Assignment 1

(Introduction to robotics)

Task2. Identify one or two examples of robots for each of the seven categories of robots mentioned in class. Submit your selected examples as a list of youtube links with 2-3 line explanations for each.

1.Manipulator

a. Industrial Robots :- These are used in manufacturing industries for performing operations like picking and placing items, welding, assemble the automotive components and more. For eg. KUKA robot, Fanuc Robot etc.

KUKA Robot YT link :- click hear

Fanuc Robot YT link :- click hear

b. Space Robots:-These types of robots are used in space works like capturing the satellite, assembling structures in space, and performing repairs on spacecraft. For eg. Canadarm Robot

Canadarm Robot YT link:-click here

2.Mobile Robot

a. Exploration Robots:-These robots are made for explore the planates and gather data. Eg. Of mobile robots are Chandrayaan3 Pragyan Rover , NASAs Perseverance Rover.

Pragyan Rover YT link:- click here

Perseverance Rover YT link:- click here

3.Aerial Robot

a. Film making drones:- These drones are use to recording the videos in high quality. DJI inspire, Matrices series.

DJI inspire YT link:- click here

Matrice series YT link:- click here

b. Military and defence drone:-These drones are used for surveillance, even for combat operations in military application.

YT link:- click here

4.Legged Robot :- These robots are designed to navigate and move using legs instead of wheels .These are often use in environment where wheel robots face difficulty. Eg. Boston dynamics big dog, MIT cheetah

Bostan dynamics big dog YT link :- click here

MIT cheetah YT link: -click here

5.Soft Robots:-These robots are constructed from flexible and deformable materials allowing them to mimic the natural movement and behaviour of living organism. Eg octobot, PneuNets.

Octobots YT link:- click here

PneuNets YT link:- click here

6.Nanobots:- These are also known as nano machines use to working on the nano scales. Nanobots are used in various applications like cancer treatment, bloodstream cleanup, neurological repair, nano scale manufacturing etc.

Cancer treatment nanobots YT link:- click here

Nanobots for neurology YT link:- click here

7.AUV(Automated under water vehicle):- These robots are used for marine related tasks like scientific research, environmental monitoring, under water mapping, exploration and more. Eg. REMUS, IVER3.

REMUS YT link:- click here

IVER3 YT link:- click here

Task3. Review the most common types of motors and summarize them with a 2-3 sentence description of each of them.

Electric motors come in various types each designed for specific applications and operating principles.

1.Ac motors

a.Induction motors

b.Synchronous motors

2.DC motors

a.Brush DC Motors(BDC)

b.Brushless DC Motors(BLDC)

c.Stepper motors

d.Servo motors

a.Induction motors:-

It is a synchronous motor run through AC current. Induction motor has two main part stator and rotor. The stator carries a set of windings called stator winding. The rotor needed to torque is obtained by electromagnetic induction from the magnetic field of stator winding.

b. Synchronous motors:-

A synchronous motor is one in which the rotor at the same speed as the revolving field in the machine. They are often used in applications requiring precise speed control such as industrial machinery and clock.

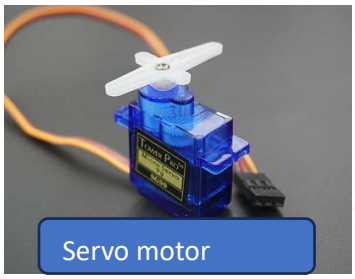
c. Brushed DC motors:-

These motor use brushes and commutator to change the direction of current flow in the armature winding causing the rotor to rotate. These are simple and inexpensive but brush wear maintenance is required.

d. Brushless DC motors:-These motors used electronic commutation to switch the current in the windings. They are more efficient and require led maintenance.

e. Stepper motors:- These motors move in discrete steps making them suitable for application that require precise control over rotation such as 3d printers, CNC machines and robotics.

f. Servo motors:-The name servo motor is related to the term servomechanism , which means that the motor is constantly monitored to control its motion. This motor often used in systems that require accurate control of position, speed and acceleration. These are commonly used in robotics automated manufacturing and remote control vehicles.


Servo motor


Brushed DC


Induction motor


Stepper motor


Synchronous motor


Brushless DC

6. To show that the columns of the Rotation matrix R_0^1 are orthogonal, we need to demostrate that the dot product b/w any two column is zero.

Lets suppose we have a Rotation matrix, the rotation is about Z-axis.

$$R_0^1 = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \\ \downarrow & \downarrow & \downarrow \\ C_1 & C_2 & C_3 \end{bmatrix}$$

$$C_1 \cdot C_2 = C_{11} \cdot C_{12} + C_{21} \cdot C_{22} + C_{31} \cdot C_{32}$$
$$= \cos\theta \cdot \sin\theta - \sin\theta \cdot \cos\theta + 0$$

$$\boxed{C_1 \cdot C_2 = 0} \quad \text{---------- (i)}$$

$$C_2 \cdot C_3 = \sin\theta \cdot 0 + \cos\theta \cdot 0 + 0 \cdot 1$$
$$= 0 + 0 + 0 = 0$$

$$\boxed{C_2 \cdot C_3 = 0} \quad \text{---------- (ii)}$$

$$C_3 \cdot C_1 = C_{13} \cdot C_{11} + C_{23} \cdot C_{21} + C_{33} \cdot C_{31}$$
$$= 0 \cdot \cos\theta + 0 \cdot (-\sin\theta) + 1 \cdot 0$$

$$\boxed{C_3 \cdot C_1 = 0} \quad \text{---------- (iii)}$$

Also we can get same result when the rotation is about x and y axis

Eqn (i), (ii), (iii) shows that the columns are orthogonal to each other.

7. ~~Consid~~ We have a rotation matrix R_0^1.

Take the rotation about Z-axis.

$$R_0^1 = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$|R_0^1| = \begin{vmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{vmatrix}$$

$$= \cos\theta(\cos\theta - 0) - \sin\theta(-\sin\theta - 0) + 0$$

$$= \cos^2\theta + \sin^2\theta = 1$$

$$\boxed{\det(R_0^1) = 1}$$

Same value we can find for rotation about y-axis and x-axis.