**0BÀI TẬP VỀ NHÀ**

**MÔN KỸ THUẬT ROBOT**

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**MSSV:20146181**

**Bài 1:**

Po = L(0,0,l1).L(0,l2,0).L(l3,0,0).R(;).L(l4,0,0).R(;).R(;). L(l5,0,0).P

L1 = [1, 0, 0, 0]  
[0, 1, 0, 0]  
[0, 0, 1, l1]  
[0, 0, 0, 1]

L2 = [1, 0, 0, 0]  
[0, 1, 0, l2]  
[0, 0, 1, 0]  
[0, 0, 0, 1]

L3 = [1, 0, 0, l3]  
[0, 1, 0, 0]  
[0, 0, 1, 0]  
[0, 0, 0, 1]

L4 = [1, 0, 0, l4]  
[0, 1, 0, 0]  
[0, 0, 1, 0]  
[0, 0, 0, 1]

L5 = [1, 0, 0, l5]  
[0, 1, 0, 0]  
[0, 0, 1, 0]  
[0, 0, 0, 1]

R4 = [1, 0, 0, 0]  
[0, cos(r4), -sin(r4), 0]  
[0, sin(r4), cos(r4), 0]  
[0, 0, 0, 1]

R5= [ cos(r5), 0, -sin(r5), 0]  
[ 0, 1, 0, 0]  
[-sin(r5), 0, cos(r5), 0]  
[ 0, 0, 0, 1]

R6= [cos(r6), -sin(r6), 0, 0]  
[sin(r6), cos(r6), 0, 0]  
[ 0, 0, 1, 0]  
[ 0, 0, 0, 1]

Po= [cos(r5)\*cos(r6),-cos(r5)\*sin(r6),sin(r5),l3+l4+l5\*cos(r5)\*cos(r6)]  
[cos(r4)\*sin(r6)+cos(r6)\*sin(r4)\*sin(r5),cos(r4)\*cos(r6)-sin(r4)\*sin(r5)\*sin(r6), -cos(r5)\*sin(r4),l2+l5\*(cos(r4)\*sin(r6)+cos(r6)\*sin(r4)\*sin(r5))]  
[sin(r4)\*sin(r6)-cos(r4)\*cos(r6)\*sin(r5),cos(r6)\*sin(r4)+cos(r4)\*sin(r5)\*sin(r6), cos(r4)\*cos(r5),l1+l5\*(sin(r4)\*sin(r6)-cos(r4)\*cos(r6)\*sin(r5))]  
[0,0,0,1]

Px= l3+l4+l5\*cos(r5)\*cos(r6)

Py= l2+l5\*(cos(r4)\*sin(r6)+cos(r6)\*sin(r4)\*sin(r5))

Pz= l1+l5\*(sin(r4)\*sin(r6)-cos(r4)\*cos(r6)\*sin(r5))

Code

L1 =5;

L2 = 3;

L3=8;

L4=6;

L5=3;

syms r4 r5 r6

for r4=0:0.1:2\*3.14\*2

for r5=0:0.1:3.14

for r6=0:0.1:3.14\*2

px=L3+L4+L5\*cos(r5)\*cos(r6);

py = L2+L5\*(cos(r4)\*sin(r6)+cos(r6)\*sin(r4)\*sin(r5));

pz= L2+L5\*(sin(r4)\*sin(r6) - cos(r4)\*cos(r6)\*sin(r5));

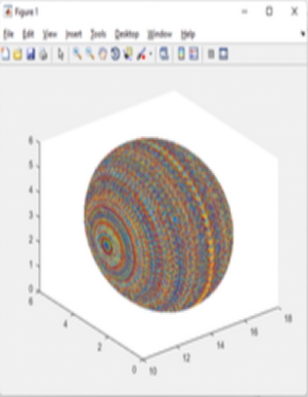
plot3(px,py,pz,'\*');

hold on;

end

end

end



**Bài 2:**

syms t1 t2 l1 l2 l3 l4 l5;

Tz1=[1 0 0 0; 0 1 0 0; 0 0 1 l1; 0 0 0 1];

Rz1=[cos(t1) -sin(t1) 0 0; sin(t1) cos(t1) 0 0; 0 0 1 0; 0 0 0 1];

Tx2=[1 0 0 l2; 0 1 0 0; 0 0 1 0; 0 0 0 1];

Rz2=[cos(t2) -sin(t2) 0 0; sin(t2) cos(t2) 0 0; 0 0 1 0; 0 0 0 1];

Tz3=[1 0 0 0; 0 1 0 0; 0 0 1 l3; 0 0 0 1];

Tx4=[1 0 0 l4; 0 1 0 0; 0 0 1 0; 0 0 0 1];

Tz5=[1 0 0 0; 0 1 0 0; 0 0 1 -l5; 0 0 0 1];

P=[0; 0; 0; 1];

simplify(T1\*P1\*T2\*P2\*T3\*T4\*T5\*P)

Kết quả:

Px=l4\*cos(t1 + t2) + l2\*cos(t1)

Py=l4\*sin(t1 + t2) + l2\*sin(t1)

Pz=l1 + l3 - l5

Code:

syms t1 t2 pi;

l1=40; l2=50; l3=10; l4=50; l5=40; s=10;

title(‘ Do thi vung lam viec robot bai 2-Mai cong Kiet-20146190 ‘)

for t1=0:0.1:pi/2

for t2=0:0.1:pi/2

x= l4\*cos(t1 + t2) + l2\*cos(t1);

y= l4\*sin(t1 + t2) + l2\*sin(t1);

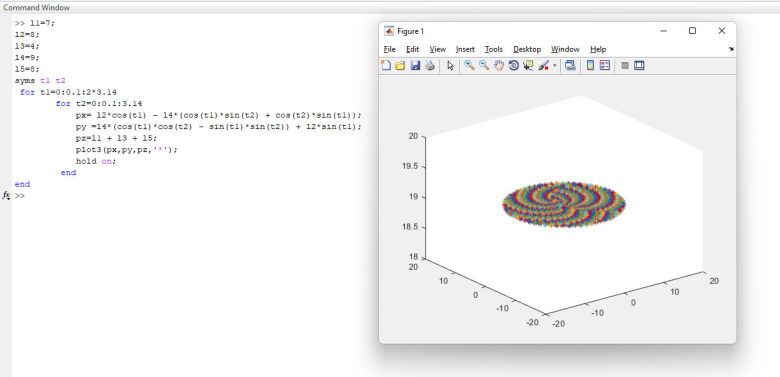
z= l1 + l3 - l5;

plot3(x,y,z,'\*');

hold on

end

end



**Bài 3:**

Po = L(0;0;L1).R(;).L(L2;0;0).L(0;0;L3).R(;).L(0;L4;0).L(0;0;L5).P

l1 =[1, 0, 0, 0]

[0, 1, 0, 0]

[0, 0, 1, L1]

[0, 0, 0, 1]

T1 =[cos(t1), -sin(t1), 0, 0]

[sin(t1), cos(t1), 0, 0]

[ 0, 0, 1, 0]

[ 0, 0, 0, 1]

l2 =[1, 0, 0, L2]

[0, 1, 0, 0]

[0, 0, 1, 0]

[0, 0, 0, 1]

T2 =[ cos(t2), 0, sin(t2), 0]

[ 0, 1, 0, 0]

[-sin(t2), 0, cos(t2), 0]

[ 0, 0, 0, 1]

l3 =[1, 0, 0, 0]

[0, 1, 0, L3]

[0, 0, 1, 0]

[0, 0, 0, 1]

l4 =[1, 0, 0, L4]

[0, 1, 0, 0]

[0, 0, 1, 0]

[0, 0, 0, 1]

T3 =[cos(t3), -sin(t3), 0, 0]

[sin(t3), cos(t3), 0, 0]

[ 0, 0, 1, 0]

[ 0, 0, 0, 1]

l8 =[1, 0, 0, 0]

[0, 1, 0, 0]

[0, 0, 1, L8]

[0, 0, 0, 1]

l5 =[1, 0, 0, L5]

[0, 1, 0, 0]

[0, 0, 1, 0]

[0, 0, 0, 1]

T4 =[ cos(t4), 0, sin(t4), 0]

[ 0, 1, 0, 0]

[-sin(t4), 0, cos(t4), 0]

[ 0, 0, 0, 1]

l6 =[1, 0, 0, 0]

[0, 1, 0, L6]

[0, 0, 1, 0]

[0, 0, 0, 1]

l7 =[1, 0, 0, L7]

[0, 1, 0, 0]

[0, 0, 1, 0]

[0, 0, 0, 1]

Px = L2\*cos(t1) - L6\*(cos(t3)\*sin(t1) + cos(t1)\*cos(t2)\*sin(t3)) - L5\*(sin(t1)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) - L3\*sin(t1) - L7\*(cos(t4)\*(sin(t1)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) + cos(t1)\*sin(t2)\*sin(t4)) + L4\*cos(t1)\*cos(t2) + L8\*cos(t1)\*sin(t2)

Py = L5\*(cos(t1)\*sin(t3) + cos(t2)\*cos(t3)\*sin(t1)) + L6\*(cos(t1)\*cos(t3) - cos(t2)\*sin(t1)\*sin(t3)) + L3\*cos(t1) + L2\*sin(t1) + L7\*(cos(t4)\*(cos(t1)\*sin(t3) + cos(t2)\*cos(t3)\*sin(t1)) - sin(t1)\*sin(t2)\*sin(t4)) + L4\*cos(t2)\*sin(t1) + L8\*sin(t1)\*sin(t2)

Pz = L1 - L7\*(cos(t2)\*sin(t4) + cos(t3)\*cos(t4)\*sin(t2)) + L8\*cos(t2) - L4\*sin(t2) - L5\*cos(t3)\*sin(t2) + L6\*sin(t2)\*sin(t3)

Code

l1= 5;

l2=5;

l3=3;

l4=4;

l5=3;

l6=2;

l7=3;

l8=2;

syms t1 t2 t3 t4

for t1=0:0.1:2\*3.14

for t2=0:0.1:3.14/2

for t3=0:0.1:0.75\*3.14

for t4=0:0.1:0.75\*3.14

px =l2\*cos(t1) - l6\*(cos(t3)\*sin(t1) + cos(t1)\*cos(t2)\*sin(t3)) - l5\*(sin(t1)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) - l3\*sin(t1) - l7\*(cos(t4)\*(sin(t1)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) + cos(t1)\*sin(t2)\*sin(t4)) + l4\*cos(t1)\*cos(t2) + l8\*cos(t1)\*sin(t2);

py=l5\*(cos(t1)\*sin(t3) + cos(t2)\*cos(t3)\*sin(t1)) + l6\*(cos(t1)\*cos(t3) - cos(t2)\*sin(t1)\*sin(t3)) + l3\*cos(t1) + l2\*sin(t1) + l7\*(cos(t4)\*(cos(t1)\*sin(t3) + cos(t2)\*cos(t3)\*sin(t1)) - sin(t1)\*sin(t2)\*sin(t4)) + l4\*cos(t2)\*sin(t1) + l8\*sin(t1)\*sin(t2);

pz=l1 - l7\*(cos(t2)\*sin(t4) + cos(t3)\*cos(t4)\*sin(t2)) + l8\*cos(t2) - l4\*sin(t2) - l5\*cos(t3)\*sin(t2) + l6\*sin(t2)\*sin(t3);

plot3(px,py,pz,'\*');

end

end

end

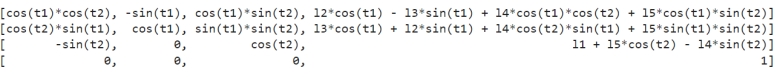
end

**Bài 4:**

Po = L1(0;0;l1).R1(Z;).L2(l2;0;0).L3(0;L3;0).R2(Y;).L4(L4;0;0).L5(0;0;Z).P

L1 =[1, 0, 0, 0]  
 [0, 1, 0, 0]  
 [0, 0, 1, l1]  
 [0, 0, 0, 1]  
R1 =[cos(t1), -sin(t1), 0, 0]  
 [sin(t1), cos(t1), 0, 0]  
 [ 0, 0, 1, 0]  
 [ 0, 0, 0, 1]  
L2 =[1, 0, 0, l2]  
 [0, 1, 0, 0]  
 [0, 0, 1, 0]  
 [0, 0, 0, 1]  
L3 =[1, 0, 0, 0]  
 [0, 1, 0, l3]  
 [0, 0, 1, 0]  
 [0, 0, 0, 1]  
R2 =[ cos(t2), 0, sin(t2), 0]  
 [ 0, 1, 0, 0]  
 [-sin(t2), 0, cos(t2), 0]  
 [ 0, 0, 0, 1]  
L4 =[1, 0, 0, l4]  
 [0, 1, 0, 0]  
 [0, 0, 1, 0]  
 [0, 0, 0, 1]  
L5 =[1, 0, 0, 0]  
 [0, 1, 0, 0]  
 [0, 0, 1, l5]  
 [0, 0, 0, 1]

Ma trận



Px = l2\*cos(t1) - l3\*sin(t1) + l4\*cos(t1)\*cos(t2) + l5\*cos(t1)\*sin(t2)

Py = l3\*cos(t1) + l2\*sin(t1) + l4\*cos(t2)\*sin(t1) + l5\*sin(t1)\*sin(t2)

Pz = l1 + l5\*cos(t2) - l4\*sin(t2)

Code

l1=5;

l2=6;

l3=2

l4=7

l5=6;

syms t1 t2

for t1=0:0.1:2\*3.14

for t2=0:0.1:3.14

px= l2\*cos(t1) - l3\*sin(t1) + l4\*cos(t1)\*cos(t2) + l5\*cos(t1)\*sin(t2);

py =l3\*cos(t1) + l2\*sin(t1) + l4\*cos(t2)\*sin(t1) + l5\*sin(t1)\*sin(t2);

pz=l1 + l5\*cos(t2) - l4\*sin(t2);

plot3(px,py,pz,'\*');

hold on;

end end

A picture containing diagram

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**Bài 6:**

Po = L1(0;0;L1).R1(Z;).L(L2;0;0).L3(0;0;L3).L2(0;L2;0).R2(X,).L4(0,L4,0). R3(X,).L5(0;L5;0). R2(X,).L(0;L6;0).P

L1 = [ 1, 0, 0, 0]

[ 0, 1, 0, 0]

[ 0, 0, 1, l1]

[ 0, 0, 0, 1]

R1 = [ cos(t1), -sin(t1), 0, 0]

[ sin(t1), cos(t1), 0, 0]

[ 0, 0, 1, 0]

[ 0, 0, 0, 1]

L3 = [ 1, 0, 0, 0]

[ 0, 1, 0, 0]

[ 0, 0, 1, l3]

[ 0, 0, 0, 1]

L2 = [ 1, 0, 0, 0]

[ 0, 1, 0, l2]

[ 0, 0, 1, 0]

[ 0, 0, 0, 1]

R2 = [ 1, 0, 0, 0]

[ 0, cos(t2), -sin(t2), 0]

[ 0, sin(t2), cos(t2), 0]

[ 0, 0, 0, 1]

L4 = [ 1, 0, 0, 0]

[ 0, 1, 0, l4]

[ 0, 0, 1, 0]

[ 0, 0, 0, 1]

R3 = [ 1, 0, 0, 0]

[ 0, cos(t3), -sin(t3), 0]

[ 0, sin(t3), cos(t3), 0]

[ 0, 0, 0, 1]

L5 = [ 1, 0, 0, 0]

[ 0, 1, 0, l5]

[ 0, 0, 1, 0]

[ 0, 0, 0, 1]

R4 = [ 1, 0, 0, 0]

[ 0, cos(t4), -sin(t4), 0]

[ 0, sin(t4), cos(t4), 0]

[ 0, 0, 0, 1]

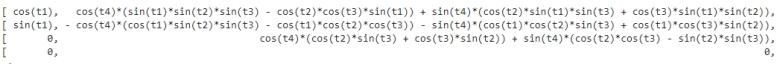
L6 = [ 1, 0, 0, 0]

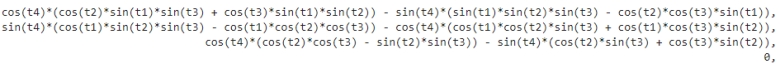
[ 0, 1, 0, l6]

[ 0, 0, 1, 0]

[ 0, 0, 0, 1]

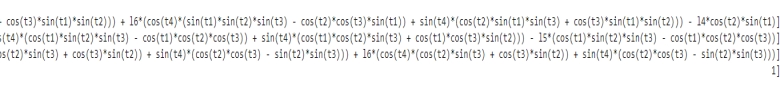
Ma trận





Text

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Px = l5\*(sin(t1)\*sin(t2)\*sin(t3) - cos(t2)\*cos(t3)\*sin(t1)) + l2\*(cos(t4)\*(sin(t1)\*sin(t2)\*sin(t3) - cos(t2)\*cos(t3)\*sin(t1)) + sin(t4)\*(cos(t2)\*sin(t1)\*sin(t3) + cos(t3)\*sin(t1)\*sin(t2))) + l6\*(cos(t4)\*(sin(t1)\*sin(t2)\*sin(t3) - cos(t2)\*cos(t3)\*sin(t1)) + sin(t4)\*(cos(t2)\*sin(t1)\*sin(t3) + cos(t3)\*sin(t1)\*sin(t2))) - l4\*cos(t2)\*sin(t1)

Py = l4\*cos(t1)\*cos(t2) - l2\*(cos(t4)\*(cos(t1)\*sin(t2)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) + sin(t4)\*(cos(t1)\*cos(t2)\*sin(t3) + cos(t1)\*cos(t3)\*sin(t2))) - l6\*(cos(t4)\*(cos(t1)\*sin(t2)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) + sin(t4)\*(cos(t1)\*cos(t2)\*sin(t3) + cos(t1)\*cos(t3)\*sin(t2))) - l5\*(cos(t1)\*sin(t2)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3))

Pz = l1 + l3 + l5\*(cos(t2)\*sin(t3) + cos(t3)\*sin(t2)) + l4\*sin(t2) + l2\*(cos(t4)\*(cos(t2)\*sin(t3) + cos(t3)\*sin(t2)) + sin(t4)\*(cos(t2)\*cos(t3) - sin(t2)\*sin(t3))) + l6\*(cos(t4)\*(cos(t2)\*sin(t3) + cos(t3)\*sin(t2)) + sin(t4)\*(cos(t2)\*cos(t3) - sin(t2)\*sin(t3)))

Code:

l1= 5;

l2=5;

l3=3;

l4=4;

l5=3;

l6=2;

l7=3;

l8=2;

syms t1 t2 t3 t4

for t1=0:0.1:2\*3.14

for t2=0:0.1:3.14/2

for t3=0:0.1:0.75\*3.14

for t4=0:0.1:0.75\*3.14

px = l5\*(sin(t1)\*sin(t2)\*sin(t3) - cos(t2)\*cos(t3)\*sin(t1)) + l2\*(cos(t4)\*(sin(t1)\*sin(t2)\*sin(t3) - cos(t2)\*cos(t3)\*sin(t1)) + sin(t4)\*(cos(t2)\*sin(t1)\*sin(t3) + cos(t3)\*sin(t1)\*sin(t2))) + l6\*(cos(t4)\*(sin(t1)\*sin(t2)\*sin(t3) - cos(t2)\*cos(t3)\*sin(t1)) + sin(t4)\*(cos(t2)\*sin(t1)\*sin(t3) + cos(t3)\*sin(t1)\*sin(t2))) - l4\*cos(t2)\*sin(t1);

py=l4\*cos(t1)\*cos(t2) - l2\*(cos(t4)\*(cos(t1)\*sin(t2)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) + sin(t4)\*(cos(t1)\*cos(t2)\*sin(t3) + cos(t1)\*cos(t3)\*sin(t2))) - l6\*(cos(t4)\*(cos(t1)\*sin(t2)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3)) + sin(t4)\*(cos(t1)\*cos(t2)\*sin(t3) + cos(t1)\*cos(t3)\*sin(t2))) - l5\*(cos(t1)\*sin(t2)\*sin(t3) - cos(t1)\*cos(t2)\*cos(t3));

pz=l1 + l3 + l5\*(cos(t2)\*sin(t3) + cos(t3)\*sin(t2)) + l4\*sin(t2) + l2\*(cos(t4)\*(cos(t2)\*sin(t3) + cos(t3)\*sin(t2)) + sin(t4)\*(cos(t2)\*cos(t3) - sin(t2)\*sin(t3))) + l6\*(cos(t4)\*(cos(t2)\*sin(t3) + cos(t3)\*sin(t2)) + sin(t4)\*(cos(t2)\*cos(t3) - sin(t2)\*sin(t3)));

plot3(px,py,pz,'\*');

hold on;

end end end end

**Bài 7:**

syms l1 l2 l3 l4 l5 l6 l7 t1 t2 t3 s

TZ1 = [1 0 0 0;0 1 0 0;0 0 1 l1;0 0 0 1];

RZ1 = [cos(t1) -sin(t1) 0 0; sin(t1) cos(t1) 0 0; 0 0 1 0; 0 0 0 1];

TZ2 = [1 0 0 0;0 1 0 0;0 0 1 l2;0 0 0 1];

TY4 = [1 0 0 0;0 1 0 l4;0 0 1 0;0 0 0 1];

TZ3 = [1 0 0 0;0 1 0 0;0 0 1 l3;0 0 0 1];

RZ2 = [cos(t2) -sin(t2) 0 0; sin(t2) cos(t2) 0 0; 0 0 1 0; 0 0 0 1];

TY5 = [1 0 0 0;0 1 0 l5;0 0 1 0;0 0 0 1];

TZ6 = [1 0 0 0;0 1 0 0;0 0 1 l6;0 0 0 1];

RZ3 = [cos(t3) -sin(t3) 0 0; sin(t3) cos(t3) 0 0; 0 0 1 0; 0 0 0 1];

TZ7 = [1 0 0 0;0 1 0 0;0 0 1 l7;0 0 0 1];

P = [0;0;0;1];

disp(simplify(TZ1\*RZ1\*TZ2\*TY4\*TZ3\*RZ2\*TY5\*TZ6\*RZ3\*TZ7));

l1 = 40;

l2 = 10;

l3 = 5;

l4 = 30;

l5 = 20;

l6 = 20;

l7 =10;

s = 10;

for t1=0:0.1:pi/2

for t2=0:0.1:pi/2

for t3=0:0.1:pi/2

Px = - l5\*sin(t1 + t2) - l4\*sin(t1);

Py = l5\*cos(t1 + t2) + l4\*cos(t1);

Pz = l1 + l2 + l3 - l6 - l7 + s;

plot3(Px,Py,Pz,'\*');

hold on

end

end

end

**Bài 8:**

E = R(Z,θ1)\*T(0,0,L2)\*T(0,L1,0) R(X,θ2)\*T(0,0,L3) \*R(X,θ3) \*T(0,L4,0) \*R(X,θ4) \*T(0,L5,0) \*R(Y,θ5) \*T(0,L6-L5,0) \*T(0,0,L5)

syms l1 l2 l3 l4 l5 l6 l7 t1 t2 t3 t2 t4 t5 STEP

l1 = 10;

l2 = 20;

l3 = 30;

l4 = 40;

l5 = 10;

l6 = 25;

l7 = l6-l5;

STEP =0.5;

for t1=0:STEP:2\*pi

for t2 = 0:STEP:pi/2

for t3=0:STEP:pi/2

for t4=0:STEP:pi/2

for t5=0:STEP:pi/2

Px = l5\*(cos(t1)\*sin(t5) + sin(t2 + t3 + t4)\*cos(t5)\*sin(t1)) - l1\*sin(t1) - l4\*cos(t2 + t3)\*sin(t1) + l3\*sin(t1)\*sin(t2) - l5\*cos(t2 + t3 + t4)\*sin(t1) - l7\*cos(t2 + t3 + t4)\*sin(t1);

Py = l5\*(sin(t1)\*sin(t5) - sin(t2 + t3 + t4)\*cos(t1)\*cos(t5)) + l1\*cos(t1) + l4\*cos(t2 + t3)\*cos(t1) - l3\*cos(t1)\*sin(t2) + l5\*cos(t2 + t3 + t4)\*cos(t1) + l7\*cos(t2 + t3 + t4)\*cos(t1);

Pz = l2 + l5\*(cos(t2 + t3)\*sin(t4) + sin(t2 + t3)\*cos(t4)) + l7\*(cos(t2 + t3)\*sin(t4) + sin(t2 + t3)\*cos(t4)) + l4\*sin(t2 + t3) + l3\*cos(t2) - l5\*cos(t5)\*(sin(t2 + t3)\*sin(t4) - cos(t2 + t3)\*cos(t4));

plot3(Px,Py,Pz,'\*');

hold on

end

end

end

Graphical user interface, application

Description automatically generated end

end