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Assignment#01

Answer01

State Variable: State variable represents the essential parts of the robot's current state or configurations. These variables are used to describe's robot's position, orientation and other relevent

Control Variable: Control variables are parameter that can be adjusted by an external controller to influence the robot's ~~influence~~ behaviour and Motion. They represent the inputs or commands given to the robot to control it's behaviour

Answer Q2 01

1) State Equation:

a) Unicycle Model:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} v\cos\theta \\ v\sin\theta \\ \omega \end{bmatrix}$$

b) Differential Drive Robot:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} v\cos\theta \\ v\sin\theta \\ \frac{v}{L}\tan\omega \end{bmatrix}$$

where,
x = horizontal axis of 2D space
y = vertical of 2D space
θ = Orientation Angle

For control variable,
V = linear velocity
ω = angular velocity

c) Simplified car Model:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \\ \dot{v} \end{bmatrix} = \begin{bmatrix} v\cos\theta \\ v\sin\theta \\ \frac{v}{L}\tan\delta \\ \dot{v}=a \end{bmatrix}$$

Answer 01 (ii)

(ii)

Robot Type	State Variable	Control Variables
(i) Linear Motion Robot	x-position y-position Heading Angle linear Velocity Angular Velocity	Linear Velocity Angular Velocity
(ii) 3-D Motion Robot	x, y, z-Position Attitude Linear & Angular velocity	Linear & Angular Velocity

Answer (Code) of 2&3 is written on Jupyter Notebook and Submitted in GC.

Answer 4(a)

Solve in Rough Paper

Given,

$\dot{x}_1 = u_1$ —— (i)

$\dot{x}_2 = u_2$ —— (ii)

$\dot{x}_3 = x_2^* u_1$

$= u_1 u_2$ —— (iii)

In (i) and (iii):

Integrating $\dot{x}_1$ and $\dot{x}_3$ wrt time we get,

$\int \dot{x}_1 \, dt = \int u_1 dt$ | $\int \dot{x}_3 dt = \int u_1 u_2 \, dt$

Solve করতে পারিনাই

$z = (x_1, x_3)$

Showed

Answer Q. 05 (a)

Given,

$\dot{x}(t) = v(t)\cos(\theta(t))$ —— (i)

$\dot{y}(t) = v(t)\sin(\theta(t))$ —— (ii)

$\dot{v}(t) = a(t)$ —— (iii)

$\dot{\theta}(t) = \omega(t)$ —— (iv)

Now, integrating (i), (ii), (iii) & (iv), we get,

(i): $\int \dot{x}(t) = \int v(t)\cos(\theta(t))$

or, $x(t) =$

(ii): $\int \dot{y}(t) = \int v(t)\sin(\theta(t))$

or, $y(t) =$