UGV: Turning Radius Test [1]

version 1.0/12-Aug-2025/YS

Purpose

The purpose of this test is to evaluate the minimum turning radius of an unmanned ground vehicle (UGV) in a flat outdoor environment. The test is intended to determine the tightest circular path the UGV can achieve while maintaining traction and stability when operating autonomously or being manipulated. This parameter is crucial for assessing the robot's maneuverability in constrained agricultural plots, greenhouses and/or polytunnels.

Test Facility

The test facility needs to meet the following requirements:

- Test site: the test shall be conducted on a flat (gradient <1%), open surface free of major irregularities or obstacles. The test site is larger than or equal to 2 times the length of the robot and 3 times the width of the robot. A schematic diagram of the test scenario is shown in Figure 1.
- **Boundary marking: the test area shall be clearly marked using cones, tape or paint to define the turning circle and robot path.**
- **Environmental conditions: n**o artificial constraints; natural conditions apply (wind, temperature, humidity).

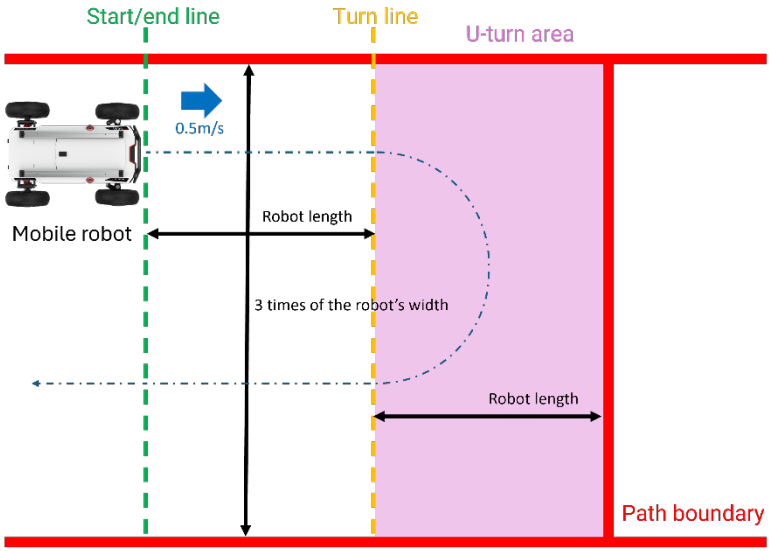

Figure 1. Test area for UGV.

Test Procedure

Each test trial shall follow the steps below:

1. The UGV is placed at the start line of the test path. Trial start time is marked.
2. The UGV travels along the test path at a speed of 0.5m/s.

3. When the robot's head crosses the turn line, maintain forward speed of 0.5m/s and make a clockwise U-turn with the robot's minimum turning radius.
4. When the robot's head has turned 180 degrees from the original direction it was facing, it continues to travel in a straight line until it reaches the end line and stops.
5. Trial end time is marked.
6. The same procedure is repeated for a counterclockwise U-turn.
7. Each direction shall be tested at least 3 times.

Evaluation Criteria and Error Conditions

Trials are evaluated based on the number of successful cycles and duration of each trial (difference between trial start and end times).

To pass the test, the UGV must complete at least three continuous trials in both directions without tipping, stopping or going beyond/touching the boundary line.

Conditions

The following test conditions shall be recorded and included in the test report:

- Field layout dimensions.
- Robot sizes.
- Observed behavior in each segment.
- Terrain conditions during testing.
- Weather conditions during testing.
- Robot configuration and payload details.
- Position sensor data (if applicable).

Test Result

The following shall be recorded and included in the test report:

- Number of successful tests.
- Average duration of trial (steps 1-5 above) and standard deviation (in seconds).
- The turning radius of the robot for each U-turn (average and standard deviation, in both directions).

References

1. BS ISO 18646-1_2016