

MATLAB and Simulink
Robotics Arena





Drone Modeling, Perception and Control

Perception

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During the Webinar

- Requirement:
 - Complete [MATLAB Onramp](#)
 - Complete [Simulink Onramp](#)
 - Complete [Stateflow Onramp](#)
 - See Video Series on [Drone Simulation and Control](#)
- ~45 minutes and open to questions
- For more questions:
 -  minidronecompetition@mathworks.com
 -  facebook.com/groups/RoboticsArena/





Control



Perceive

- Complete MATLAB Onramp
- Complete Simulink Onramp
- Complete Stateflow Onramp
- See Video Series on Drone Simulation and Control



Implement



Plan



Control



Perceive



Implement



Plan



Recap

The image shows a Simulink Stateflow chart on the left and a 3D rendering of a drone simulation on the right.

Stateflow Chart:

- TakeOff** (during: $x = 0;$, $y = 0;$, $z = -1.1;$)
 - Transitions to **GoFront** after 3 seconds: `[after(3,sec)]`
- GoFront** (during: $x = x + 0.005;$)
 - Transitions to **GoRight** after 2 seconds: `[after(2,sec)]`
- GoRight** (during: $y = y + 0.005;$)
 - Transitions to **Land** after 2 seconds: `[after(2,sec)]`
- Land** (during: $z = 0;$)

3D Rendering:

- Shows a drone flying over a green field with a building in the background.
- A red path is visible on the ground, indicating the drone's trajectory.
- Simulation status: Running, T=0.000, Pos: [46.99 1.36 90.25] Dir: [0.97 -0.22 0.07]

Agenda

- Introduction to Image Processing
- Color Thresholding
- Image Processing using Simulink
- Follow a Red Line using Camera
- Explanation of a fun exercise
- How you can use drone for learning and teaching?

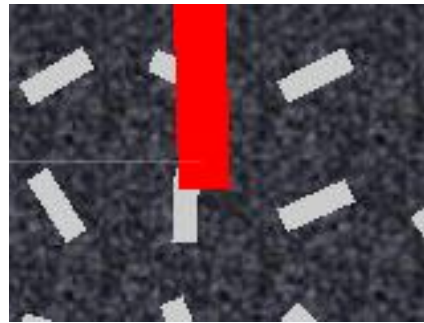


Camera Sensor

- Camera
 - To capture the view
 - To calculate horizontal velocities
- 120*160 image Y1UY2V format image



Real World Camera View



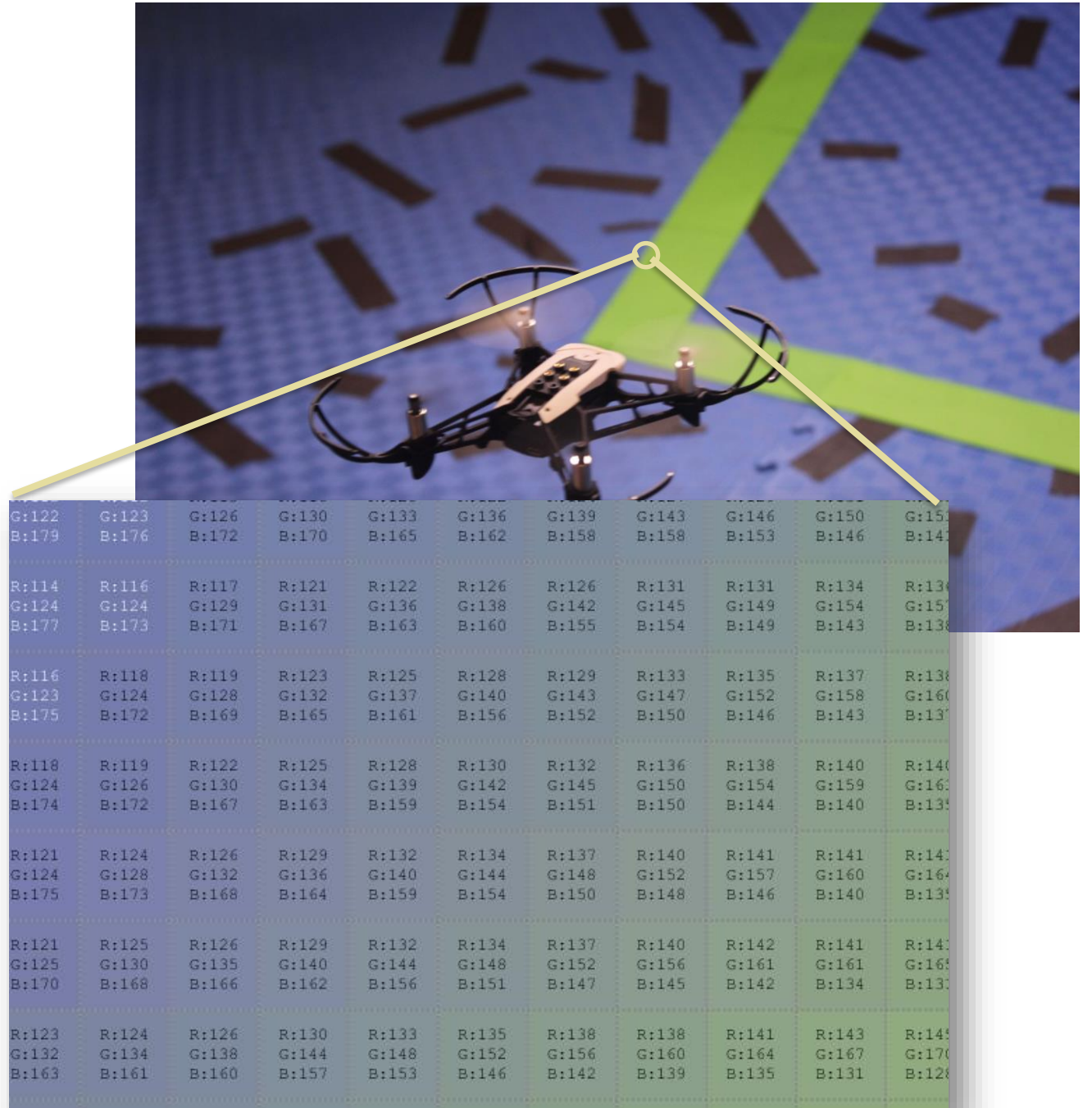
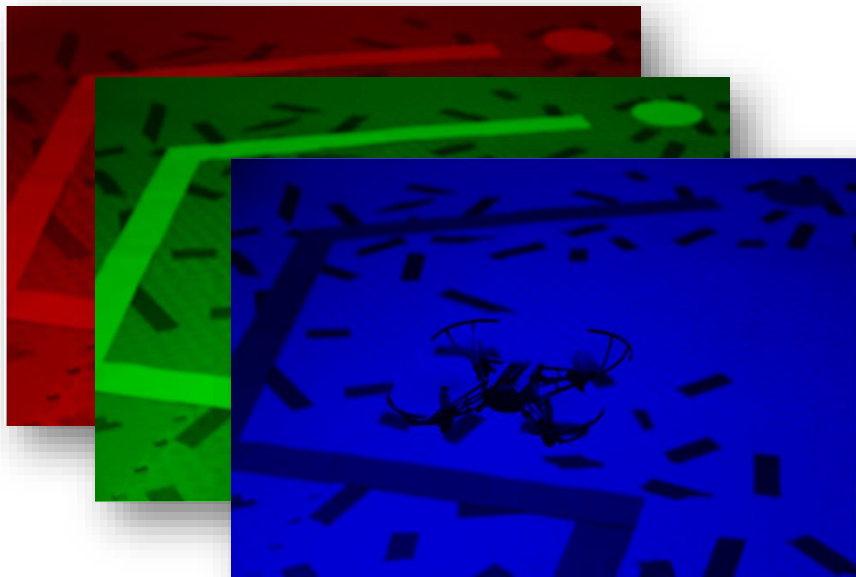
Simulation Camera View

Camera



What is an image?

- Collection of pixels
 - Typically, a pixel has a value between 0 to 255
- Concatenation of channels in third dimension

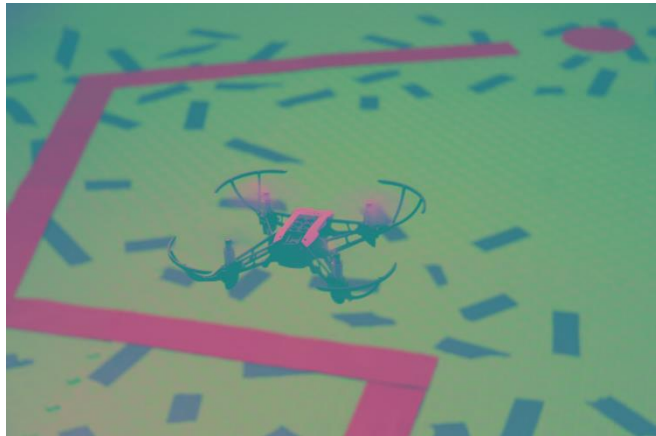


Color Spaces

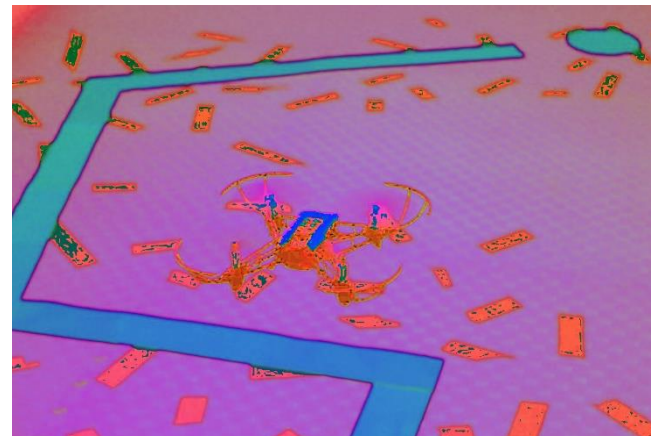
RGB



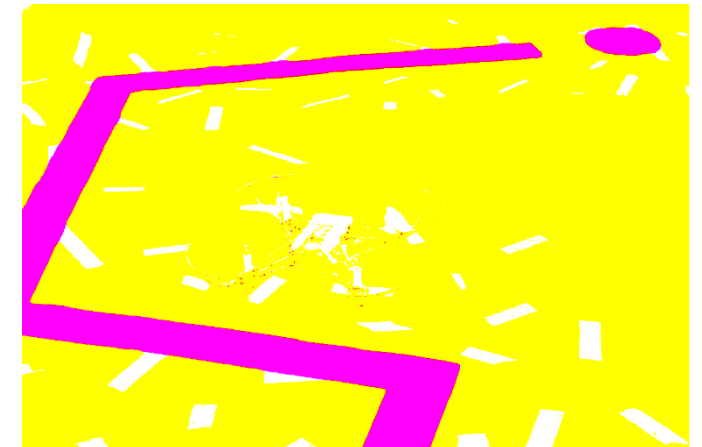
YCbCr



HSV



L*a*b*



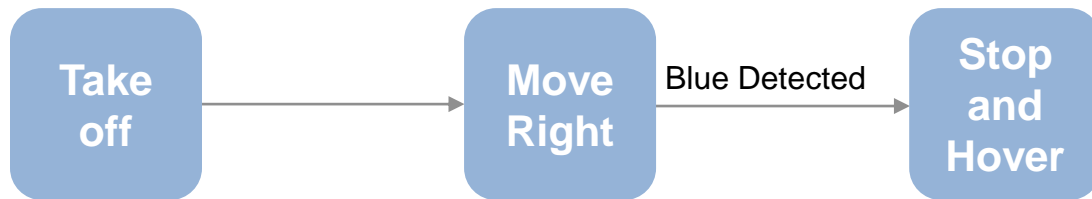
[*parrotMinidroneCompetition*: Image Processing System]



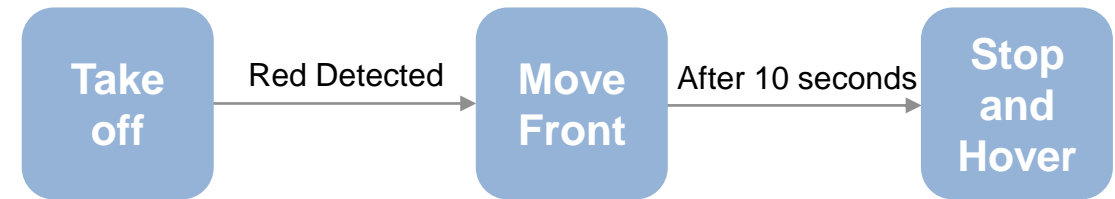
Tracking the first line segment

Task Difference

What we presently do?



What we want to do?

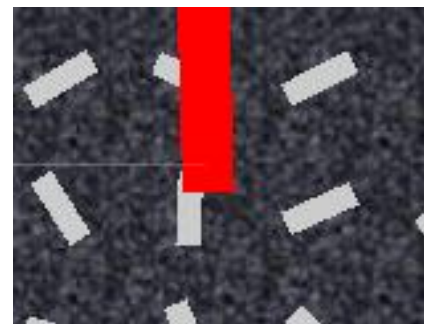


Note: We are tracking only the first line segment for 10 seconds.

[Color Thresholder Example] [Optional Hands-on]



Real World Camera View



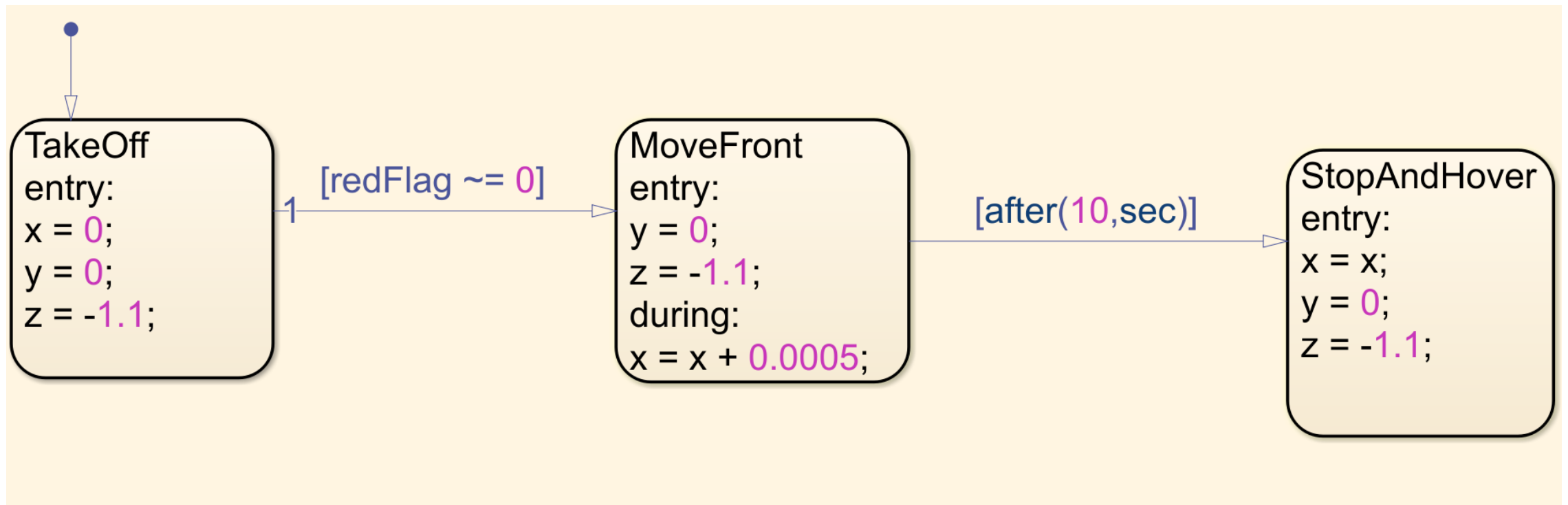
Simulation Camera View

[parrotMinidroneCompetition]



Tracking the first line segment

Stateflow



How can we make this algorithm better to follow the entire track?
What are the loopholes in this algorithm?
[Please post in the chat]





Control



Perceive

What did we learn through the series?



Implement



Plan

Learn MATLAB and Simulink

Self-Paced Onramp Courses

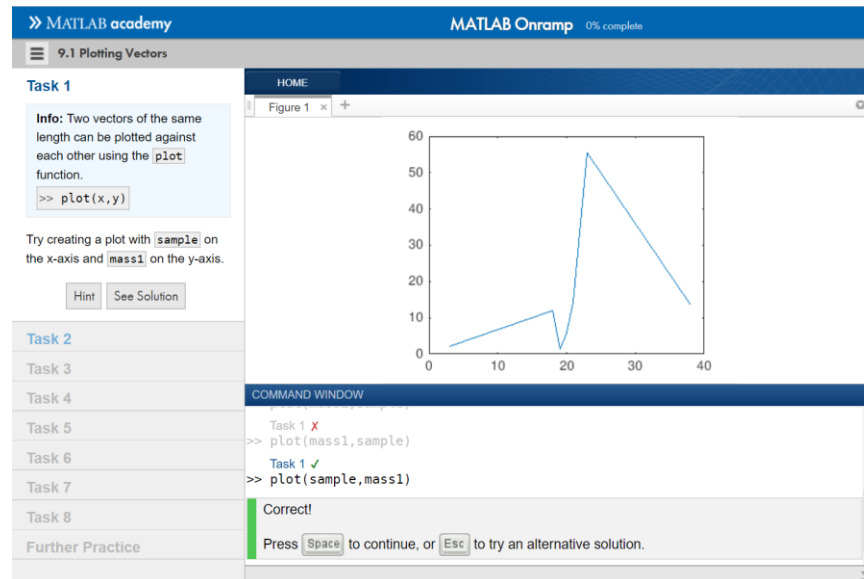
Learn basics with free 2-hour modules

- MATLAB
- Simulink
- Stateflow

Student Competition Tutorials:

Access videos and exercises on

- Mobile robotics basics
- Computer vision
- Code generation



The screenshot shows the MATLAB Onramp interface for a task titled "9.1 Plotting Vectors". The task instructions state: "Info: Two vectors of the same length can be plotted against each other using the `plot` function." Below this, a code editor shows the command `>> plot(x,y)`. The task further instructs: "Try creating a plot with `sample` on the x-axis and `mass1` on the y-axis." There are "Hint" and "See Solution" buttons. The task list on the left shows "Task 1" as the current task. The main window displays a plot of two vectors, and the command window shows the execution of `plot(mass1,sample)` and `plot(sample,mass1)`, both resulting in "Correct!" messages.



Student Competition - Mobile Robotics Training

version 1.1.0.0 (13.8 MB) by [MathWorks Student Competitions Team](#)

All files related to Student Competition - Mobile Robotics Training video series.



Fun Exercise!

- Task:
 - Complete the red track and land on the circle
- Let us know what you have done:
 - Post a video/photo of your demo on social media (Instagram / Facebook / LinkedIn / Twitter) with
#simulink #droneseries @MATLAB @MathWorks
- [MathWorks Minidrone Competition](#) which is a way for students to learn Model-Based Design



How to access the Onramps/Tools to try hands-on?

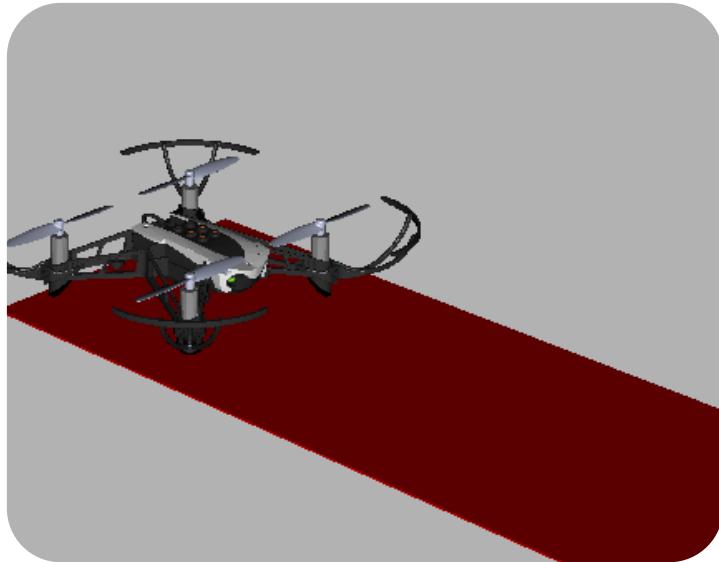
- Check if your institute has Campus Wide License:
 - <https://www.mathworks.com/academia/tah-support-program/eligibility.html>
- E-mail us at minidronecompetition@mathworks.com for access to license to work with exercise
 - First Name:
 - Last Name:
 - Institute/University:



MathWorks Minidrone Competition

Round 1: Simulation Round:

Design algorithms using Simulink



Round 2: Deployment Round:

Deploy on hardware using Simulink Support Package



MathWorks Minidrone Masters



IROS 2019

5 November 2019: The Venetian Macao, Macau, China

Winner: *SRMUAV*, SRM Institute of Science and Technology

First runner-up: *Beeclust*, SRM Institute of Science and Technology

Second runner-up: *KNUT_ROVI*, Korea National University of Transportation



NUMA 2019

18 October 2019: NUMA Bengaluru, Bengaluru, India

Winner: *HiveX*, B.M.S. College of Engineering

First runner-up: *PVGCOET*, Pune Vidyarthi Griha's College of Engineering

Second runner-up: *Madg(w)EEK*, SRM Institute of Science and Technology

Resources

Robotics Arena

- **Contact us**

 minidronecompetition@mathworks.com

 facebook.com/groups/RoboticsArena/

- **Student Videos and Tutorials**

mathworks.com/academia/student-competitions/tutorials-videos.html

- **Software offer**

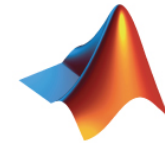
mathworks.com/academia/student-competitions

- **Racing Lounge blog:**

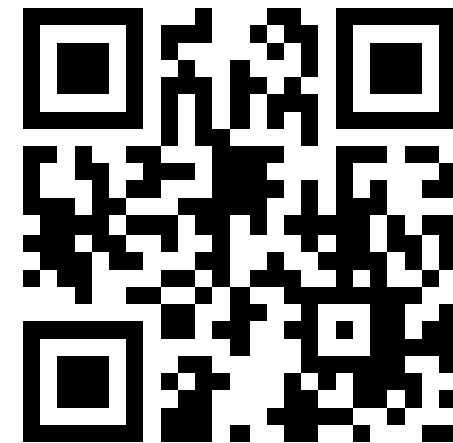
blogs.mathworks.com/racing-lounge



- Post a video/photo of your demo on social media:
 - Instagram / Facebook / LinkedIn / Twitter with #simulink **#droneseries**
- Fill out the feedback form:
bit.ly/minidrone-webinar-series
- Reach out to us to host/participate at
minidronecompetition@mathworks.com



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