

Robotics Project

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介面說明

使用Matlab2019b開發，直接使用matlab執行即可。

程式架構說明

Forward :

- 輸入6個角度
- 代入a2,a3
- 算出A1~A6
- 算出x,y,z,phi,theta,psi

backward :

- 輸入N,O,A,P
- 代入a2,a3,d3,d4
- 分別利用講義的公式求出theta1~theta6
- 將每個答案輸入ans矩陣
- 印出每個解答

數學運算說明

Forward :

$$T6 = A1 * A2 * A3 * A4 * A5 * A6$$

$$x = (a2 * \cos(\theta_2) + a3 * \cos(\theta_2 + \theta_3)) * \cos(\theta_1)$$

$$y = (a2 * \cos(\theta_2) + a3 * \cos(\theta_2 + \theta_3)) * \sin(\theta_1)$$

$$z = -a2 * \sin(\theta_2) - a3 * \sin(\theta_2 + \theta_3)$$

$$\phi = \text{atan}(T6(10)/T6(9))$$

$$\theta = \text{atan}((\cos(\phi) * T6(9) + \sin(\phi) * T6(10))/T6(11))$$

$$\psi = \text{atan}((- \sin(\phi) * T6(1) + \cos(\phi) * T6(2))/(- \sin(\phi) * T6(5) + \cos(\phi) * T6(6)))$$

Backward :

θ_1 :

$$Fi\theta_{1\sim4} = \text{atan}(d3/((px^2 + py^2 - d3^2)^{0.5}))$$

$$Fi\theta_{5\sim8} = \text{atan}(d3/(-(px^2 + py^2 - d3^2)^{0.5}))$$

$$\theta_{1\sim8} = \text{atan}(py/px) - Fi\theta_{1\sim8};$$

θ3

```
M = (px^2 + py^2 + pz^2 - a2^2 - a3^2 - d3^2 - d4^2)/(2*a2)
theta_3s(1) = sqrt(a3^2+d4^2-M^2)
theta_3s(2) = -sqrt(a3^2+d4^2-M^2)
theta_3(1~4) = atan2(M/(theta_3s(12為1,34為2))-atan2(a3,d4))
theta_3(5~8) = atan2(M/(theta_3s(56為1,78為2))-atan2(a3,d4))
```

θ2

i 從1到8

```
m1 = px*cosd(theta_1(i)) + py*sind(theta_1(i))
m2 = pz
n1 = pz
n2 = m1
z1 = a3 + a2*cosd(theta_3(i))
z2 = d4 + a2*sind(theta_3(i))
x = (z1*n2 + z2*n1)/(m1*n2 + m2*n1)
y = (z2*m1 - z1*m2)/(n2*m1 + n1*m2)
theta_2(i) = atan2d(y,x) - theta_3(i)
```

θ4

i = 1,3,5,7

```
c1 = cos(theta_1(i));
c2 = cos(theta_2(i));
c3 = cos(theta_3(i));
s1 = sin(theta_1(i));
s2 = sin(theta_2(i));
s3 = sin(theta_3(i));代入求A1,A2,A3
```

```
A1 = [c1 0 -s1 0;
      s1 0 c1 0;
      0 -1 0 0;
      0 0 0 1];
A2 = [c2 -s2 0 a2*c2;
      s2 c2 0 a2*s2;
      0 0 1 0;
      0 0 0 1];
A3 = [c3 0 s3 a3*c3;
      s3 0 -c3 a3*s3;
      0 1 0 d3;
      0 0 0 1];
```

```
T3_6 = inverse(A3)*inverse(A2)*inverse(A1)*C_P;
theta_4(i) = atan2d(T3_6(2,3),T3_6(1,3));
```

再處理i = 2,4,6,8

```
c1 = cos(theta_1(i))
c2 = cos(theta_2(i))
```

```

c3 = cos(theta_3(i))
s1 = sin(theta_1(i))
s2 = sin(theta_2(i))
s3 = sin(theta_3(i))

A1 = [c1  0 -s1  0
      s1  0  c1  0
      0 -1  0  0
      0  0  0  1 ]
A2 = [c2 -s2  0 a2*c2
      s2  c2  0 a2*s2
      0  0  1  0
      0  0  0  1 ]
A3 = [c3 0  s3 a3*c3
      s3 0 -c3 a3*s3
      0 1  0  d3
      0 0  0  1 ]
T3_6 = inverse(A3)*inverse(A2)*inverse(A1)*C_P
theta_4(i) = atan((-T3_6(2,3))/(-T3_6(1,3)))

```

θ5

```

c1 = cos(theta_1(1~8))
c2 = cos(theta_2(1~8))
c3 = cos(theta_3(1~8))
c4 = cos(theta_4(1~8))
s1 = sin(theta_1(1~8))
s2 = sin(theta_2(1~8))
s3 = sin(theta_3(1~8))
s4 = sin(theta_4(1~8))代入求A1,A2,A3

```

用inverse(同上)算出T46

裡面第三行的1,2列相除取arctan即可求得

θ6

一樣代入求得A1,A2,A3後用inverse求得T36

取第三行1,2列相除求得

最後依序把8組答案顯示出來