CSE140: Introduction to Intelligent Systems
Quiz - 3

Date of Examination: 10.05.2023 Duration: 30 mins Total Marks: 10 marks

---

Instructions –

- Attempt all questions.
- MCQs have a single correct option.
- State any assumptions you have made clearly.
- Standard institute plagiarism policy holds.
- No evaluation without suitable justification.

---

1. Which of the following statements is true about localization and mapping? **[1 mark]**

    1. Localization is the process of creating a map of the environment, while mapping is the process of determining the robot's position and orientation.
    2. Localization and mapping are two completely separate processes and are never performed together.
    3. Mapping is the process of determining the robot's position and orientation, while localization is the process of creating a map of the environment.
    4. Localization and mapping are interrelated processes that are often performed together in a loop fashion.

    Solution D

2. Which of the following statements are FALSE **[1 mark]**

    1. Configuration space is represented using joint angles, joint velocities or joint torques.
    2. Configuration space is represented using Cartesian coordinates, Euler angles, or quaternions.
    3. Workspace coordinates are represented using Cartesian coordinates, Euler angles, or quaternions.
    4. Workspace coordinates are represented using joint angles, joint velocities or joint torques.
        (a) A and C
        (b) Only A
        (c) B and D
        (d) Only D

    Solution C

3. Which sensor is more suitable for estimating the distance between a drone and its surroundings while flying in an outdoor environment with no GPS signal?**[1 marks]**

    1. LIDAR
    2. IMU
    3. Both LIDAR and IMU
    4. None of the above

    Solution A OR Solution C with proper justification

4. What is calibration in a stereo camera? **[1 marks]**

    1. A process of tuning stereo cameras for capturing high-resolution images
    2. A process of adjusting the disparity between two camera images to obtain accurate 3D depth information
    3. A process of testing the accuracy of the stereo cameras before they are used for image capturing
    4. A process of adjusting the focal length of the lenses in stereo cameras to achieve better image quality

Solution B

5. Which of the following best describes the difference between active and passive sensing? **[1 mark]**

    1. Active sensing involves using sensors that emit energy, while passive sensing involves using sensors that only receive energy.
    2. Active sensing involves using sensors that only receive energy, while passive sensing involves using sensors that emit energy.
    3. Active sensing is more accurate than passive sensing.
    4. Passive sensing is more expensive than active sensing.

Solution A

6. Which of the following is an advantage of closed-loop systems over open-loop systems? **[1 marks]**

    1. Closed-loop systems are always less accurate than open-loop systems
    2. Closed loop systems can correct errors due to disturbances
    3. Closed loop systems require less complex control algorithms
    4. Closed loop systems are not suitable for applications where precise control is required

Solution B

7. A robot arm is used to pick and place objects on a conveyor belt in a manufacturing plant. The robot arm is controlled by a closed loop control system with feedback.
MCQ: What would be the error or deviation that needs to be feedback in this scenario?
[1 marks]

    1. The deviation between the setpoint position and the actual position of the robot arm.
    2. The deviation in temperature of the manufacturing plant from the desired value.
    3. The deviation in speed of the robot arm from the desired speed.
    4. The deviation in color of the objects on the conveyor belt from the desired color.

Solution A

8. Consider a 2 DOF robot with the following specifications:
    Joint 1 is a revolute joint with a rotation angle of 1=30°.
    Joint 2 is a revolute joint with a rotation angle of 2=60°.
    The length of Link 1 (l1) is 2 meters.
    The length of Link 2 (l2) is 1.5 meters.
    Assuming the robot's base frame is at (0,0), answer the following questions:

    1. What is the position of the end effector of the robot (in meters)? **[2 marks]**
    2. What is the orientation of the end effector of the robot (in degrees)? **[1 marks]**

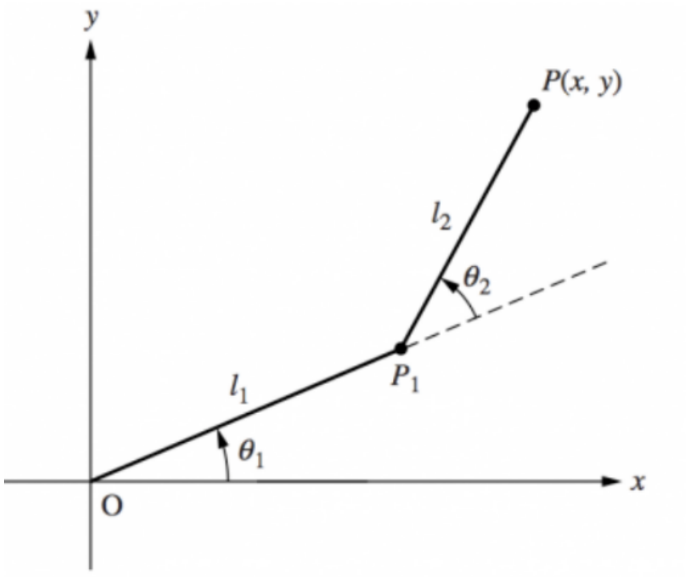
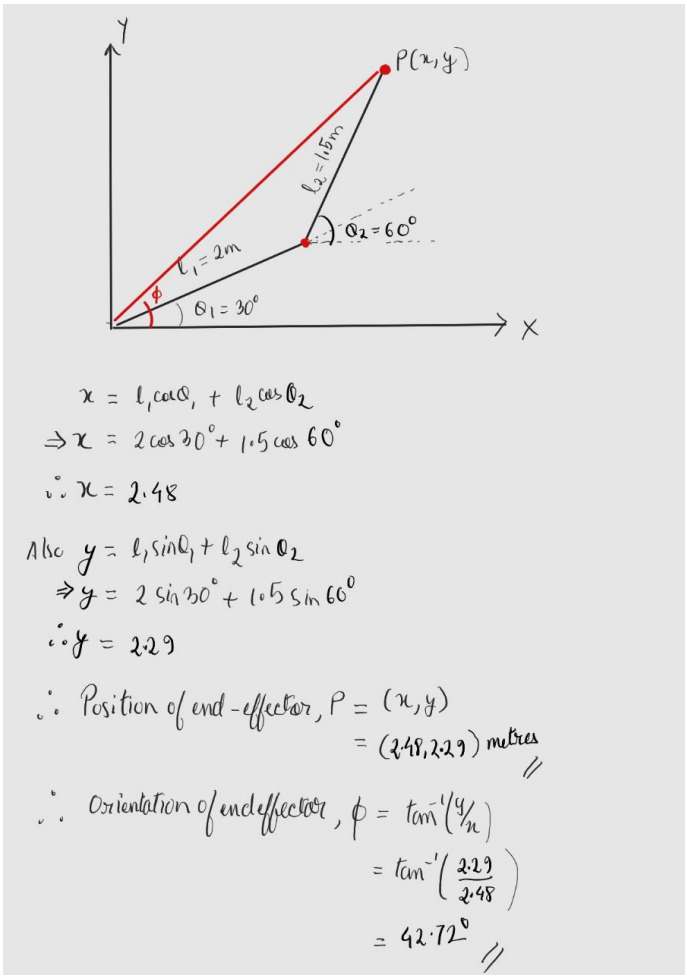


Figure 1:



$x = l_1 \cos\theta_1 + l_2 \cos\theta_2$

$\Rightarrow x = 2\cos 30^\circ + 1.5\cos 60^\circ$

$\therefore x = 2.48$

Also $y = l_1 \sin\theta_1 + l_2 \sin\theta_2$

$\Rightarrow y = 2\sin 30^\circ + 1.5\sin 60^\circ$

$\therefore y = 2.29$

$\therefore$ Position of end-effector, $P = (x, y)$

$= (2.48, 2.29)$ metres //

$\therefore$ Orientation of end effector, $\phi = \tan^{-1}\left(\frac{y}{x}\right)$

$= \tan^{-1}\left(\frac{2.29}{2.48}\right)$

$= 42.72^\circ$ //

Figure 2: