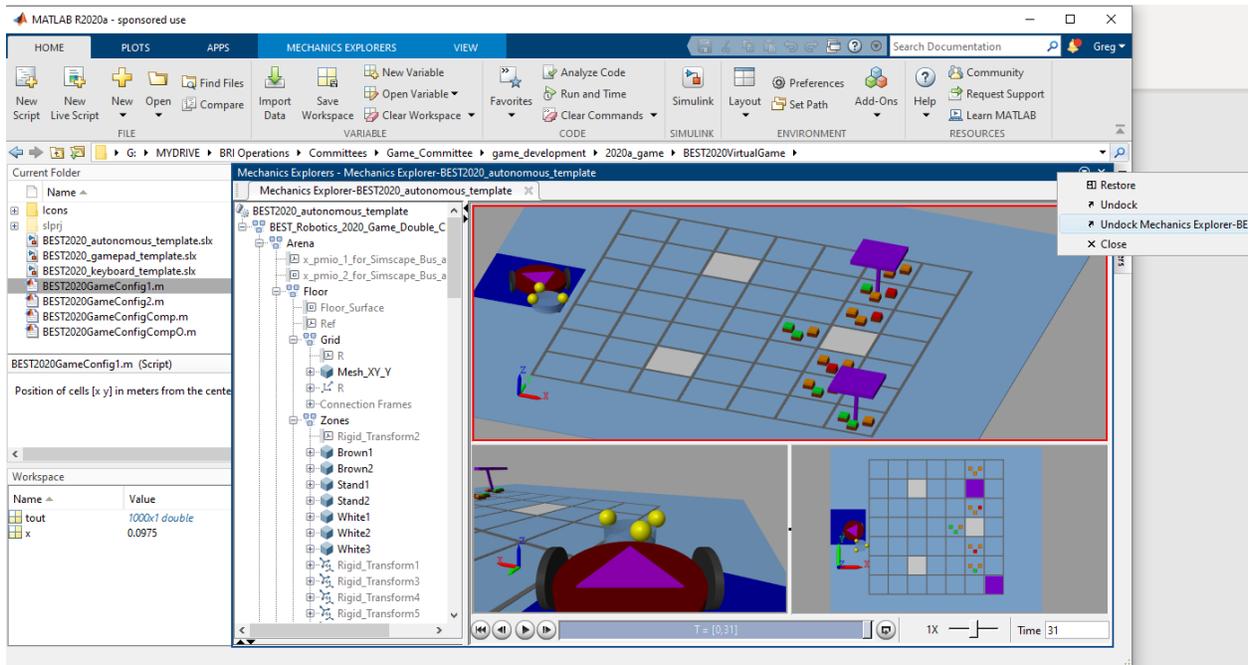


Click and it will restore the window.

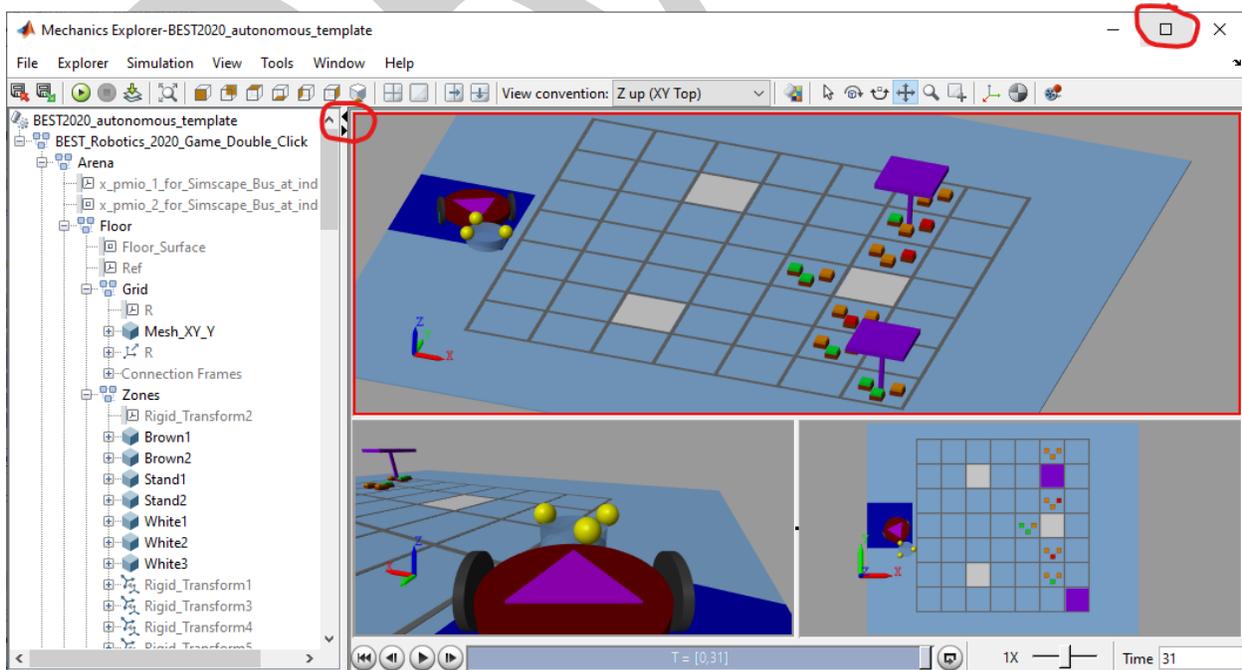


If the Mechanics Explorer window is not open, you can type “CTRL-D” to update the model (compile it) and the window will open automatically after the compile completes successfully.

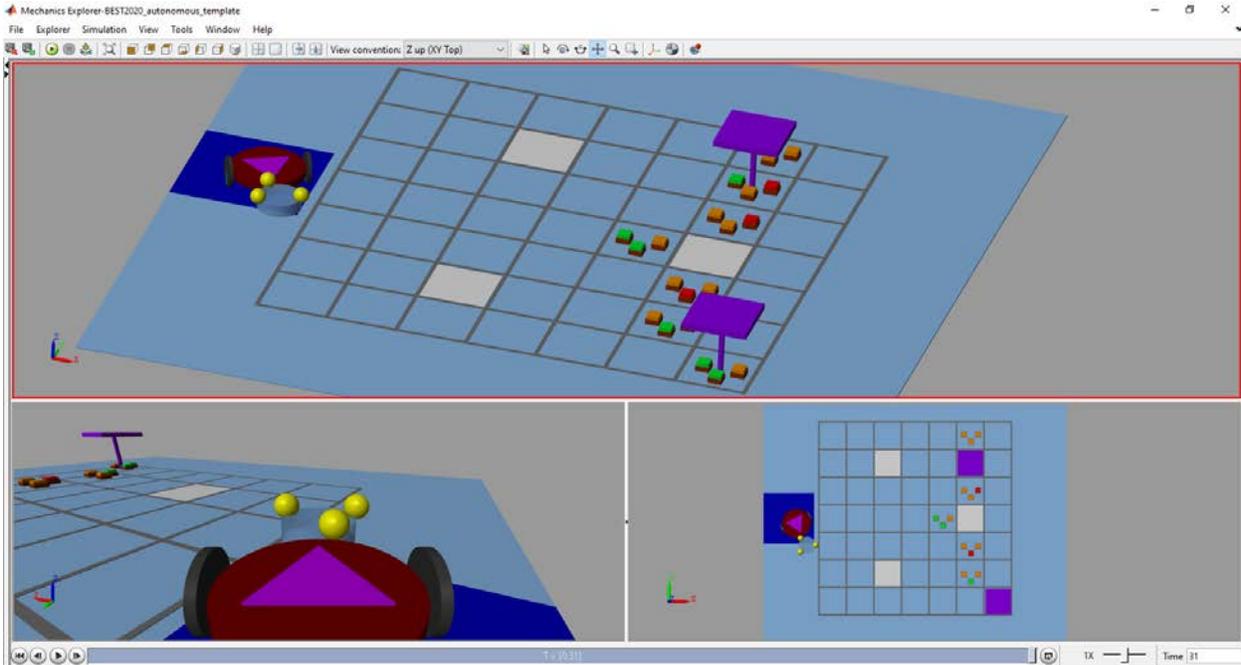
Now, preparing for the time trial, you want to maximize the viewable 3D robotics playground, so follow these instructions to get to a full screen view:



Undock the Mechanics Explorer, then Maximize and click on the small arrows next to the browser to collapse the browser.

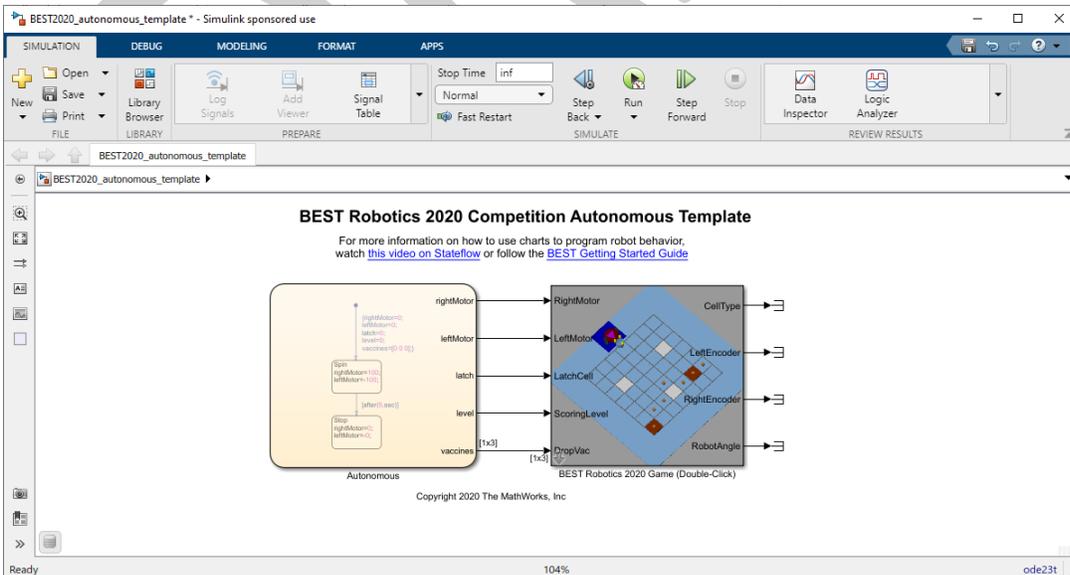


Viola! You have gone full screen and eliminated the clutter...



You can start a new run using the PLAY button on the top menu bar. This will invoke the model compile followed by the simulation.

You can also start the run from the Simulink model by clicking the RUN icon on the menu bar at the top ribbon as well but you will need to switch screens to the Mechanics Explorer window to watch the simulation.



1.6 Competition Time Trials

1.6.1 Procedure

1. Select and install the Autonomous Configuration file(s) as instructed by the Head referee.
2. Type CTRL-D to update (compile) the model and open the Mechanics Explorer.
3. Adjust windows to maximize the view for all those watching.
4. Start the simulation by clicking PLAY button on the top menu ribbon of the mechanics explorer window. The simulation has started when you see the timer counting up.
5. If using MATLAB/Simulink Online, let the simulation run to completion (180sec) as there will be no real-time graphic visualization. Then playback using the PLAY button on the Mechanics Explorer (lower left of screen).
6. At the end of the time trial,
 - a. The head referee, at his/her discretion, may request the student to perform a screen capture before scoring begins.
 - b. The head referee will instruct the team regarding any steps need to complete the scoring assessment for that trial run.
 - c. DO NOT reset or restart the simulation until the head referee confirms that all scoring is complete and shares the results with the team.
7. During the time trials, hubs may allow the teams time to alter their programming and recompile the Simulink model. The amount of time allowed is at the discretion of the hub.

Some Cool Features To Note:

The head referee will instruct the team if any of these features should be utilized during the time trials.

“Instant Replay” - The time trial simulation can be replayed using the PLAY button along the bottom left of the Mechanics Explorer window.



Note: DO NOT select the following for Instant Replay

- 1) Clicking the Play button on Simulink window restarts the compile/simulation.
- 2) Choosing Simulation > Start (Ctrl-T) menu option or Restart Simulation button on the mechanics explorer top menu will restart the simulation without a new compile.

The playback speed can be adjusted with the slider along the bottom right of the Mechanics Explorer screen.

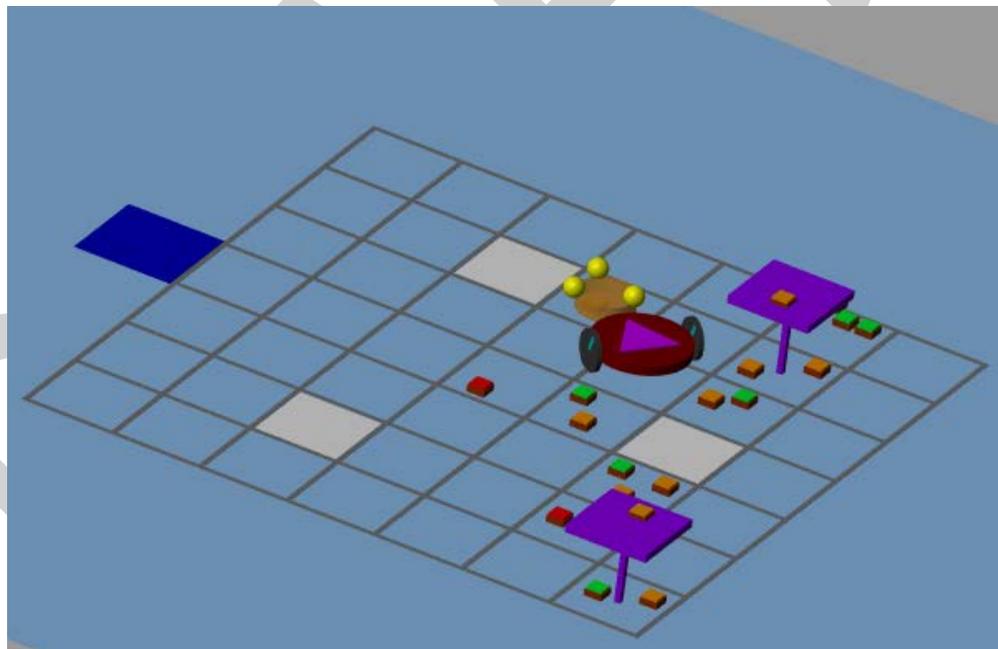
“Highlight Reel” - The trial run can also be recorded...after the time trial, from mechanics explorer window, select “Tools > Video Creator”. The captured simulation will be converted to a video file.

The above features can also be invoked through buttons directly embedded into the Autonomous template Simulink model. These buttons are necessary only when using MATLAB/Simulink Online.

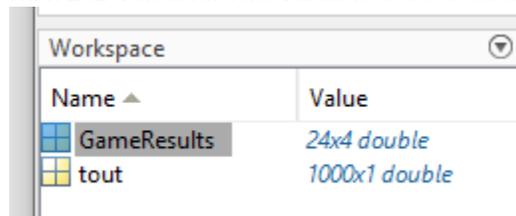
1.6.2 Scoring

1. At the end of a time trial run,
 - a. If the “Show cell types after run” was selected, the cells will change color and reveal their type. The field can be rotated and manipulated however desired to study the field and cells.

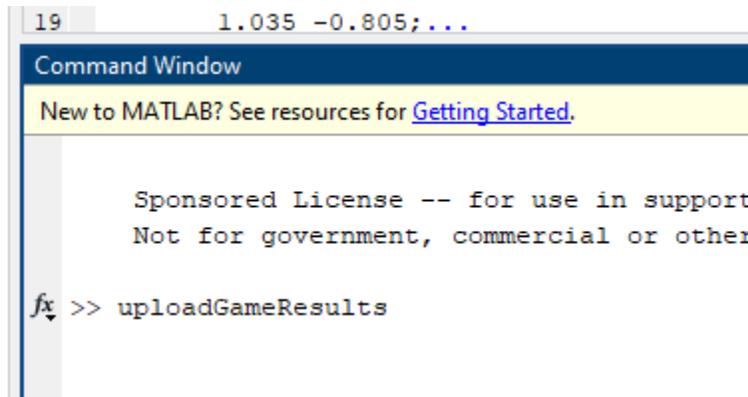
CellType	Color	Description
0	Orange	Uninfected
1	Green	Immune
2	Red	Infected



- b. the results (cell types & locations, vaccine locations) are stored automatically in a MATLAB variable. This variable is accessible from the MATLAB window.



2. The student running MATLAB/Simulink will enter the following command in the MATLAB command window to send the results to BEST Robotics.
 - a. `uploadGameResults`



A popup window will prompt for Time Trial information

The screenshot shows a dialog box titled "Upload Virtual Game Results". It has three input fields: "Team Number:" with the value "0000", "Trial Number:" with the value "0", and "Auton or Driver :". At the bottom right, there are "OK" and "Cancel" buttons.

- b. Fill in the form:
 - Team Number* = your 4-digit team number
 - Trial Number* = the # matching your config file (1..8)
 - Auton or Driver* = Enter 'A' or 'D' for Autonomous or Driver-Controlled
3. The results will be sent to the head referee/judge as the FINAL results for that time trial.
4. The team may save a local copy of the results if desired by entering the following command in the MATLAB command window.

```
save("filename.txt","GameResults","-ascii","-tabs")
```

5. The head referee/judge will load the results file into the Outbreak Infection Analysis Tool XLS and perform the infection analysis and score calculation.
6. The head referee/judge will then enter scores from the XLS file into the Online Scoring Manager.

1.7 Online Meetings With Mathworks Robotics Playground (Virtual Field)

1. Teams should NOT use simple window sharing of the Robotics Playground simulation during the Time Trials online meeting with judges; video of this type requires a higher frame rate or it will have lag and be choppy to the viewers.
2. Time Trials should use the online meeting platform with the special settings for sharing the simulation video (i.e., Robotics Playground simulation). See Section 1.8 .
3. During Autonomous Programming Challenge Time Trials, the MathWorks Mechanics Explorer window (showing the virtual field and robot) will be **shared** during the trial and evaluation. Other video feeds of participants will still be available in the online meeting.

1.8 Sharing Virtual Game Simulation (or a video)

The team should use these settings when sharing video or virtual game simulation (i.e., Robotics Playground virtual field time trials) with the judges in the online meeting platform.

1.8.1 Webex

Select “optimize for video” when you select the window (MATLAB) to share. This uses a higher frame-rate. Be sure to change back to “optimize for text and images” for normal sharing.

<https://www.youtube.com/watch?v=XN3Z96oEvQA>

1.8.2 Zoom

Select the “optimize for full screen video clip” when sharing. Uses higher frame-rate. Be sure to uncheck this option for normal sharing of documents and images.

<https://sas-lps.freshdesk.com/support/solutions/articles/42000069726-how-to-play-a-video-in-zoom>
<https://support.zoom.us/hc/en-us/articles/202954249-Optimizing-a-shared-video-clip-in-full-screen>

1.8.3 Google Meet

Use Chromecast.

<https://www.youtube.com/watch?v=3Xui69IphEo>