tea_arm_5d

January 6, 2022

[ ]:
```
import sympy
import numpy as np

## Transform function using Euler angle (RPY)(zyx)
def transform(x, y, z, alpha, beta, gamma):
    ca = sympy.cos(alpha)
    sa = sympy.sin(alpha)
    cb = sympy.cos(beta)
    sb = sympy.sin(beta)
    cg = sympy.cos(gamma)
    sg = sympy.sin(gamma)
    trans = sympy.Matrix([[1, 0, 0, x], [0, 1, 0, y], [0, 0, 1, z], [0, 0, 0,␣
 ↪1]])
    rotat_x = sympy.Matrix(
        [
            [1,0,0, 0],
            [0,ca,-sa, 0],
            [0,sa,ca, 0],
            [0, 0, 0, 1],
        ]
    )
    rotat_y = sympy.Matrix(
        [
            [cb,0,sb, 0],
            [0,1,0, 0],
            [-sb,0,cb, 0],
            [0, 0, 0, 1],
        ]
    )
    rotat_z = sympy.Matrix(
        [
            [cg,-sg,0, 0],
            [sg,cg,0, 0],
            [0,0,1, 0],
            [0, 0, 0, 1],
        ]
    )
```

```
    return trans*rotat_z*rotat_y*rotat_x
x,y,z,alpha,beta,gamma=sympy.symbols('x,y,z,alpha,beta,gamma')
transform(x,y,z,alpha,beta,gamma)
```

[ ]:

$$\begin{bmatrix} \cos(\beta)\cos(\gamma) & \sin(\alpha)\sin(\beta)\cos(\gamma)-\sin(\gamma)\cos(\alpha) & \sin(\alpha)\sin(\gamma)+\sin(\beta)\cos(\alpha)\cos(\gamma) & x \\ \sin(\gamma)\cos(\beta) & \sin(\alpha)\sin(\beta)\sin(\gamma)+\cos(\alpha)\cos(\gamma) & -\sin(\alpha)\cos(\gamma)+\sin(\beta)\sin(\gamma)\cos(\alpha) & y \\ -\sin(\beta) & \sin(\alpha)\cos(\beta) & \cos(\alpha)\cos(\beta) & z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

[ ]:

```
## Just test
a=transform(0,0,0,0,0,0)
T=transform(1,1,1,sympy.pi/2,0,sympy.pi/2)
T2=transform(1,1,1,0,0,0)
a*T*T2
```

[ ]:

$$\begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

[ ]:

```
## 5 degree arm simulation (forward kinematics)
pi=sympy.pi
base=transform(0.066972, -0.052 ,1.9,pi/2,0,0)
x,y,z,theta1,theta2,d1,d2,d3,d4,d5,d6=sympy.
 ↪symbols('x,y,z,theta1,theta2,d1,d2,d3,d4,d5,d6')
x_joint=transform(0.066972, -0.052 ,-0.071717,pi,pi/2,0)
x_move=transform(x,0,0,0,0,0)
y_joint=transform(0.0755, 0, 0.18051,pi/2,pi/2,0)
y_move=transform(-y,0,0,0,0,0)
z_joint=transform(0.0755 ,0.0375, -0.15871,pi/2,0,pi/2)
z_move=transform(0,z,0,0,0,0)
a_joint=transform(0 ,-0.418, -0.027,-pi/2,0,pi)
a_move=transform(0,0,0,0,0,theta1)
b_joint=transform(0.012265, 0.014063, 0.079591,pi/2,0,pi)
b_move=transform(0,0,0,theta2,0,0)
#␣
 ↪base*x_move*x_joint*y_move*y_joint*z_move*z_joint*a_move*a_joint*b_move*b_joint
final=base*x_joint*x_move*y_joint*y_move*z_joint*z_move*a_joint*a_move*b_joint*b_move
final
```

[ ]:

$$\begin{bmatrix} \sin(\theta_1) & -\sin(\theta_2)\cos(\theta_1) & -\cos(\theta_1)\cos(\theta_2) & -y-0.012265\sin(\theta_1)-0.014063\cos(\theta_1)+0.001934 \\ \cos(\theta_1) & \sin(\theta_1)\sin(\theta_2) & \sin(\theta_1)\cos(\theta_2) & x+0.014063\sin(\theta_1)-0.012265\cos(\theta_1)+0.132717 \\ 0 & -\cos(\theta_2) & \sin(\theta_2) & z+1.191699 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$