MathWorks Minidrone Competition

Rules and Guidelines

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A. Competition Overview

The MathWorks Minidrone Competition will introduce participants to Model-Based Design using Simulink.

The competition consists of two rounds:

- **Round 1 Simulation Round** Teams will work virtually on designing a Minidrone line follower algorithm. Teams will need to use their modeling skills to refine a Simulink model.
- **Round 2 Simulation and Hardware Deployment Round** The teams that qualify from the virtual Round 1 will be invited to the Round 2 live event. Teams will deploy their Simulink model at the live event on the Parrot Mambo Minidrone hardware using the Simulink Support Package for Parrot Minidrones.

B. Simulation Round

This is the virtual round of the competition which will aim at performing the line follower task in simulation using Simulink.

B.1 Pre-work

- Participating teams are expected to complete the Simulink Onramp course before starting to work on their algorithm.
- It is recommended that participating teams view the video series MathWorks Minidrone Competition to better understand the model.

B.2 Rules

- Teams can use only the latest release of Simulink and related MathWorks products to complete the task.
- The complete logic for the task completion must be contained in the *parrotMinidroneCompetition* folder that the teams submit for Round 1 evaluations.
- The models that the teams submit should be code generation capable. More details about this can be found in this video.

B.3 Judging

- This round will be judged by MathWorks engineers.
- The model will be evaluated based on the capability of completing the line follower track followed by landing on the circular marker.
- The model will be tested on multiple tracks with multiple number of track sections. The color of the track for the simulation round will be Red (#FF0000).
- The model performance will be verified using an internal judging interface which focuses on:
  - Code generation capability of the model
  - Number of tracks completed by the Minidrone
  - Successful landing of the Minidrone on the circular landing marker
  - Accuracy of the path traced with respect to the track laid in the Simulink 3D environment
  - Time taken by the Minidrone to complete the track
- The most efficient and accurate algorithms that complete maximum number of tracks/track sections in the shortest simulation time will be shortlisted for Round 2.
- The decision made by the judges will be final.

B.4 Submission

To submit an entry, the team captain needs to send the Simulink Project to MathWorks. To do so, please use the following guidelines:

1. Compress the main folder that includes all the project files The acceptable compression formats are *.zip*, *.rar* and *.tar.gz*.
2. Rename the compressed folder to <TeamName> where <TeamName> is the name of your team.
3. Send the model to studentcompetitions@mathworks.com with the subject as '<TeamName> at <EventCity> <EventYear>' where <EventCity> is the name of the city where the Round 2 of competition is to be held and <EventYear> is the year when the deployment round of the competition is to be held.
   For example, if your team name is 'Drone Squad' and you are participating in an event in London in 2019, your email would be titled 'Drone Squad at London 2019'

C.Simulation and Deployment Round

C.1 General Guidelines

- Round 2 of the Competition will be judged by a designated set of engineers organizing the event.
- The Minidrone should follow the line follower track laid on the arena and land on the *End Circular Marker* in the shortest time to win.
- Teams will be ranked in the ascending order of time taken to complete the track and land on the circular marker.
- The track will be disclosed to the teams only on the day of the deployment round.
- The complete track will be divided into multiple sections. The track will have only straight lines and no smooth curves.

C.2 Competition Set-Up

The deployment round will be a day-long (8 hour) event and will be divided into two parts:

a. Practice Round:

- In this round, each team gets a maximum of **two slots of 15 minutes each** in the Arena to calibrate their model gains and thresholds.
- Performance of the Minidrone during this round will not be considered to declare the winners.

b. Live Round:

- Each team will get one **15-minute** assigned slot in the arena. This includes the setup time and the Minidrone flight.
- Each team gets **maximum 7 chances** during the 15 minutes to fly the Minidrone.
- At the end of the 15-minute slot the team must **nominate the Minidrone flight** that they wish to be their ***final* entry.**
    - Submit the *Flight Log and the MAT files* to the judge.
    - Nominate this entry within 5 minutes of their assigned slot ending.
    - If the team does not submit the entry within 5 minutes, they will be disqualified from the competition.
    - No other entry apart from the one the team has submitted will be considered for evaluation.

C.3 Scoring and Judging

- The scoring criteria used for evaluation will be based on the maximum number of section stages the Minidrone has completed. The following are the guidelines for the division of the task into stages (*N* is the number of track sections):
    - **Stage 0:** Take off complete
    - **Stage 1:** Track Section 1 complete
    - **Stage 2:** Track Section 2 complete
    - **Stage 3:** Track Section 3 complete
    - **Stage 4:** Track Section 4 complete
        - .
        - .
        - .
    - **Stage N:** Track Section *N* complete
    - **Stage Land:** Landing Complete
    - **Stage Complete:** Validating landing on the circular marker

- The judge will be responsible for assessing the Minidrone's *Stage* in a given Minidrone run. The higher the stage, the higher the ranking of the team.
- **The time factor will come into account only when the drone is in *Stage Complete*.** A team is in *Stage Complete* when the Minidrone bottom touches the landing marker and stays there. A few examples of correct and incorrect landings are illustrated below:

Successful landings:

Complete minidrone landing on the circle

A part of minidrone landing on the circle

Unsuccessful Landings:

Minidrone's bumper hovering over the circle

Minidrone landing upside down on the circle

- The judge will note the time from the Minidrone's takeoff to landing. The team that reaches the farthest stage in the shortest time will win the competition.
- If two or more entries are in the same stage except the *Stage Complete*, the corresponding submitters will receive the same prize. Decisions made by the judges are final.

D. Safety Rules

- Teams will not be allowed to fly the Minidrone outside the arena.
- No team member can enter the Arena while the Minidrone is flying.
- No team member is allowed in the Arena during the Live Round. A Judge will oversee placing the Minidrone at the necessary location on the track.
- Team members entering the arena during the test round must wear safety goggles which will be available on the day of the competition.
- If the Minidrone crashes into the net during a live round run, the entry for that run will be disqualified.

E. Participation Requirements

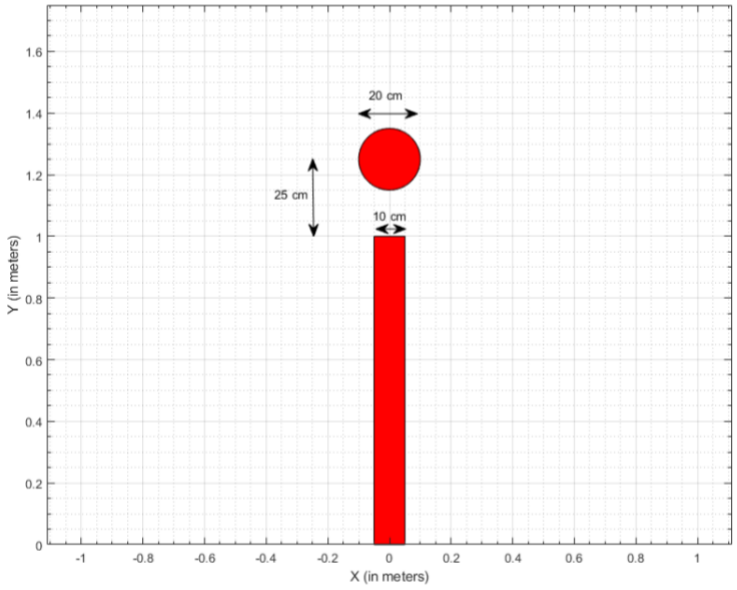
It is mandatory for teams to be present on the day of the deployment round with the following:

- **MATLAB installation:**
  A system with the latest release of MATLAB used during the simulation round installed.
  For example, if the simulation round of the competition was launched when R2019a was the latest release, the teams are expected to be present for the Round 2 of the competition with R2019a even if R2019b may be released by that time.
- **Hardware Support Package installation:**
  Teams should install 'Simulink Support Package for Parrot Minidrones'. The procedure for installation of the support package can be found below:
  https://www.mathworks.com/help/supportpkg/parrot/ug/install-support-for-parrot-minidrone.html
- **Bluetooth Low Energy Driver:**
  - *Windows system:* Install the Bluetooth CSR driver from the following link: http://47.88.26.219:81/Driver/CSR%20Harmony/
    Complete the installation of the driver and when the prompt appears, ensure to keep the following settings:
    Discovery Mode : ON
    SCMS-T: Enabled
  - *Mac System:* Ensure that your system has a Bluetooth 4.0 adapter. To check the Bluetooth version on your Mac, see Finding the LMP Version of Bluetooth Adapter on Your Mac System.
  - *Linux System:* Ensure that your system has Bluetooth 4.0. To check the Bluetooth version on your Linux System, see Finding the LMP Version of Bluetooth Adapter on Your Linux System.
- **Competition Model:**
  The submitted simulation model with changes, if necessary.

F. Arena Information

The following are the details about the arena track:

- The arena would be a rectangular space enclosed by nets on all sides.
- The arena track will be 10 cm in width.
- The landing circular marker will have a diameter of 20 cm.
- The line follower track will consist of connected line segments only and will not have any smooth curves at the connections.
- The distance from the end of the track to the center of the circle will be 25 cm.
- The color and the track will be disclosed on the day of the competition**,** i.e., the background of the track will not be white, and the color of the track will not be red.
- The background will not be a single color and will have a texture.
- The track for the Practice Round and the Live Round may be different.



G. Reference Material

- Recommended Tutorials:
  - MATLAB Onramp:
    https://matlabacademy.mathworks.com/
  - Simulink Onramp:
    https://in.mathworks.com/learn/tutorials/simulink-onramp.html
  - MathWorks Minidrone Competition Video Series
    https://www.mathworks.com/videos/series/mathworks-minidrone-competition.html

- Additional Video Tutorials:
  - Programming Drones using Simulink:
    https://www.mathworks.com/videos/programming-drones-with-simulink-1513024653640.html
  - Tech Talk on Drone Simulation and Control:
    https://in.mathworks.com/videos/series/drone-simulation-and-control.html
  - Tutorials on Computer Vision and Code Generation:
    https://www.mathworks.com/academia/student-competitions/tutorials-videos.html
  - Tech Talk on State Machines:
    https://www.mathworks.com/videos/tech-talks/state-machines.html
  - Tutorials on Stateflow:
    https://www.mathworks.com/videos/series/stateflow-tutorials-94460.html

- Documentation Links:
  - Simulink Support Package for Parrot Minidrones:
    https://www.mathworks.com/hardware-support/parrot-minidrones.html
    https://in.mathworks.com/help/supportpkg/parrot/index.html
  - Aerospace Blockset:
    https://in.mathworks.com/products/aeroblks.html
  - Simulink 3D Animation:
    https://www.mathworks.com/products/3d-animation.html
  - Stateflow:
    https://www.mathworks.com/products/stateflow.html
  - Color Thresholder App:
    https://in.mathworks.com/help/images/ref/colorthresholder-app.html