Lecture 6 - D.H. Continued

Announcements:

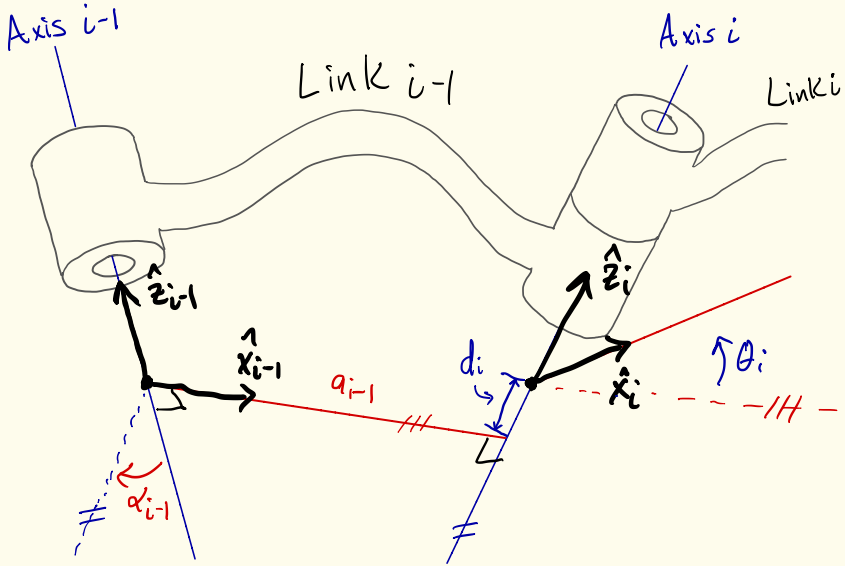
- Amazon Tech Talk on 9/6 ⇐ See Sakai
- HW 2 assigned: Due Friday 8:20 AM
- See Sakai for Notation Guide & Media Gallery Example Videos

Goals for Today:

- Review DH
- Examples w/ 3D mechanisms

Reminder: Simplify Kinematics $\theta_1, \ldots, \theta_n \rightarrow {}^{\circ}T_n$

Attaching Coordinate Frames



α_{i-1} : angle between $\hat{z}_{i-1}$ and $\hat{z}_i$

a_{i-1} : distance between $\hat{z}_{i-1}$ and $\hat{z}_i$

d_i : distance between $\hat{x}_{i-1}$ and $\hat{x}_i$

θ_i : angle between $\hat{x}_{i-1}$ and $\hat{x}_i$

General Rules:

(1) $\hat{z}_{i-1}$ along axis $i-1$

(2) $\hat{x}_{i-1}$ along common normal of axis $i-1$ and i

Special Rules:

(1) Intersecting Axes?

$\hat{x}_{i-1} = +/- \hat{z}_{i-1} \times \hat{z}_i$

(2) Parallel Axes $\hat{z}_i, \hat{z}_{i+1}$?

$d_i = 0$

(3) First / Last Link?

Set frame s.t.

$a_i, d_i, \theta_i, \alpha_i = 0$

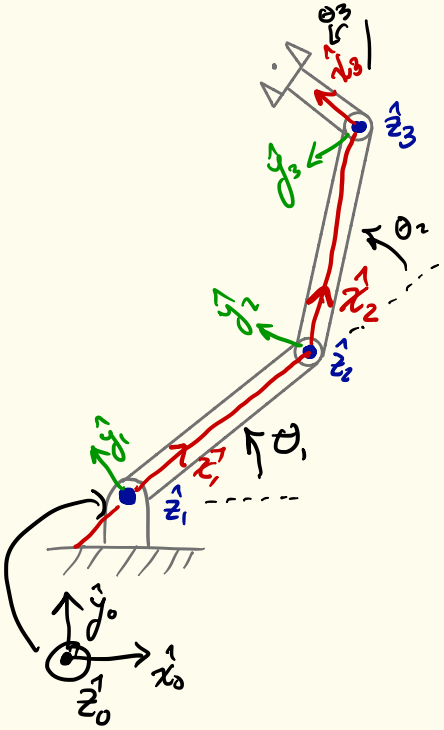
Where possible.

Example 1

DH Table

i	α_{i-1}	a_{i-1}	d_i	θ_i
1	0	0	0	θ_1
2	0	L_1	0	θ_2
3	0	L_2	0	θ_3

$^0T_1$ $^1T_2$ $^2T_3$

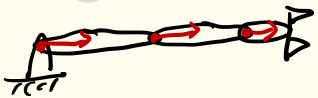


α_{i-1} $\hat{x}_{i-1}$: α_{i-1}: angle between $\hat{z}_{i-1}$ and $\hat{z}_i$

a_{i-1} $\hat{x}_{i-1}$: a_{i-1}: distance $\hat{z}_{i-1}$ and $\hat{z}_i$

d_i $\hat{z}_i$: d_i: distance between $\hat{x}_{i-1}$ and $\hat{x}_i$

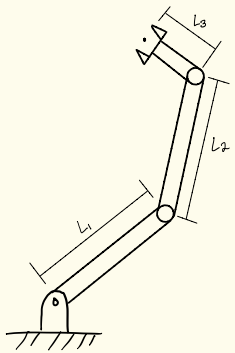
θ_i $\hat{z}_i$: θ_i: Angle between $\hat{x}_{i-1}$, $\hat{x}_i$



Joint Variable: Revolute θ_i

Prismatic d_i

Zero configuration: Config. when all joint vars are 0

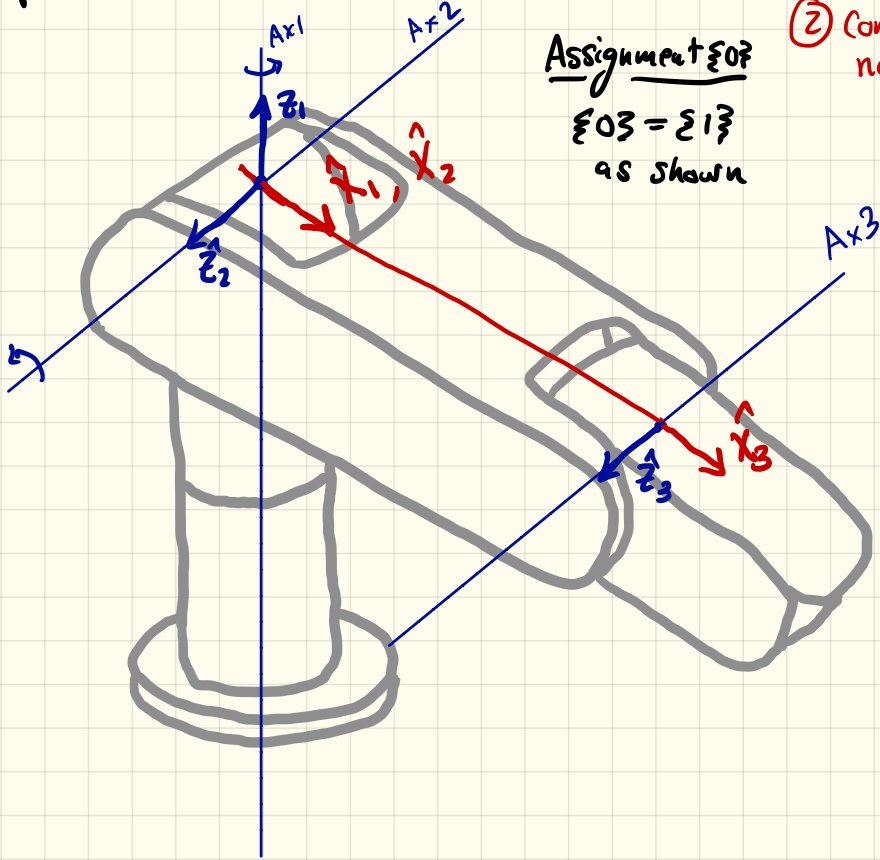


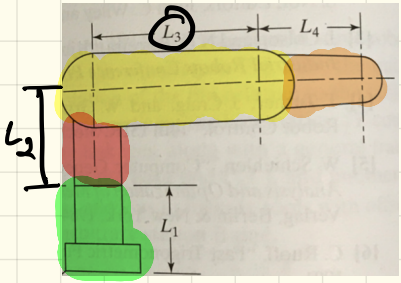
Example: RRR Manipulator (In the zero Config as Shown)

① Axes
② Common normals

Assignment of {0} = {1}
as shown

	$\hat{x}_{i-1}$	$\hat{x}_{i-1}$	$\hat{z}_i$	$\hat{z}_i$
i	α_{i-1}	a_{i-1}	d_i	θ_i
1	0	0	0	θ_1
2	90°	0	0	θ_2
3	0	L_3	0	θ_3





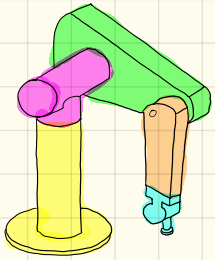
PUMA 560 (Shown in the zero config)

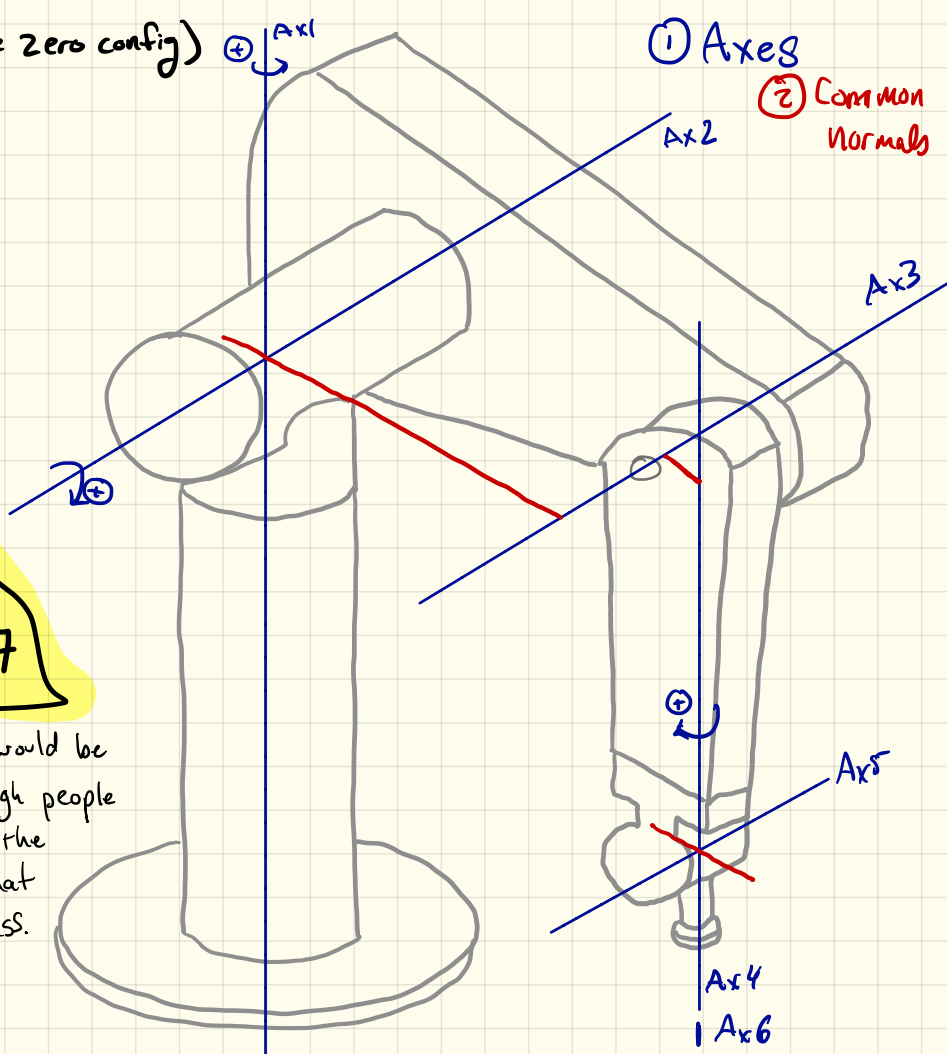
$\circlearrowleft \hat{x}_{i-1} \uparrow \hat{x}_{i-1} \uparrow \hat{z}_i \circlearrowleft \hat{z}_i$

i	α_{i-1}	a_{i-1}	d_i	θ_i
1				
2				
3				
4				
5				
6				

TO BE CONTINUED IN LECTURE 7

I had said there would be a video but enough people found DH to be the fuzziest concept that we'll do this in class.





① Axes

② Common normals

Wrist Kinematics