NPTEL Online Course

# Wheeled mobile robots: Week 5 by Dr.Asokan Thondiyath

Assignment 5

Question 1:

Given a differential drive robot which localizes itself in the work environment using the odometry based on the wheel sensor readings. Select the deterministic errors that can be eliminated by proper calibration of the system.

* 1. Limited resolution during integration
  2. Uncertainty in the wheel diameter and in particular unequal wheel diameter
  3. Variation in the contact point of the wheel
  4. Misalignment of the wheels
  5. Unequal floor contact

Solution: **Ans**(*b and d*)

Uncertainty in the wheel diameter and in particular unequal wheel diameter

Misalignment of the wheels

Question 2 to 4:

For a differential-drive robot the initial pose at ‘A’ is given as and the robot moves to another point ‘B’. Given the distance between the two wheels is 1 unit and the right and left wheel traverse distances are 3 and 2.5 units respectively.

1. the absolute traverse distance of the robot is
2. 5.5 units
3. 3 units
4. 2.75 units
5. 2.5 units

Solution: **Ans**(*c*)

1. What will be the change in the pose from point ‘A’ to point ‘B’.

Solution: **Ans**(*d*)

1. Find the ‘y’ coordinate of new pose of the robot \_\_\_\_\_\_\_\_\_\_\_. (up to two decimal places)

Solution range: **4.16 to 4.18 units**

units

Question 5:

Choose the True statement:

* 1. Prediction update is based on the updated belief state
  2. Perception update decreases the uncertainty as the robot moves.
  3. Action update is based on the prior belief state.
  4. Prediction update increases uncertainty as the robot moves.

Solution: **Ans**(*b, c and d*)

Perception update decreases the uncertainty as the robot moves.

Action update is based on the prior belief state.

Prediction update increases uncertainty as the robot moves.

Question 6:

The Markov assumption made in Markov localization is given as

1. Only current sensor measurements are required for accurate localization.
2. The current state is only dependent on the previous state and its most recent actions and perception.
3. The probability that a robot’s state estimate equals the actual robot state is maximized.
4. Tracks the robot and is inherently very precise and efficient

Solution: **Ans**(b)

The current state is only dependent on the previous state and its most recent actions and perception.

Question 7:

Select the false statements

1. In Markov localization to update the probability of all positions within the whole state space at any time requires a discrete representation of the space (grid). The required memory and calculation power can thus become very important if a fine grid is used.
2. Markov localization starts from any unknown position
3. In Markov localization the recovery from ambiguous situations is not possible.
4. Markov localization tracks the robot and is inherently very precise and efficient.

Solution: **Ans**(*c and d*)

In Markov localization the recovery from ambiguous situations is not possible.

Markov localization tracks the robot and is inherently very precise and efficient.

Question 8:

For a robot moving in the negative ‘y’ direction in a global coordinate frame and which uses control inputs to predict position estimates, for such a robot its position estimate will have

1. Variance equal in the ‘x’ and ‘y’ directions
2. Least variance in the direction orthogonal to its motion
3. Least variance in the direction of its motion
4. Variance will be greater in the ‘y’ direction

Solution: **Ans**(*c*)

Least variance in the direction of its motion

Question 9:

Choose the incorrect statement:

1. SLAM is a process by which a mobile robot can build a map of an environment and at the same time use this map to deduce its location.
2. In SLAM, both the trajectory of the platform and the location of all landmarks are estimated online without the need for any a priori knowledge of location.
3. SLAM stands for simple localization and mapping.
4. In SLAM, only the trajectory of the platform is estimated online with the need of a priori knowledge of location.

Solution: **Ans**(*c and d)*

SLAM stands for simple localization and mapping.

In SLAM, only the trajectory of the platform is estimated online with the need of a priori knowledge of location.

Question 10:

Choose the statement that best suits for the Prediction update of a robot

1. Estimates its current position based on previous position and the odometric input.
2. Predicts the current position based on previous position and the sensor input.
3. Predicts its current position based on previous position and the previous uncertainty.
4. Estimates its current position based on odometry and sensor input.

Solution: **Ans**(*a)*

Estimates its current position based on previous position and the odometric input.