



A Collaborative Robotics Program

2020 Line Following Challenge

Goal: Design, build, and program a line following robot that can (In three minutes time) follow a black line on a white background to a tower and deliver at least one (1) ball and then return to its starting point. Then, in the remaining time, return to the tower (as many times as needed) to deliver a set number (not over, not under) of balls as per your teams division requirements.

Divisions: Teams in this challenge compete in separate divisions

- Elementary School
- Middle School
- High School
- University/Professional

Requirements: Autonomous robot, any platform, costing \$1,500 USD or less, and meets the following design constraints, which will be verified during Check-In.

- Robot can demonstrate it is running a line following program on a test track.
- Robot can demonstrate it will stop upon reaching the tower; you do not have to prove the ability to deliver a ball, or turn around.
- Multiple sensors and processors are allowed.
- Volume of the robot must **not** exceed 65030 cm^3 .

General Rules of Play:

- The Event Director will establish the number of official runs allowed, and the number of those official runs that will be counted for the aggregate score used to determine the Top 8 teams that will compete in the Tournament.
- The robot has 3 minutes to complete the tasks.
- A line following program must control your robot's motion at all times.
- Only players can operate and manipulate the robot during the heat. Remember, "Players Play, Coaches Coach, Parents Cheer".
- The tower cannot be touched by any person during payload delivery.
- **No scooping of balls out of the tower by any person during payload delivery.**
- Touching the robot at any time requires it to be picked up and returned to home.

Challenge Equipment Specifications:

The Tower: (dimensions are approximate, and might vary slightly)

- All divisions use the same 20 cm tall x 10 cm wide x 35 cm long tower with a 10 cm x 10 cm opening at the top and an open back to allow the balls to roll out during delivery. The tower is held firm to the track by a strip of Velcro tape
- If a track monitor sees that a team touches or reaches INTO the tower, the run will be stopped and the team will receive only 400 points for completing the challenge track regardless of how many balls were delivered.

The Track:

- Tracks are typically printed on durable paper, or PVC Vinyl Background
- Elementary Division - No intersections, 1.25 cm black line
- Middle School Division - One intersection, 1.25 cm black line
- High School & Big Kid Division - Two intersections, 0.75 cm black line
- A new design is created each year.
- There will be a minimum of 20 cm of straight line leading into the tower.
- The line will be no closer than 10 cm from the edge of the track or any other line
- Advertisement, or printed instructions can be placed anywhere on the track surface, but must be a minimum of 10cm from any line
- Curves can have different/changing radiuses, but no part of the curve can have a radius less than 15cm for ES & MS, and 10cm for HS & UP divisions.

Track Examples:



Tracks shown are an **example**. The design changes every year **and** are revealed on the first day of an event.

Other Significant Items:

- The challenge may be held in areas with natural light present which may change the lighting conditions of the track. Teams should be prepared to engineer around this natural condition.
- Event Directors have the option of using the HS track or creating a more difficult challenge track for the UP division. Also, the tower opening can be reduced in size for the UP Division.

Scoring:

The overall score is a combination of points earned from:

- Running the track to the tower
- Delivering at least one ball
- Returning back home
- Running the track again as many times as necessary to deliver the required number of balls

Each division will have a set number of balls to deliver: The numbers will be published at the event. Below is the range from which the division numbers must be chosen:

- Elementary School – between 75 and 125
- Middle School – between 125 and 200
- High School – between 200 and 250
- University/Professional – between 100 and 350 (keep the number in the lower range if tower opening is reduced)

See the Scoring Matrix for your division below for details on the scores assigned during your first trip to the tower and back.

A successful run is defined as:

- The robot traversing the track from Home to the Tower, delivering at least 1 ball and traversing the track back home. Any balls delivered during this run are removed and do not count towards achieving the bonus runs.
- It may take several attempts to accomplish the above tasks. Once all tasks have been completed, teams may make bonus ball runs.
- A Bonus Ball Run is when the robot traverses the track from Home to the Tower and delivers the required number of balls set for your division. During Bonus Ball runs, the robot does not have to traverse the track from the tower back to home.

Scoring the Bonus Ball delivery:

- If the number of balls is less than the required number of balls, then that number is your Bonus Ball Score.
- If the number of balls is more than the required number of balls, then the extra will be subtracted from the required number resulting in your ball score.

Scoring Matrix:

	Leaves Home	Pass 1 st "T"	Pass 2 nd "T"	Stops at Tower	Delivers a Ball
ES	50	N/A	N/A	100	100
MS	25	25	N/A	100	100
HS/UP	25	25	25	50	100

	Starts Back Home	Pass 1 st "T"	Pass 2 nd "T"	Returns Home	Total
ES	50	N/A	N/A	100	400
MS	25	25	N/A	100	400
HS/UP	25	25	25	100	400

Tournament Scoring

- The top eight teams from each division will compete in the final tournament.
- Advancing teams will be seeded into the tournament bracket according to their aggregate score (see bracket below).



- Runner Up is used to determine 3rd place based on outcome of semi-finals.