

## Forward Kinematics TODO

1) Derive the DH-Std parameters and the neighbouring homogeneous transformation matrices , for  $i=1,2,3$ , as functions of the joint angles. Draw the joint frames.

```
clear
mdl_3link3d
R3
```

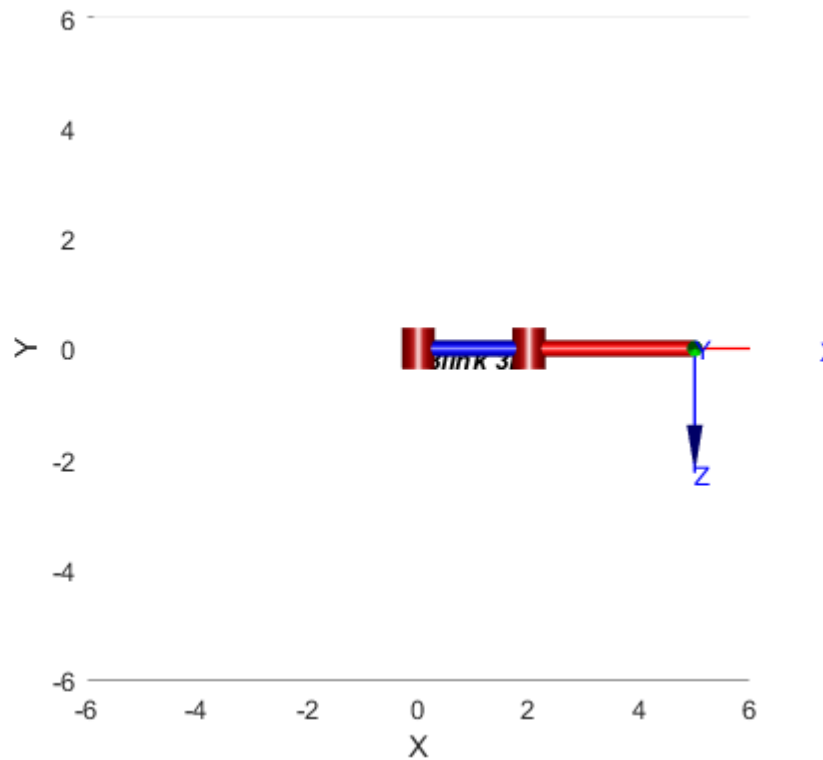
R3 =

```
3link 3D (3 axis, RRR, stdDH, fastRNE)
Spong p106;
```

| j | theta | d | a | alpha | offset |
|---|-------|---|---|-------|--------|
| 1 | q1    | 1 | 0 | 1.571 | 0      |
| 2 | q2    | 0 | 2 | 0     | 0      |
| 3 | q3    | 0 | 3 | 0     | 0      |

```
grav =    0  base = 1  0  0  0  tool = 1  0  0  0
          0      0  1  0  0      0  1  0  0
        9.81    0  0  1  0      0  0  1  0
              0  0  0  1      0  0  0  1
```

```
R3.plot([0 0 0])      % Mueve el brazo
R3.teach
```

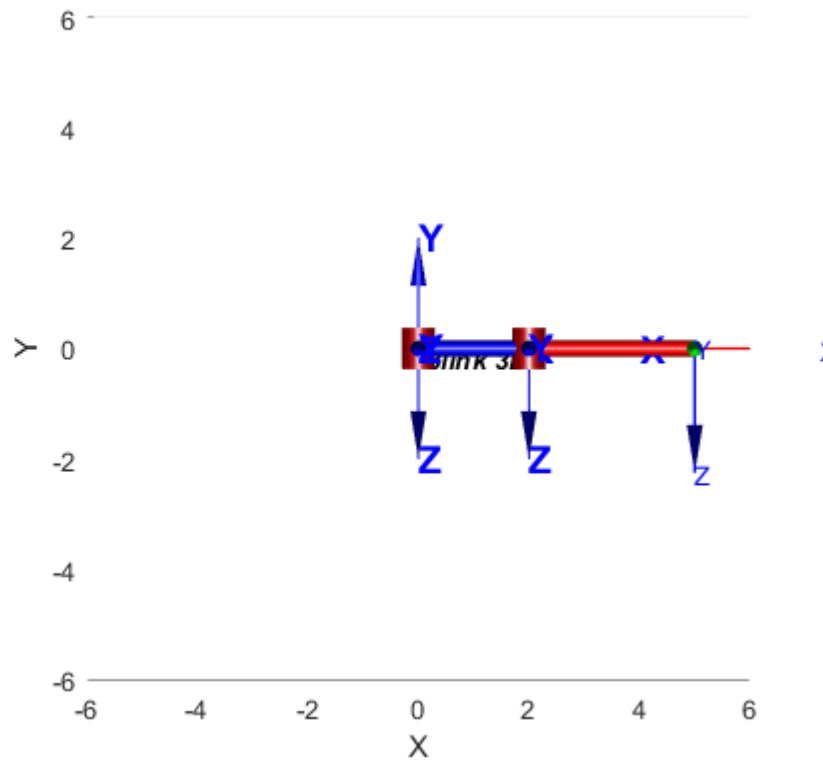


```

T4 = eye(4);
T3_4 = T4 * link_A_B_Std(R3.links(1).alpha, R3.links(1).a, R3.links(1).d, R3.links(1).theta);
T2_3 = T3_4 * link_A_B_Std(R3.links(2).alpha, R3.links(2).a, R3.links(2).d, R3.links(2).theta);
T1_2 = T2_3 * link_A_B_Std(R3.links(3).alpha, R3.links(3).a, R3.links(3).d, R3.links(3).theta);

hold on
trplot(T4, 'length', 2, 'arrow', 'width', 0.5, 'color', 'b', ...
       'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T3_4, 'length', 2, 'arrow', 'width', 0.5, 'color', 'b', ...
       'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T2_3, 'length', 2, 'arrow', 'width', 0.5, 'color', 'b', ...
       'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
hold off

```



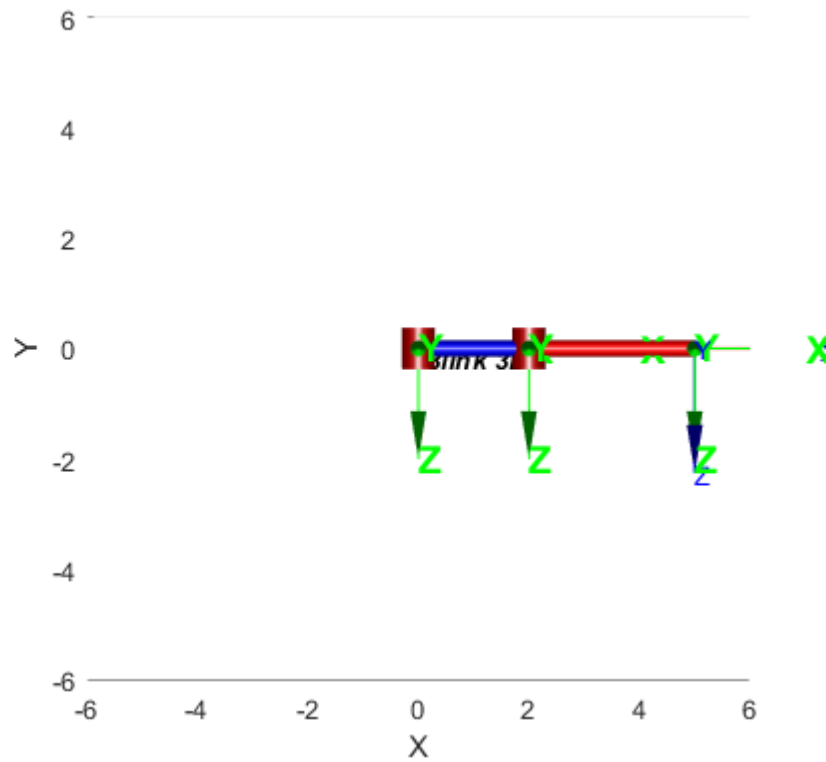
```
% Already represented
% trplot(T1, 'length', 2, 'arrow', 'width', 0.5, 'color','b', ...
%         'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
```

**3) Calculate the result for the following joint angles:  $(0, 0, 0)$ ,  $(0, \pi/2, 0)$ , and  $(0, \pi/2, \pi/6)$ .**

$(0, 0, 0)$

```
clf
R3.teach
hold on
T3_4_fw1 = T3_4 * trotz(0);
T2_3_fw2 = T2_3 * trotz(0);
T1_2_fw3 = T1_2 * trotz(0);

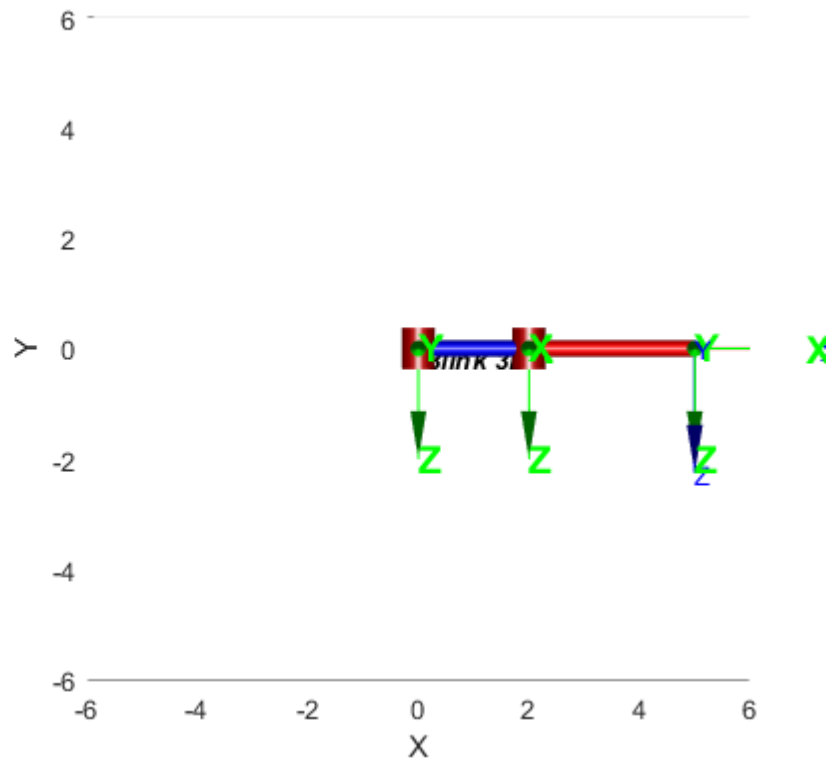
trplot(T3_4_fw1, 'length', 2, 'arrow', 'width', 0.5, 'color','g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T2_3_fw2, 'length', 2, 'arrow', 'width', 0.5, 'color','g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T1_2_fw3, 'length', 2, 'arrow', 'width', 0.5, 'color','g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
```



$(0, \pi/2, 0)$

```
clf
R3.teach
hold on
T3_4_fw1 = T3_4 * troz(0);
T2_3_fw2 = T2_3 * troz(pi/2);
T1_2_fw3 = T1_2 * troz(0);

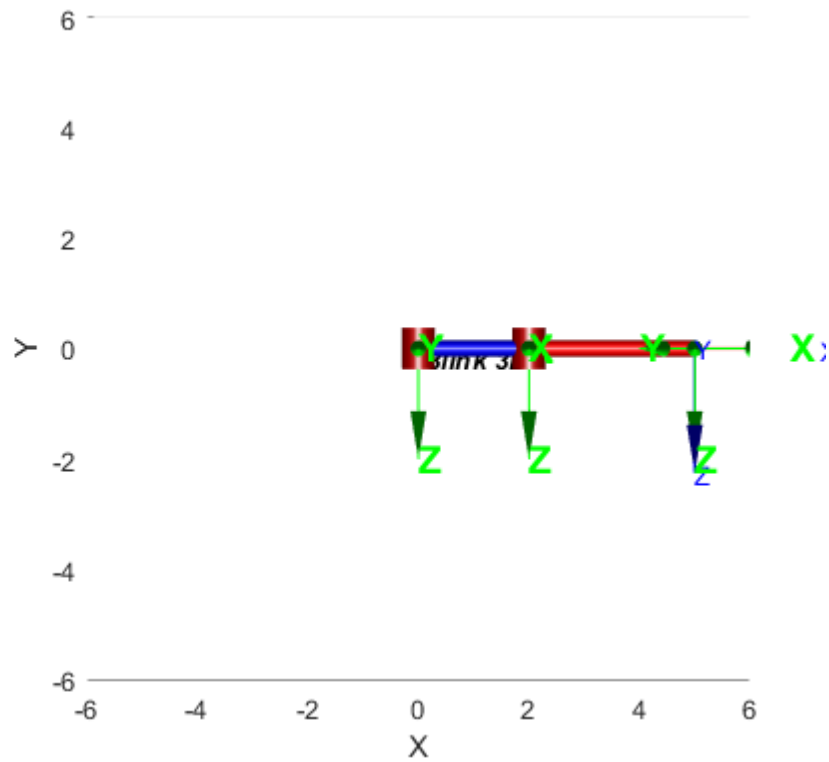
trplot(T3_4_fw1, 'length', 2, 'arrow', 'width', 0.5, 'color', 'g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T2_3_fw2, 'length', 2, 'arrow', 'width', 0.5, 'color', 'g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T1_2_fw3, 'length', 2, 'arrow', 'width', 0.5, 'color', 'g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
```



$(0, \pi/2, \pi/6)$

```
clf
R3.teach
hold on
T3_4_fw1 = T3_4 * troz(0);
T2_3_fw2 = T2_3 * troz(pi/2);
T1_2_fw3 = T1_2 * troz(pi/6);

trplot(T3_4_fw1, 'length', 2, 'arrow', 'width', 0.5, 'color','g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T2_3_fw2, 'length', 2, 'arrow', 'width', 0.5, 'color','g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
trplot(T1_2_fw3, 'length', 2, 'arrow', 'width', 0.5, 'color','g', ...
        'text_opts', {'FontSize', 14, 'FontWeight', 'bold'})
```



## Functions in the mlx

Put at the end all specific function that clarify the code.

```
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
```