UGV: Manual Control Tests [1][2]

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Purpose

The purpose of this test is to verify the robot's ability to respond to manual control commands, including *start*, *stop*, *directional control*, and *speed adjustment.* Operability reflects the reliability of command execution and the quality of human-machine interaction.

Test Facility

The test should be conducted in an obstacle-free, flat terrain (e.g., grassy field or dirt path, gradient <10%). The minimum recommended test area is 5m × 5m. Visual markers should be placed at target points to guide the robot's movement.

The Test Equipment is comprised of the following:

- Target robot.
- Handheld controller or remote-control terminal.
- Marker objects (cones or flags, and boundary marking lines).
- Optional: Video recording equipment.

The setup is shown in Figures 1 and 2.

Test Procedure

The tests include a sequence of operations to be executed three times in a row to verify consistency.

1. Move and Stop Test

The test area is a straight path. Path width is 1.5 times of the robot's maximum width. Start line, brake line, and end line are set on the path. The distance between the start line and the brake line should be at least 5 metres and the distance between the brake line and the finish line should be 0.5 metres. The test scenario is shown in Figure 1. The test flow is as follows:

a) Place the robot at the initial position, facing forward and in standby mode.
b) Issue a 'Move Forward' command: robot moves forward 5 meters at 0.5 m/s.
c) Issue a 'Stop' command: robot stops within 0.5 meters.

2. Right-angle (90°) Turn Test

The test area contains 2 90° turns, a left and a right. Path width is 1.5 times of the robot's maximum width. There is a straight section with a length 1.5 times the robot's own length before each turn. Start line and end line are set on the path. The test scenario is shown in Figure 2. The test flow is as follows:

a) Place the robot at the initial position, facing forward and in standby mode. Robot head coincides with the midpoint of the start line.
b) Issue a 'Move Forward' command: robot moves forward 5 meters at 0.5 m/s.
c) Issue a 'Turn Right 90°' command: the robot's head enters the right turning area, maintains the same forward speed and performs a right turn of 90°.

d) Issue a 'Turn Left 90°' command: the robot's head enters the left turning area, maintains the same forward speed and performs a left turn of 90°.
e) Issue a 'Stop' command: when the robot's head passes over the end line, a stop command is issued, and the robot stops moving.

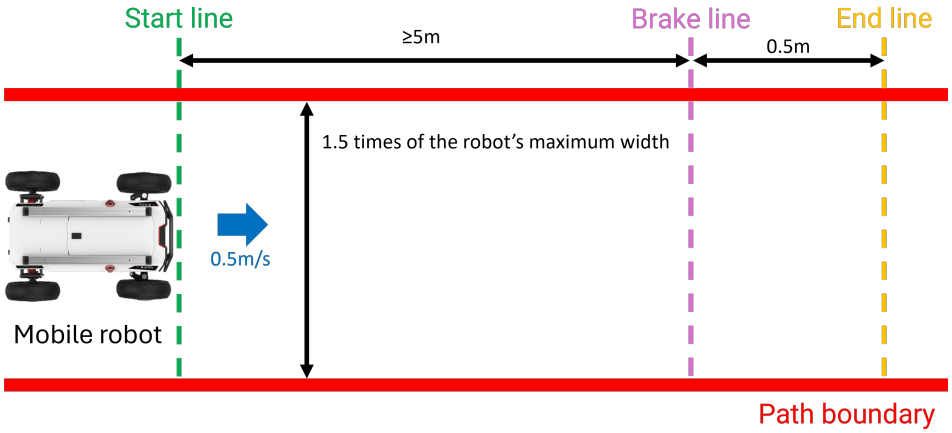

Figure 1. The UGV move and stop test scenario.

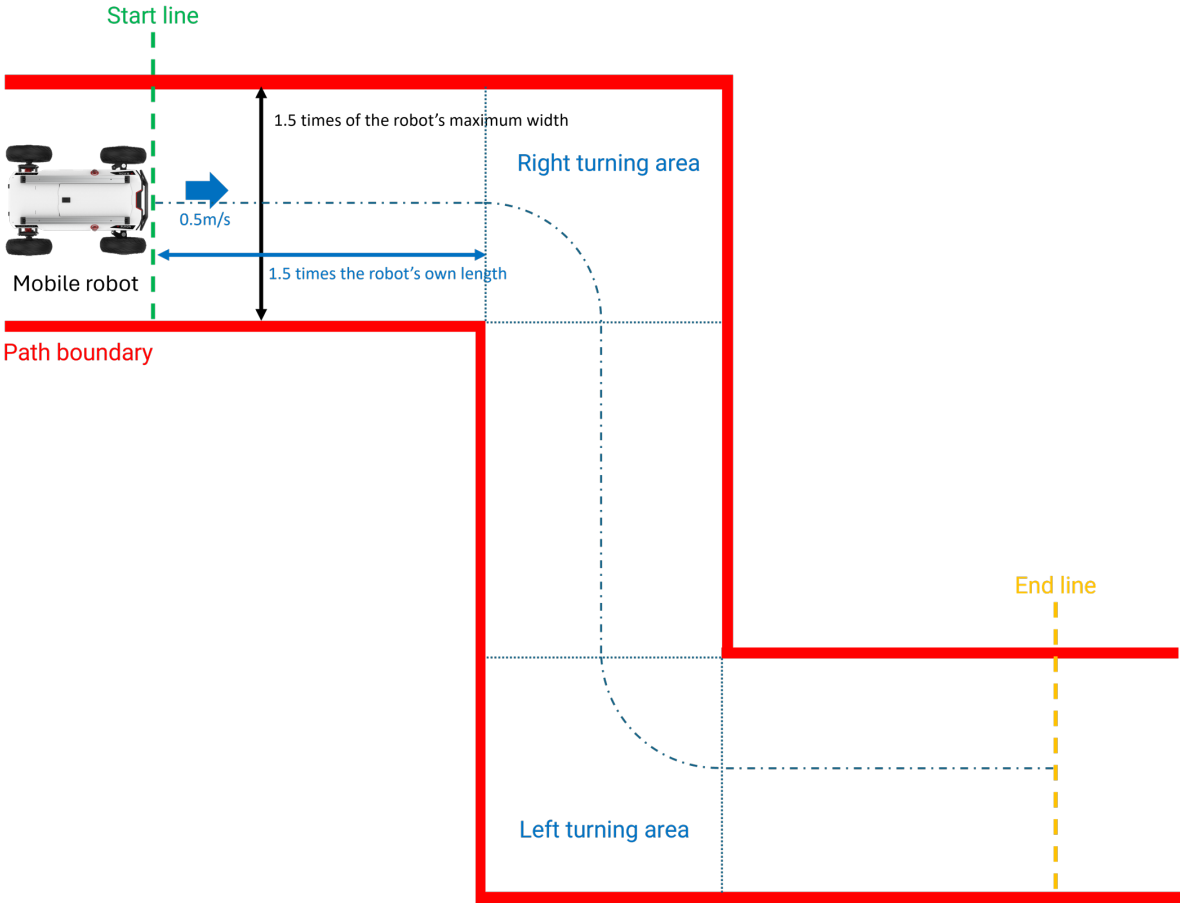

Figure 2. The UGV 90° turns test scenario.

Evaluation Criteria and Error Conditions

1. Move and Stop Test

- Each command must be responded to within 1 second.
- The robot's head crosses the brake line and begins to decelerate, and the robot comes to a complete stop before the end line.
- The robot does not touch or cross the boundary line during the entire process.
- The robot is able to successfully complete the test 3 times in a row.
- No false triggers, delays, communication failures or abnormal behaviors occur during the process.

2. Right-angle (90°) Turn Test

- Each command must be responded to within 1 second.
- The robot does not touch or cross the boundary line during the entire process.
- The robot is able to successfully complete the test 3 times in a row.
- No false triggers, delays, communication failures or abnormal behaviors occur during the process.

Conditions

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

- Robot and path sizes and gradient (%).
- Terrain conditions (soil softness, grass cover density, moisture if relevant).
- Observed behavior in each segment (stability, wheel/track slippage, yaw drift).
- Robot configuration and payload details.
- Control interface used (remote, GUI, etc.)

Test Result

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

1. Move and Stop Test

- Number of successful cycles.
- Response time for each command.
- Stopping distance.

2. Right-angle (90°) Turn Test

- Number of successful cycles.
- Response time for each command.

References

1. BS ISO 18646-1_2016
2. BS ISO 18646-2_2024