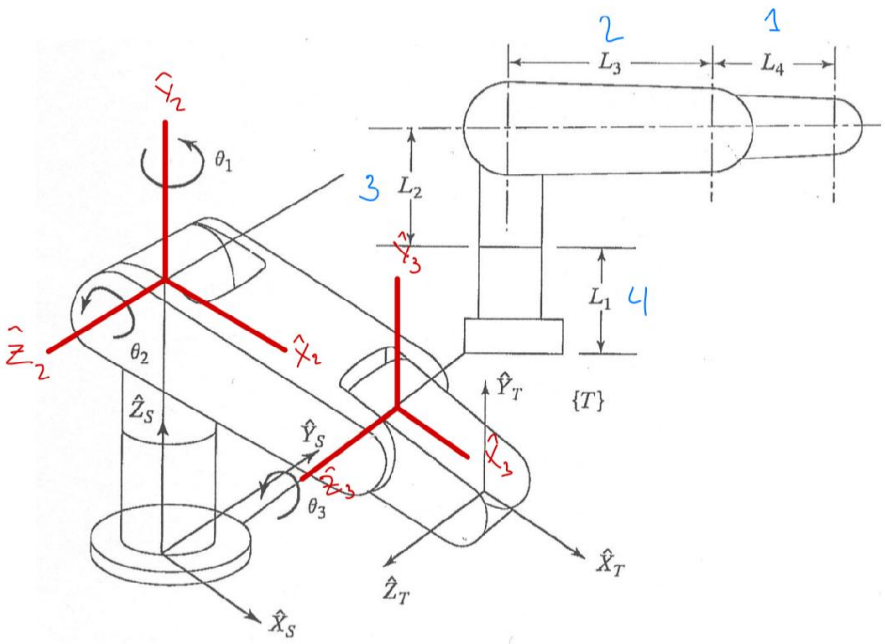
FORWARD KINEMATICS

José Torres Garcia & Iván López Buira **[G11 - F]**

Table of Contents

FRAMES

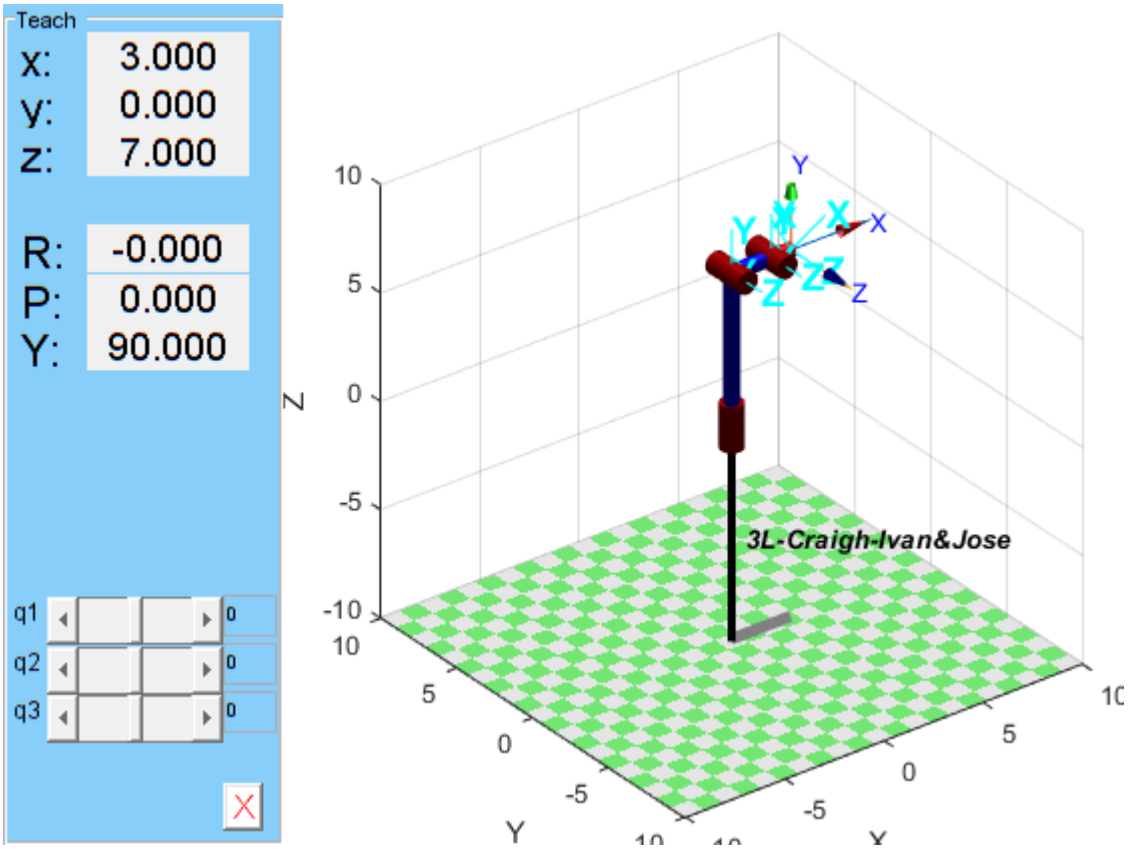


DH PARAMETERS

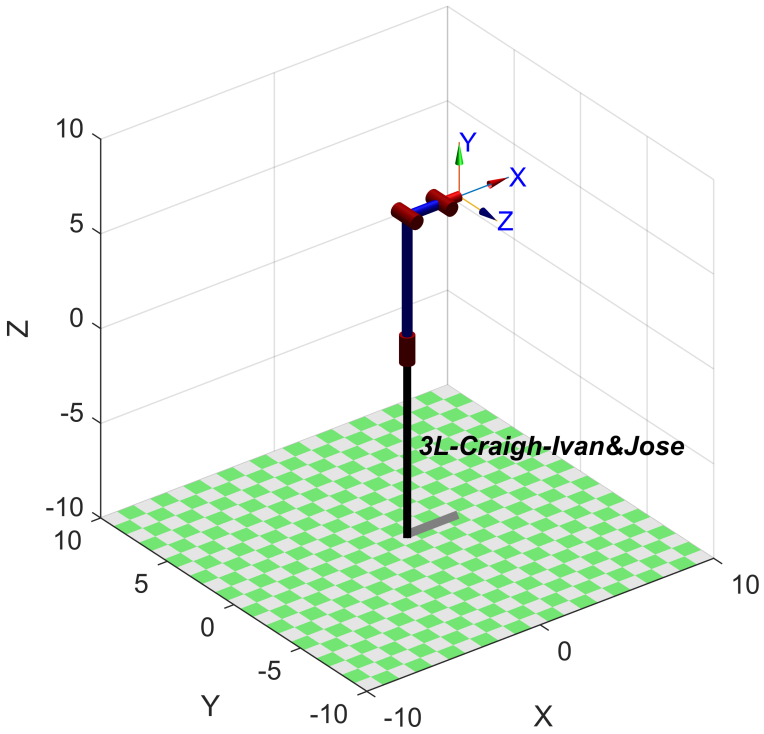
```
clear
mdl_3L_me
p3LCraigh
```

```
p3LCraigh =

3L-Craigh-Ivan&Jose [Unimation]:: 3 axis, RRR, stdDH, slowRNE
 - Craigh;
+---+-----------+-----------+-----------+-----------+-----------+
| j |     theta |         d |         a |     alpha |    offset |
+---+-----------+-----------+-----------+-----------+-----------+
|  1|         q1|          7|          0|     1.5708|          0|
|  2|         q2|          0|          2|          0|          0|
|  3|         q3|          0|          1|          0|          0|
+---+-----------+-----------+-----------+-----------+-----------+
```

```
figure
p3LCraigh.plot([0,0,0],'zoom',1.5)
```

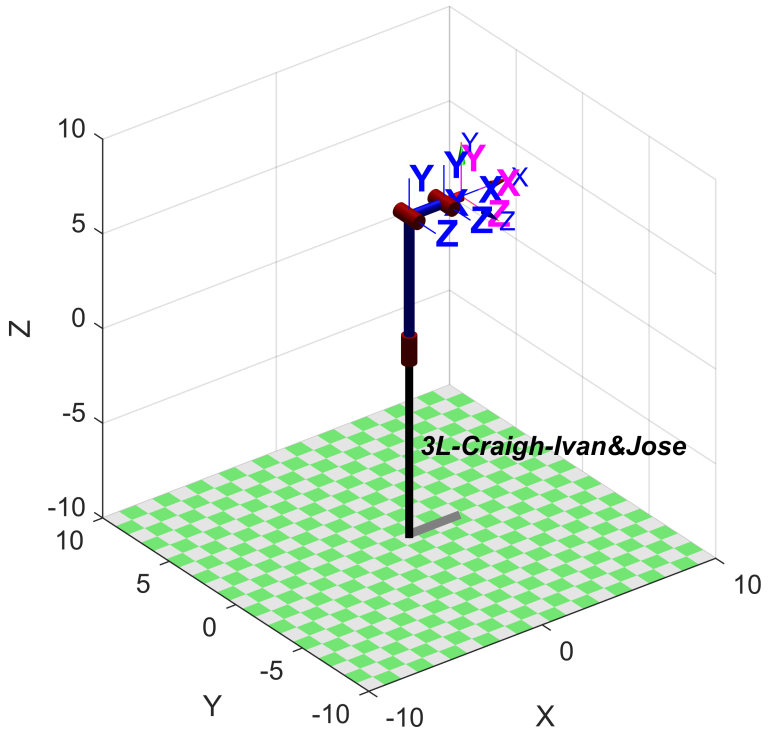

Teach
x:
3.000
y:
0.000
z:
7.000
R:
-0.000
P:
0.000
Y:
90.000
q1
0
q2
0
q3
0
3L-Craigh-Ivan&Jose
Z
Y
X

```
hold off
```


3L-Craigh-Ivan&Jose
Z
Y
X

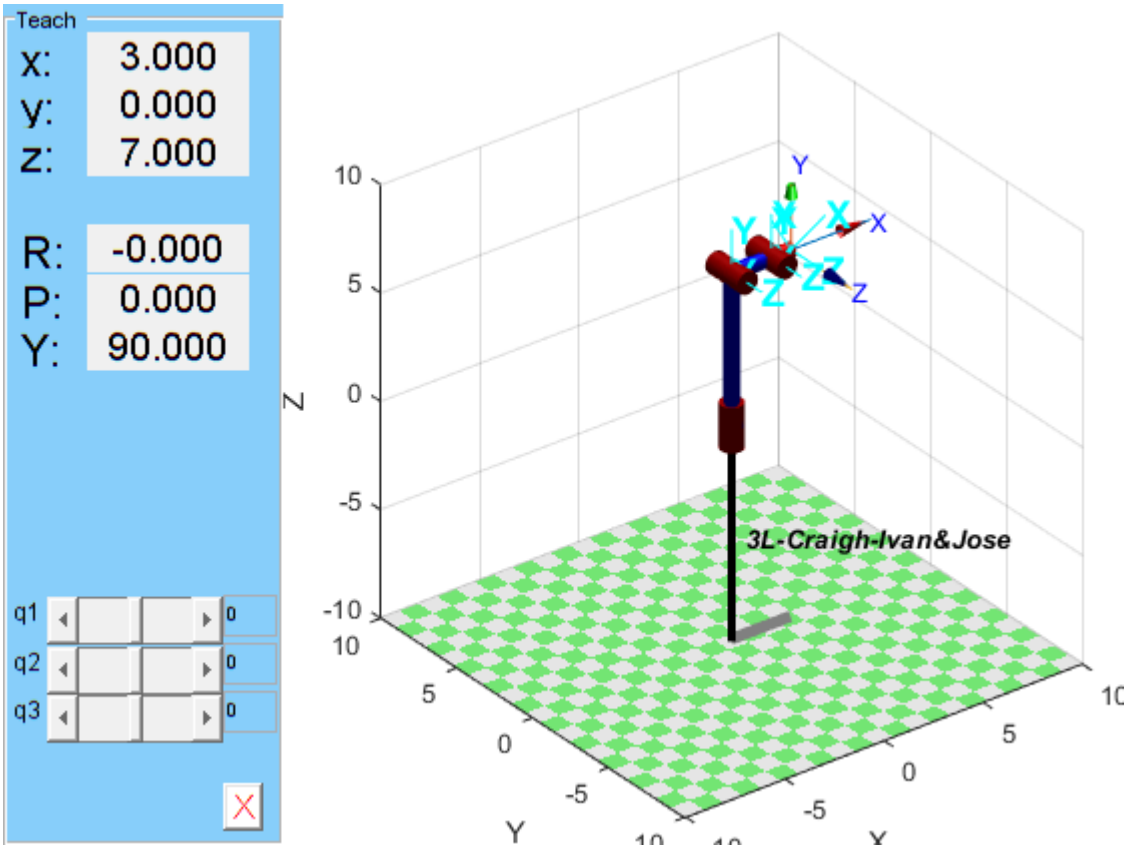
IMPLEMENT ${}^{T}T_{S}$

```
T_S_T = eye(4);
T_2_3 = T_S_T * link_A_B_Std(pi/2, 0, 7, 0);
T_1_2 = T_2_3 * link_A_B_Std(0, 2, 0, 0);
T_0_1 = T_1_2 * link_A_B_Std(0, 1, 0, 0);

T_EE_HANDMADE = T_0_1;

hold on
trplot(T_EE_HANDMADE, 'length', 2, 'width', 0.5, 'color', 'magenta', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_2_3, 'length', 2, 'width', 0.5, 'color', 'blue', 'text_opts', {'FontSize',
14, 'FontWeight', 'bold'})
trplot(T_1_2, 'length', 2, 'width', 0.5, 'color', 'blue', 'text_opts', {'FontSize',
14, 'FontWeight', 'bold'})
hold off
```



a) (0,0,0)

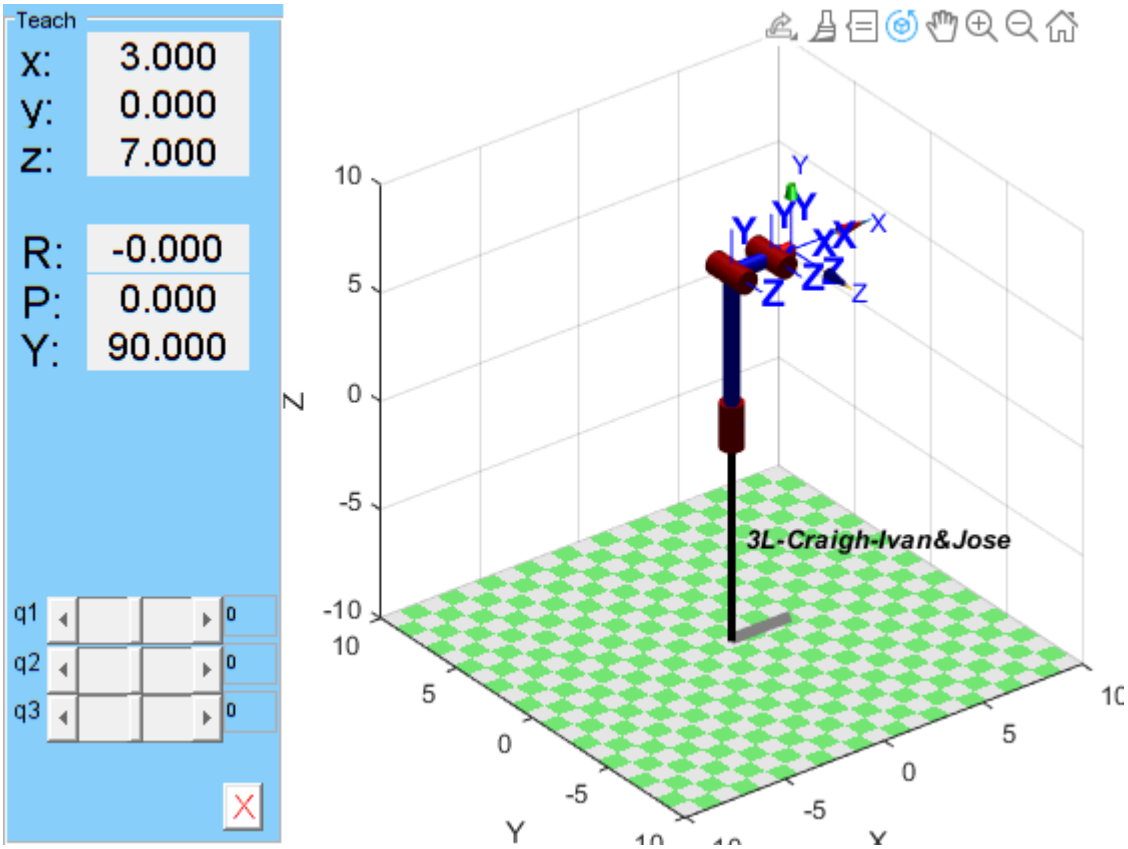
```
clf
p3LCraigh.teach
```




```
hold on
T_2_3_a = T_2_3 * trotz(0);
T_1_2_a = T_1_2 * trotz(0);
T_0_1_a = T_0_1 * trotz(0);

T_S_T_a = T_0_1_a * T_1_2_a * T_2_3_a
```

```
T_S_T_a = 4×4
     1     0     0     5
     0     0     1    -7
     0    -1     0     0
     0     0     0     1
```

```
%trplot(T_EE_HANDMADE, 'length', 2, 'width', 0.5, 'color', 'magenta', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_2_3_a, 'length', 2, 'width', 0.5, 'color', 'blue', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_1_2_a, 'length', 2, 'width', 0.5, 'color', 'blue', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_0_1_a, 'length', 2, 'width', 0.5, 'color', 'blue', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
```

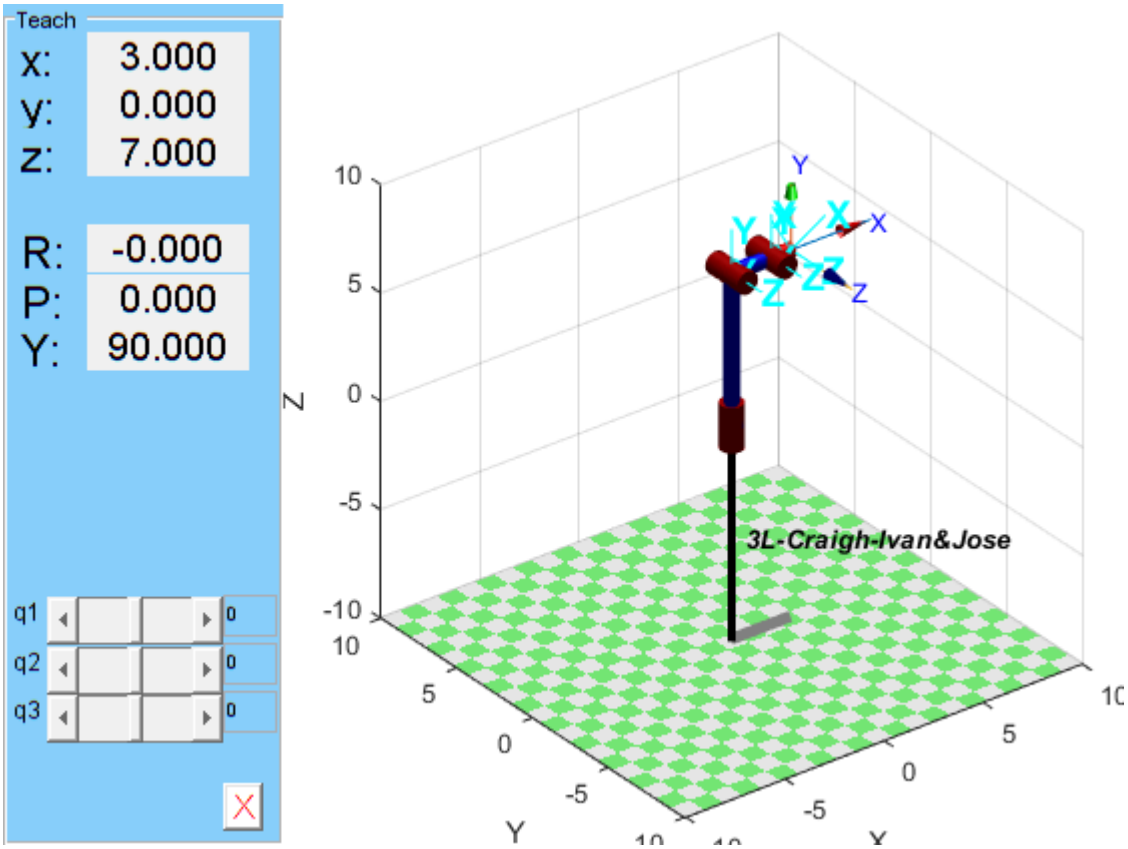



```
T_EE_1 = p3LCraigh.fkine([0,0,0])
```

```
T_EE_1 =
        1        0        0        3
        0        0       -1        0
        0        1        0        7
        0        0        0        1
```

b) (0,π/2,0)

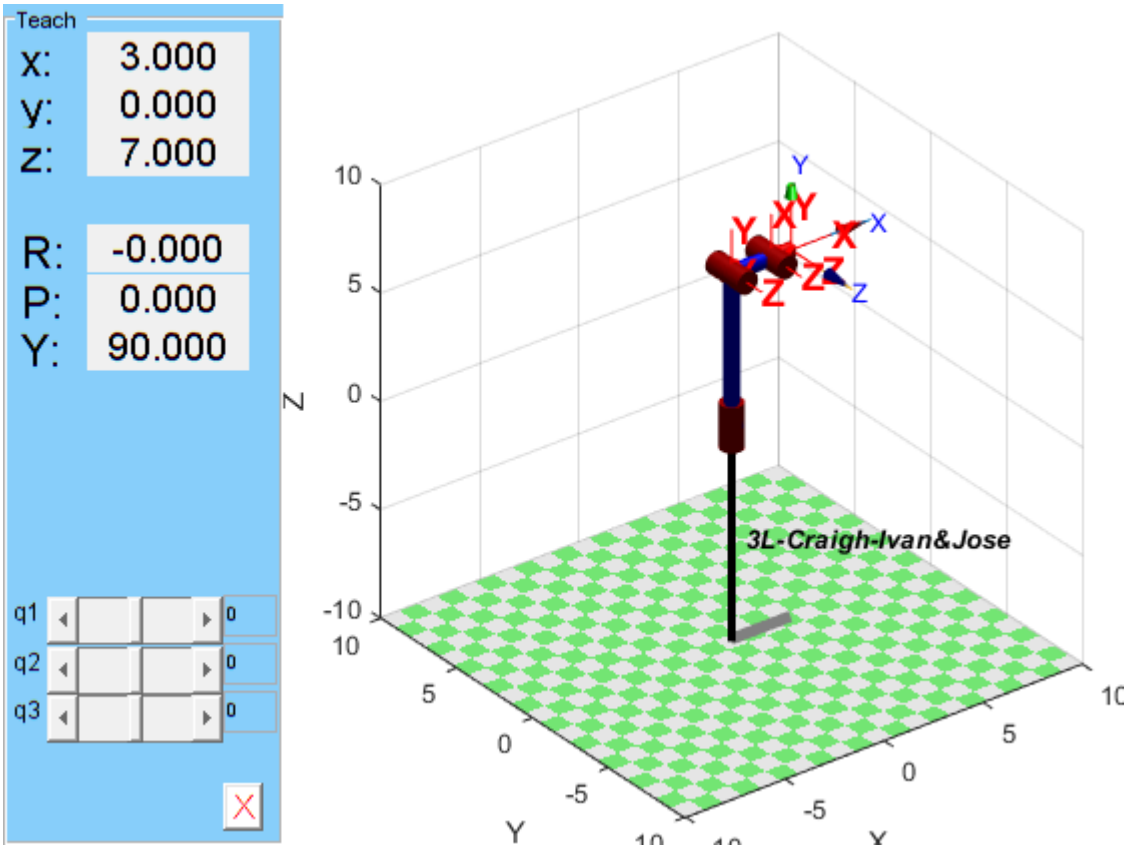
```
clf
p3LCraigh.teach
```




```
hold on
T_2_3_b = T_2_3 * trotz(0);
T_1_2_b = T_1_2 * trotz(pi/2);
T_0_1_b = T_0_1 * trotz(0);

T_S_T_b = T_0_1_b * T_1_2_b * T_2_3_b
```

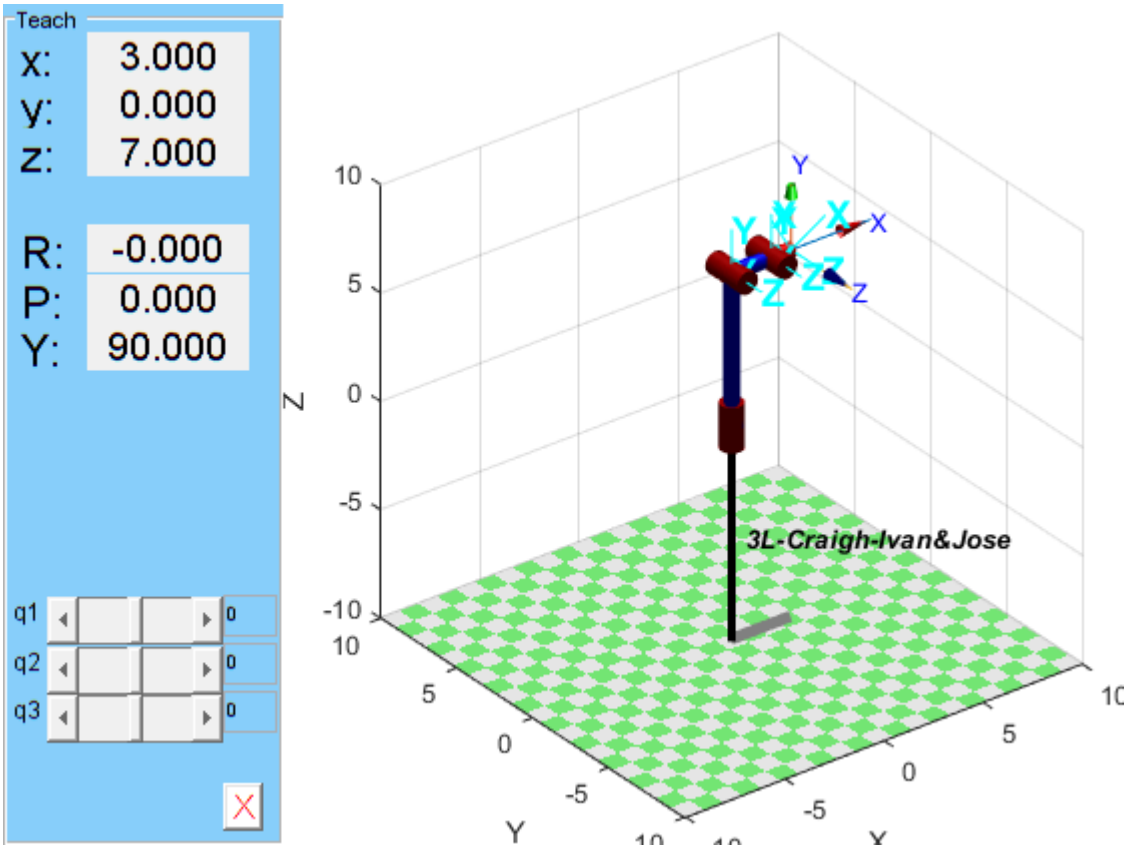
```
T_S_T_b = 4×4
     0     0     1     5
    -1     0     0    -7
     0    -1     0     0
     0     0     0     1
```

```
trplot(T_2_3_b, 'length', 2, 'width', 0.5, 'color', 'red', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_1_2_b, 'length', 2, 'width', 0.5, 'color', 'red', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_0_1_b, 'length', 2, 'width', 0.5, 'color', 'red', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
hold off
```



c) (0,π/2,π/6)

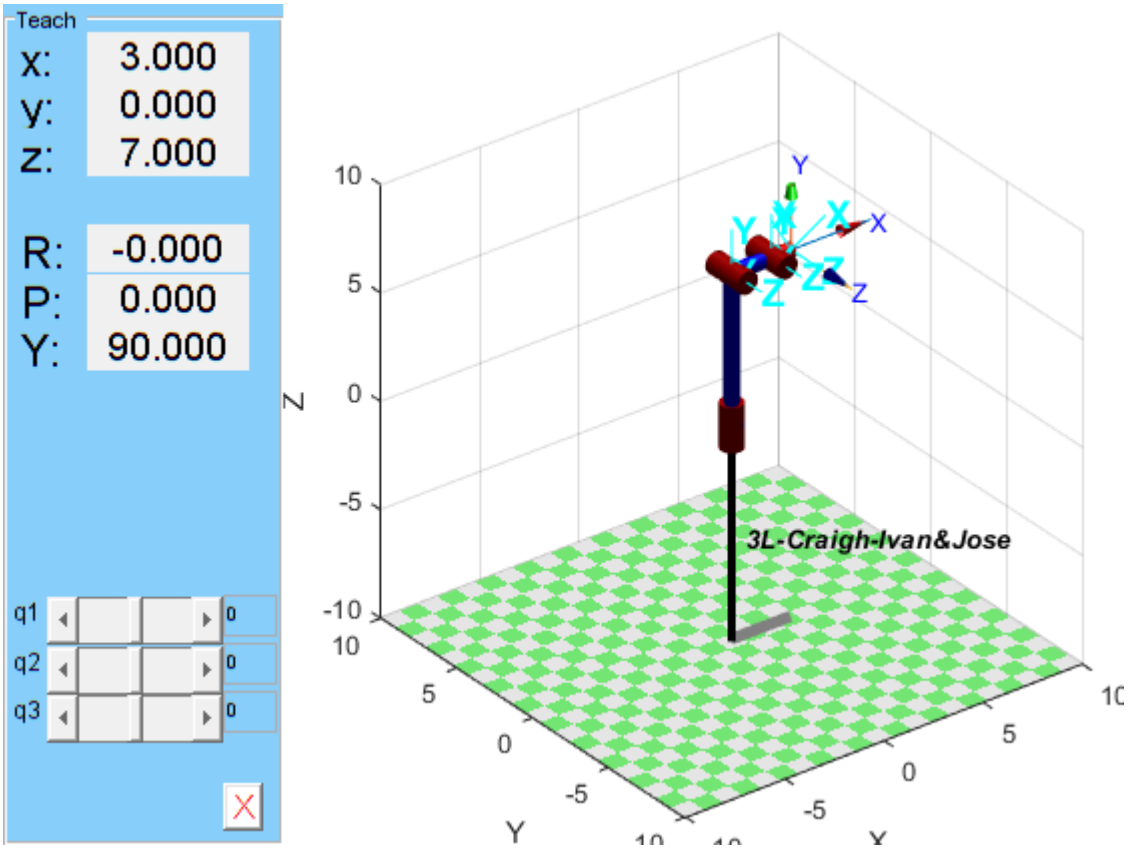
```
clf
p3LCraigh.teach
```




```
hold on
T_2_3_c = T_2_3 * trotz(0);
T_1_2_c = T_1_2 * trotz(pi/2);
T_0_1_c = T_0_1 * trotz(pi/6);

T_S_T_c = T_0_1_c * T_1_2_c * T_2_3_c
```

```
T_S_T_c = 4×4
         0    0.5000    0.8660    8.2321
   -1.0000         0         0   -7.0000
         0   -0.8660    0.5000    1.9378
         0         0         0    1.0000
```

```
trplot(T_2_3_c, 'length', 2, 'width', 0.5, 'color', 'cyan', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_1_2_c, 'length', 2, 'width', 0.5, 'color', 'cyan', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
trplot(T_0_1_c, 'length', 2, 'width', 0.5, 'color', 'cyan', 'text_opts',
{'FontSize', 14, 'FontWeight', 'bold'})
```



Used Functions

```
function T_b_a=link_A_B_Std(alpha,a,d,theta)
T_b_a=trotz(theta)*transl(0,0,d)*transl(a,0,0)*trotx(alpha);
end
```