3 Arm Kinematics

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September 5, 2014

Source Code

../../func/fkin.m

```
1  #forward kinematics for a N joint endeffector
2  function [r,theta,gamma] = fkin(A)
3
4          gamma = 0;
5          z = 0;
6          for i = 1:columns(A)
7                  gamma += A(2,i);
8                  z += A(1,i)*[cos(gamma); sin(gamma)];
9          endfor
10
11         #store the length and theta for p
12         r = sqrt(z(1)^2+z(2)^2);
13         theta = atan2(z(2),z(1));
14 endfunction
```

../../func/rkin.m

```
1  #reverse kinematics for a two joint endofactor
2  #returns NaN if p and l are invalid values
3  function T = rkin(p,l)
4
5          #find location of last joint
6          x = p(1);
7          y = p(2);
8          a = l(1);
9          b = l(2);
10
11         #solve for theta2
12         d = 2*a*b;
13         f = x^2+y^2-a^2-b^2;
14
15         #check for impossible values
16         if (f > d)
17                 T = NaN
18                 return
19         endif
20
```

```
21          c2 = f/d;
22          theta2 = acos(c2);
23
24          s2 = sin(theta2);
25
26          #solve for theta1
27          A = [a + b*c2, -b*s2,p(1); b*s2, a+b*c2,p(2)];
28
29          r = rref(A)*[0;0;1];
30
31          theta1 = atan2(r(2),r(1));
32
33          #solve for thetb1,2
34          thetb1 = 2*atan2(p(2),p(1))-theta1;
35          thetb2 = -theta2;
36
37          T = [theta1,thetb1;theta2,thetb2];
38  endfunction
```

../../func/rkin3.m

```
1   function A = rkin3(p,gamma,l)
2
3           #find q for 2R kin solution
4           q = p-l(3)*[cos(gamma); sin(gamma)];
5
6           #solve for theta1 and 2
7           T = rkin(q,[l(1);l(2)]);
8
9           #check for invalid values
10          if (T == NaN)
11                  A = NaN
12                  return
13          endif
14
15          #solve for theta3s
16          t31 = gamma-(T(1,1)+T(2,1));
17          t32 = gamma-(T(1,2)+T(2,2));
18
19          #append to solution matrix
20          A = [T;t31,t32];
21  endfunction
```

../../script/asn4.m

```
1   S = [   1,  1,  1;
2                   -pi/6,pi/4,pi/3]
3
4
5   [r,t,g] = fkin(S)
6
7   rx = r*cos(t)
8   ry = r*sin(t)
```

```
9
10 A = rkin3([rx;ry],S(2,1)+S(2,2)+S(2,3),[S(1,1);S(1,2);S(1,3)])
11
12 [r1,t1,g1] = fkin([S(1,1),S(1,2),S(1,3);A(1,1),A(2,1),A(3,1)])
13 [r2,t2,g2] = fkin([S(1,1),S(1,2),S(1,3);A(1,2),A(2,2),A(3,2)])
```

Output of asn4.m

```
octave:1> asn4
S =

   1.00000   1.00000   1.00000
  -0.52360   0.78540   1.04720

r =  2.2128
t =  0.33368
g =  1.3090
rx =  2.0908
ry =  0.72474
A =

  -0.52360   0.26180
   0.78540  -0.78540
   1.04720   1.83260

r1 =  2.2128
t1 =  0.33368
g1 =  1.3090
r2 =  2.2128
t2 =  0.33368
g2 =  1.3090
octave:2>
```