Unit 3 - Week 1

Assignment 1

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-09-30, 23:59 IST.

1) Which of the following is the zeroth Law of robotics? *1 point*

- A robot must protect its own existence as long as such protection does not conflict with the First or Second Law
- A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law
- A robot may not injure a human being or, through inaction, allow a human being to come to harm
- A robot may not harm humanity, or, by inaction, allow humanity to come to harm

No, the answer is incorrect.
Score: 0
Accepted Answers:
A robot may not harm humanity, or, by inaction, allow humanity to come to harm

2) What is a four rotor drone called? *1 point*

- Octarotor drone
- Quadrotor drone
- Trirotor drone
- Hexarotor drone

No, the answer is incorrect.
Score: 0
Accepted Answers:
Quadrotor drone

3) Which of the following in the automation pentagon does a camera come under? *1 point*

- Sensors
- Actuators
- Processors
- Software
- Networks

No, the answer is incorrect.
Score: 0
Accepted Answers:
Sensors

4) Consider a three dimensional fixed orthonormal coordinate frame $F = \{f^1, f^2, f^3\}$ and a mobile coordinate frame $M = \{m^1, m^2, m^3\}$ that are aligned, such that the two frames are having same origin and f^1, f^2, f^3 are along the same direction with m^1, m^2, m^3 respectively. The coordinate transformation matrix is: *1 point*

- Null matrix
- Skew-symmetric matrix
- Identity matrix
- Unit upper triangular matrix

No, the answer is incorrect.
Score: 0
Accepted Answers:
Identity matrix

5) A tool tip undergoes a yaw-pitch-roll transformation of $30°$, $45°$, and $60°$ respectively w.r.t to the fixed frame. Find the resulting composite rotation matrix *1 point*

- $R = \begin{bmatrix} 0.35 & -0.57 & 0.74 \\ 0.61 & 0.74 & 0.28 \\ 0.71 & -0.35 & 0.61 \end{bmatrix}$
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- $R = \begin{bmatrix} 0.35 & 0.57 & 0.74 \\ 0.61 & 0.74 & 0.28 \\ 0.71 & 0.35 & 0.61 \end{bmatrix}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$R = \begin{bmatrix} 0.35 & -0.57 & 0.74 \\ 0.61 & 0.74 & 0.28 \\ -0.71 & 0.35 & 0.61 \end{bmatrix}$

6) A robotic arm fixed to the ground performs a composite rotation on an object by a yaw of π radians, a roll of $\frac{\pi}{2}$ radians and a pitch of $\frac{\pi}{2}$ radians, in that order, w.r.t. to the ground frame. A position sensor attached to the wall determined the position of the tip of the object after the rotations, w.r.t. the ground frame, to be $\begin{bmatrix} 2 \\ 6 \\ 1 \end{bmatrix}$ units. *1 point*

Find the position of the tip of the object w.r.t. its own frame of reference.

- $\begin{bmatrix} 3.535 \\ 2 \\ -4.949 \end{bmatrix}$ units
- $\begin{bmatrix} 0.5 \\ 6 \\ -2.121 \end{bmatrix}$ units
- $\begin{bmatrix} 6 \\ 0.707 \\ -2.121 \end{bmatrix}$ units
- $\begin{bmatrix} -6 \\ -2.121 \\ 0.707 \end{bmatrix}$ units

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\begin{bmatrix} 6 \\ 0.707 \\ -2.121 \end{bmatrix}$ *units*

7) A screw transformation is defined as a combination of rotation and translation along the same axis. Consider the initial pose of a body w.r.t. the fixed frame as: *1 point*

$$\begin{bmatrix} -1 & 0 & 0 & 1 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

what will the pose of the object be after a screw transformation of 30 and 4 units about the z axis of the fixed frame is made, also can the rotation and translation be done in any order in a screw transformation?

- $\begin{bmatrix} 0.866 & 0.5 & 0 & 0.866 \\ -0.5 & -0.866 & 0 & 0.5 \\ 0 & 0 & 1 & -5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$. Yes, it can be done in any order
- $\begin{bmatrix} 0.866 & -0.5 & 0 & 0.866 \\ -0.5 & -0.866 & 0 & 0.5 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$. No it needs to be done with rotation first then followed by translation
- $\begin{bmatrix} 0.866 & 0.5 & 0 & 0.866 \\ -0.5 & -0.866 & 0 & 0.5 \\ 0 & 0 & 1 & -5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$. No, it needs to be done with translation first then followed by rotation
- $\begin{bmatrix} -0.866 & 0.5 & 0 & 0.866 \\ -0.5 & -0.866 & 0 & 0.5 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$. Yes, it can be done in any order
- $\begin{bmatrix} -0.866 & 0.5 & 0 & 0.866 \\ -0.5 & -0.866 & 0 & 0.5 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$. No, it needs to be done with translation first then followed by rotation

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\begin{bmatrix} -0.866 & 0.5 & 0 & 0.866 \\ -0.5 & -0.866 & 0 & 0.5 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ *. Yes, it can be done in any order*

8) For the homogeneous transformation matrix, *1 point*

$$\begin{bmatrix} -1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & -1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

mark the statements that are $\mathbf{TRUE}$:

- The x axis of the fixed frame and that of the mobile frame are along the same direction
- The y axis of the fixed frame and that of the mobile frame are along the same direction
- The origins of the fixed and mobile frame coincide
- The z axis of the fixed frame and that of the mobile frame are anti-parallel

If the position vector of a point in mobile frame is $P^{m} = \begin{bmatrix} 0.5 \\ 2 \\ 1 \end{bmatrix}$. Then its position vector in the fixed frame will be $P^{f} = \begin{bmatrix} 1.5 \\ 4 \\ 0 \end{bmatrix}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
The y axis of the fixed frame and that of the mobile frame are along the same direction
The z axis of the fixed frame and that of the mobile frame are anti-parallel

If the position vector of a point in mobile frame is $P^{m} = \begin{bmatrix} 0.5 \\ 2 \\ 1 \end{bmatrix}$. *Then its position vector in the fixed frame will be* $P^{f} = \begin{bmatrix} 1.5 \\ 4 \\ 0 \end{bmatrix}$

Common data for Q9-Q11 :

Two frames $\mathbf{A}$ and $\mathbf{B}$ are initially coincident. Frame $\mathbf{B}$ undergoes the following four motions in sequence w.r.t. its own axes:

(a) A rotation of θ degrees about the z axis.
(b) A translation of "d" units about the z axis
(c) A translation of "a" units along the x axis.
(d) A rotation of α degrees about the x axis

Determine the final homogeneous transformation matrix to describe the pose of frame $\mathbf{B}$ w.r.t. to the frame $\mathbf{A}$. Let (θ,d,a,α)=(45°, 5 units, 8 units ,30°). What would the final position of the $\mathbf{B}$ be w.r.t. to frame $\mathbf{A}$ (rounded of to 3 decimal places) .

9) P_x = _____units

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 5.5,6.0

0.3 points

10) P_y = _____ units

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 5.6,6.0

0.3 points

11) P_z = _____units

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 4.950,5.000

0.4 points

12) A robot has the control over 6 dof in a 3 dimensional space. What type of robot can it be classified into? *1 point*

- Redundant
- Non-holonomic
- Over-constrained
- Holonomic

No, the answer is incorrect.
Score: 0
Accepted Answers:
Holonomic