

FK with MATLAB



Based on :MATLAB 2011 and Robotic Toolbox V8.0

Recommended

rotx, roty, rotz: compute rotation matrix

transl: compute translation matrix

r2t : rotation matrix to homogenous matrix

round: to round off number

link: construct robot link object based on DH

robot: construct a robot object

fkine: compute forward kinematics

plot : plot/ animation robot

drivebot: plot/ animation robot with variables

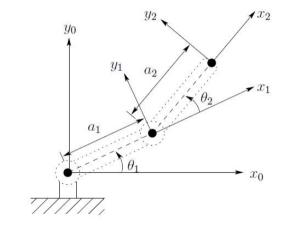
FK: 2 links manipulator using MATLAB



Link	a_i	$ \alpha_i $	d_i	θ_i
1	a_1	0	0	θ_1^*
2	a_2	0	0	θ_2^*

$$A_{1} = \begin{bmatrix} c_{1} & -s_{1} & 0 & a_{1}c_{1} \\ s_{1} & c_{1} & 0 & a_{1}s_{1} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_{2} = \begin{bmatrix} c_{2} & -s_{2} & 0 & a_{2}c_{2} \\ s_{2} & c_{2} & 0 & a_{2}s_{2} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$



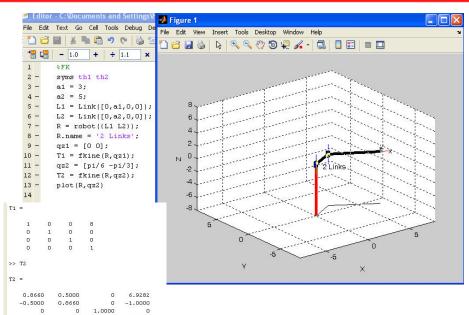
$$T_1^0 = A_1$$

$$T_2^0 = A_1 A_2 = \begin{bmatrix} c_{12} & -s_{12} & 0 & a_1 c_1 + a_2 c_{12} \\ s_{12} & c_{12} & 0 & a_1 s_1 + a_2 s_{12} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

FK: 2 links manipulator using MATLAB

1.0000

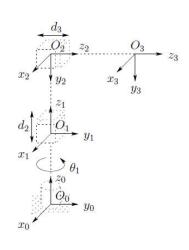




FK: RPP using MATLAB



Link	a _i	α_i	d _i	ą
1	0	0	0 (offset)	\mathcal{G}_{1}^{ullet}
2	0	-90°	d_2^*	0
3	0	0	d_3^{\star}	0



*: denote variables

FK: RPP using MATLAB



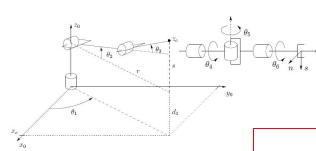
```
Link
                              \alpha
                                                           а
  1
                Λ
                              0
                                                           \theta_{i}^{*}
                                         (offset)
 2
                0
                             -90°
                                             ď,
                                                           0
  3
                                             ď.
                0
                               0
                                                            0
```

```
%FK RPP
       %DH alpha a theta D
       syms thi d2 d3
      L1 = Link([0,0,th1,0]);
      L2 = Link([-pi/2,0,0,d2,1]);
      L3 = Link([0,0,0,d3,1]);
      R = robot({L1 L2 L3});
     qz =[th1 d2 d3];
      T1 = fkine(R,qz)
10
11
FK 2A.m
       × FK_3.m ×
                                       script
   T1 =
    cos(th1), 0, -sin(th1), -d3*sin(th1)]
     sin(th1), 0, cos(th1), d3*cos(th1)]
           0, -1, 0,
                                       d21
           0, 0,
                          0.
                                        11
```

*: denote variables

FK: RRR with 3 DOF Wrist using MATLAB





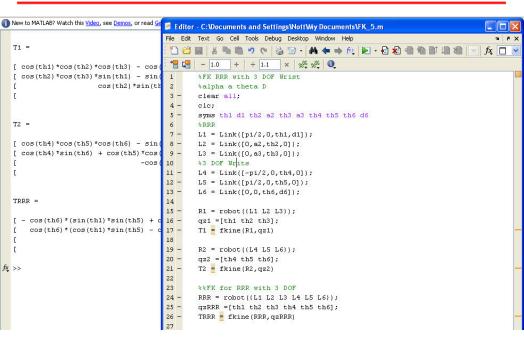
RRR

Link	a_i	α_i	d_i	θ_i
1	0	90	d_1	θ
2	a_2	0	0	θ_{2}^{*}
3	a_3	0	0	θ_{2}^{s}

Wrist
$$R_6^3 = A_4 A_5 A_6 = \begin{bmatrix} c_4 c_5 c_6 - s_4 s_6 & -c_4 c_5 s_6 - s_4 c_6 & c_4 s_5 \\ s_4 c_5 c_6 + c_4 s_6 & -s_4 c_5 s_6 + c_4 c_6 & s_4 s_5 \\ -s_5 c_6 & s_5 s_6 & c_5 \end{bmatrix}$$

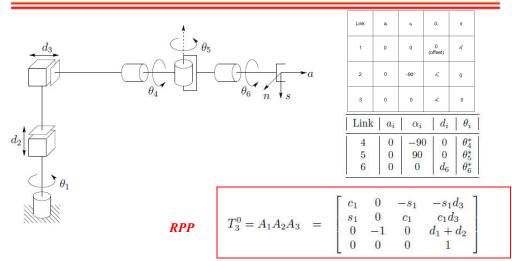
FK: RRR with 3 DOF Wrist using MATLAB





FK: RPP with 3 DOF Wrist using MATLAB





 $c_4 s_5 d_6$ $c_4c_5c_6 - s_4s_6 - c_4c_5s_6 - s_4c_6$ $c_{4}s_{5}$ $s_4 s_5 d_6$ $s_4c_5c_6 + c_4s_6 - s_4c_5s_6 + c_4c_6$ 8485 $T_6^3 = A_4 A_5 A_6 =$ Wrist c_5d_6 8586 c_5

FK: RPP with 3 DOF Wrist using MATLAB



Link	a	αį	di	q
1	0	0	0 (offset)	e,
2	0	-90°	d ₂ *	0
3	0	0	d ₃ *	0

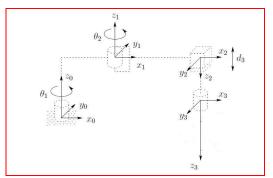
Link	a_i	α_i	d_i	θ_i
4	0	-90	0	θ_4^*
5	0	90	0	θ_5^*
6	0	0	d_6	θ_6^*
			(c)	

```
%FK RPP with 3 DOF Wrist
       %alpha a theta D
       syms thi d2 d3 th4 th5 th6 d6
       &RPP
       L1 = Link([0,0,th1,0]);
       L2 = Link([-pi/2,0,0,d2,1]);
       L3 = Link([0,0,0,d3,1]);
       %3 DOF Writs
       L4 = Link([-pi/2, 0, th4, 0]);
10 -
       L5 = Link([pi/2,0,th5,0]);
       L6 = Link([0,0,th6,d6]);
11 -
12
13
       %%FK for RPP with 3 DOF
14 -
       RPP = robot((L1 L2 L3 L4 L5 L6));
15 -
       qzRPP =[th1 d2 d3 th4 th5 th6];
       TRPP = fkine(RPP, gzRPP)
16 -
17
```

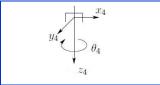
FK: RRP (SCARA) with 1 DOF Wrist using MATLAB



RRP



Link	a_i	α_i	d_i	θ_i
1	a_1	0	0	θ^{\star}
2	a_2	180	0	θ^{\star}
3	0	0	d^{\star}	0
4	0	0	d_4	θ^{\star}



1 DOF Wrist Mechanism

FK: RRP (SCARA) with 1 DOF Wrist using MATLAB



Link	a_i	α_i	d_i	θ_i
1	a_1	0	0	θ^{\star}
2	a_2	180	0	θ^{\star}
3	0	0	d^{\star}	0
4	0	0	d_4	θ^{\star}

```
%FK RRP with 1 DOF Wrist
%alpha a theta D
syms a1 a2 th1 th2 d3 d4 th4
% RRP
L1 = Link([0,a1,th1,0]);
L2 = Link([pi,a2,th2,0]);
L3 = Link([0,0,0,d3,1]);
%1 DOF Wrist
L4 = Link([0,0,th4,d4]);
%%FK for RRP with 1 DOF Wrist
RRP = robot({L1 L2 L3 L4});
qzRRP =[th1 th2 0 th4];
TRRP = fkine(RRP,qzRRP)
```