

Module 6 : Robot manipulators kinematics

Lecture 19 : D-H representation of kinematics linkages

Objectives

In this course you will learn the following

- D-H Parameters of general manipulators
- Application to simple manipulator as example

Dimentberg, Denavit, Hartenberg' s parameters of kinematics linkages:

For general mechanism shown above, linkage parameters $a_i, \alpha_i, d_{i+1}, \theta_i$ are defined as follows

- Common normal length between $i-1$ & i link is a_i and the twist angle is α_i . These are usually fixed parameters of linkages.
- The other parameters are d_{i+1} , the offset distance between perpendiculars and θ_i , the angle of perpendiculars.

Here for revolute pairs, offset distance d is fixed and its angle, θ_i is variable. And For prismatic pairs, offset distance is variable and the angle fixed. **Denavit, Hartenberg' s** defines the reference frames X_i & Z_i as follows. (Conventions to be used while deciding kinematic parameters of a robot)

- At joint J_{i+1} , define Z_i along joint axis and suitable X_i to start with & $Y_i = X_i * Z_i$
- a_i & α_i are obtained as ; take Z_{i-1} to Z_i along X_i
- d_i & θ_i are obtained as ; Take X_{i-1} to X_i along Z_{i-1}
- Set Direction of Z axis along any +ve or -ve direction.
- For position of Z axis for prismatic joint à choose convenient position
- Choose position of common normal on 2 parallel axis, conveniently
- Robot is serial chain of binary links except base & EE.
- For reference frame on unary link, set Z_0 along joint 1 axis.

Figure 19.1

These conventions are used in PUMA robot as follows (Refer figure 19.2)

Example of PUMA Robot: This is all revolute pair robot as follows : R _|_R||R _|_R _|_R _|_R

i	a _i	α_i	d _i	θ_i
1	0	90	d ₁	θ_1
2	a ₂	0	d ₂	θ_2
3	0	90	d ₃	θ_3
4	0	90	d ₄	θ_4
5	0	90	0	θ_5
6	0	0	d ₆	θ_6

Set the parameters of PUMA robot as per conventions mentioned above. i.e.

- Set X_0, Y_0, Z_0 along joint 1 as shown.
- Z_1 along axis of joint 2
- X_1 along common normal.
- Similarly other parameters are to be set to get table shown where θ_1 to θ_6 are joint variables.

Recap

In this course you will learn the following

- How D-H parameters are represented for general manipulator
- Application of D-H parameters for PUMA robot

Congratulations, you have finished Lecture 19. To view the next lecture select it from the left hand side menu of the page