



Middle East Technical University
METU Robotics Society

18. International METU Robotics Days – 2022

Line Follower Category Rules

A. CATEGORY GOAL

1. Complete the specified track as soon as possible without leaving the track.

B. COMPETITION FORMAT

1. Robots will participate in the ranking according to their finish time.
2. Robots should have maximum **250mm length** and **200mm width**. They should be able to pass through an imaginary rectangular prism that has a base area of **250*200mm²**. Robots that do not fit this measure will be **disqualified**.

C. TRACK

1. The roads are white lines on a black background.
2. There are 2 shortcuts on the track. The shortcuts are black lines on a white background. In approximately 200mm before the shortcuts, there are two white lines perpendicular to the direction which the robot follows.
3. There are two white lines on most of the track.
4. The white lines are **19±1mm** thick.
5. The white lines are **150±mm** from the sides of the road. Except **2nd Stage**, there is a distance of **200±mm** between the white lines. At the 2nd Stage, the white lines are **150±mm** from the sides of the road. There is a distance of **250±5mm** between the white lines. (At **2nd Stage**, the width of the track is increasing.)
6. There is one dead road on the track. This dead road is there for moving obstacle to leave the track. In approximately 300mm before the dead-end road separation, there is a white line perpendicular to the direction which the robot follows. If the robot enters the dead end in **2nd Stage**, 15 seconds penalty will be given.
7. There is one fixed obstacle, one opening and closing door and one moving obstacle in the track. Some parts of the track also have **90-degree** turns.
8. There is a start line at the beginning of the track.
9. In some parts of the track, the two lines on the road will merge into a single line that will be in the middle of the road.

D. COMPETITION

1. Robots compete in turns. The list will be announced before the start of the competition.
2. The competition starts with the robot passing through the starting line, ends with it entering the parking area at the end of the track.
3. The robots will start from the right line.
4. In the **200mm** before the short cut, there are two lines perpendicular to the direction which the robot follows.

5. When the robots do not take the short cut, and follow the white line, these ones will not be penalized.
6. In the parts of the track where the single line on the road becomes two, the robot is expected to follow the line on the right. The ones which follow the wrong line are considered to have violated the line.
7. The robot which comes into contact with the outside of the track is considered to have come out of the track.
8. Robots that come into contact with the ground (or leave the track completely) and return to the track without intervention will also be considered to have come out of the runway.
9. If the robot comes out of the runway, the time will be stopped, and the robot will be put back on the line where it lost the track. This will result in a penalty of **5 seconds**.
10. Robot is expected to continue moving on its way without turning to the dead-end road.
11. If robot turns to the dead-end road, it will be considered as it is left the track. The timer will be stopped, and 15 seconds penalty will be given.
12. The robot which turns to the dead-end road, is placed ahead of the dead-end road, at the point where the normal road line is restarted.
13. The robots must follow the race through the line where the left lines are joined to the right lines.
14. If robot does not follow the line, it will be considered to have violated the line and will receive a penalty of **10 seconds**. Robot will be taken from the track and placed where it first had the line violation.
15. As long as the robot does not come out of the pit, the right to intervene can only be given by the referees, resulting in a penalty of **5 seconds**.
16. When a robot moves on a line that should not be followed, by any part of the robot, it will be considered to have violated the line.
17. A robot that violates a line will receive a 10-second penalty, according to the division in which the line violation is made, the robot is not intervened or it is taken from the track by the command of the referee and continues from the determined place.
18. The robot which has total of **5-time penalties** will be **disqualified** from the race.

19. The robot that leaves the track must be placed by the competitor at the point which is indicated by the referees.
20. It is **strictly forbidden** to make any changes or actions on the robot during this time. (To count lines, to repair, to clean the wheels, etc.)
21. Right to intervene may be given only by the referees if such a situation that could damage the structure of the track occurs.
22. Competitors cannot set, test or register during the competition. There will be no extra time for breaks, maintenances or repairs except as mentioned above.
23. The competitor who insists on making and adjustments despite the warnings, testing or registration (robotic entry of any kind of data entry record) on the robot will be **disqualified** during the race or when the race is stopped.
24. Metu Robotics Society does not take responsibility if the robot is harmed during the competition.

a. First Stage

1. At this stage, the robot is expected to continue on its way by passing a stationary obstacle on the road in a traffic-like manner in traffic.
2. There is one immobile obstacle on the line where the robot starts the race.
3. The size of the obstacle is $100 \times 100 \times 100 \text{ mm}^3$
4. The color of the flat obstacle will be white.
5. The obstacle will be placed so that its midpoint is on the line.
6. Robots cannot change lines before the front end of the robot is within 300mm of the stationary obstacle.
7. A robot that changes lines before approaching 300mm will be penalized for 10 seconds. The robot will not be taken off the track for violating this rule and will continue the race.
8. After the robot crosses the obstacle, it must return to the line where it started the race again, and where the obstacle is also on, before the front end point moves 500 mm away from the obstacle.
9. If the robot does not return to the line on which it started the race, before the front end point is 500mm away from the obstacle after crossing the obstacle, it will be penalized for 10 seconds. The robot will not be taken off the track for violating this rule and will continue the race.

10. If the robot touches the obstacle anywhere on the track, it will be disqualified.

b. Second Stage

1. At this stage, the robot is expected to continue its way by passing a moving obstacle on the road in a traffic-like manner in traffic.
2. The maximum size of the obstacle will be **250*200*150mm³** and the minimum size will be **150*150*150mm³**. At the back of the moving obstacle, there will be white and flat structure.
3. The line that the obstacle will follow will be partly straight white line and partly dashed white lines.
4. Dashed lines are **20mm** each.
5. The moving obstacle will start its motion and the width of the track will increase when the robot is **500 mm** behind. Speed of the moving obstacle is **0.1±0.01 m/s**. It is expected that the racing robot will adjust its speed according to the speed of the moving obstacle and continue the race in that way.
6. The robot cannot change line before the front-end point reaches the dashed line. If the robot changes the line before reaching the dashed line, it will take **20 seconds of penalty**. The robot will continue the race and will not be taken from the track.
7. After the robot's front point reaches the dashed line, the robot must change its line. If the robot does not change the line until the front-end point finishes the dashed line, the robot will get 10 seconds penalty. The robot will continue the race and will not be taken from the track.
8. The robot will not return to its old line and will continue its way after changing the line.
9. At the end of this stage, the obstacle will enter a dead road. The robot should continue its way without entering the dead road.
10. The robot will be **disqualified** if it touches the moving obstacle anywhere in the track.

c. Third Stage

1. At this stage, the robot is expected to continue its way when it realizes that whether the door is open or closed as expected in a real traffic situation.

2. There is a door and a traffic light on the road. The traffic light will be at least **300mm** high from the ground. The traffic light is **only for visibility** and **will not be an impact** on the competition.
3. When the door is closed, the height of the center of the door will be **55mm**, the width of the door will be **50mm** and the length will be **500+mm**.
4. When the door is fully open, no part of it will be on the track and it will stay near the track, and it will be perpendicular to the track.
5. When the red light is on, the door will be closed.
6. When the yellow light is on, the door will start to open and when the green light is on, it will be in the fully open position.
7. The yellow light will be on for 2 seconds.
8. The robot does not have to wait for the green light to start the motion. It can start moving when the yellow light is on.
9. The robot will be **disqualified** if it touches the door anywhere in the track.
10. The robot cannot change the line to pass through the door. It has to continue that line to the race until the next stage.
11. If the robot inflicts a line violation, it will receive a **penalty of 10 seconds**, the timer will be stopped, and the robot will be removed from the track and placed on the track at end point of the door.

d. Fourth Stage

1. At this stage, robots are expected to park in the designated area.
2. At the end of the track, there will be a rectangle parking zone that has a area of $400*400\text{mm}^2$
3. When the robot's front-end point is on one side of this rectangle, the timer will be stopped and recorded. The penalty points will be added to the track duration of the robot, and it will be the finishing time.
4. As soon as the robot enters the parking area, the time it takes to park is not added to the duration.
5. If robot leaves the track after entering the parking zone, it will be considered as failed the parking section and will be given **10 seconds** penalty.

6. From the moment the robot enters the parking area, there will be **10 seconds**
7. given to park the robot.
8. If a robot cannot park within **10 seconds**, it will be penalized for **10 seconds**.
9. If a penalty occurs during the park, the penalty will be added to the duration of the track.
10. For the robot to be parked, no part of the robot should be on the parking area line, it must be in the parking area, and it must be completely stationary.

E. ADDITIONAL RULES

1. Robots must be autonomous.
2. No permanent mark can be left on the road or the road can be damaged. If the referee decides that the robot has damaged the track, the competitor is disqualified.
3. Robots must follow the line.
4. Competitors can use any power source that will not harm the road or the audience.
5. The referee committee is competent to decide on the cleanliness of the track, suitability or competitiveness. The decision of the referee committee shall be deemed valid.
6. If a laser is used, only level 1 laser can be used.
7. It is the responsibility of the participants to inform the referees of the extra circumstances.
8. Robots that do not obey the rules above will be eliminated from the competition.
9. There may be changes in the manufacturing process that do not disrupt the overall construction of the track.

F. EVALUATION

1. The first three teams will be awarded after the race.
2. Creative ideas and designs can be rewarded if necessary.

WARNING 1: In order to avoid interference from the sensors used in the robots, flash shooting cannot be done by an electronic device in the hall where the races

are made. We ask that the competitors and the visitors to pay attention to this issue and not insist.

WARNING 2: It is recommended that the distance sensors do not react to distances greater than **30 cm** in order to prevent the robots from being affected by off-track elements. Any objections to that will not be taken into consideration.

- **As in all categories, General Category Rules are valid for the Line Follower Category.**
- **METU Robotics Society have the right to alter the rules if necessary.**





