

**运动控制**

题 目 运动控制作业三报告

专 业 控制科学与工程

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实验代码：

Main函数：

clc;

clear;

syms theta1 theta2 theta3 theta4 theta5 l1 l2 l0;

%%

%通过ppt上的SCARA机器人来验证子函数是否写对

% q0 = [0 l1+l2 l0];

% q1 = [0 0 0];

% q2 = [0 l1 0];

% q3 = [0 l1+l2 0];

% g\_st0 = [1 0 0 0;0 1 0 l1+l2;0 0 1 l0;0 0 0 1];

% matrix\_1 = convert\_exponential\_rotation([0 0 1],theta1,q1);

% matrix\_2 = convert\_exponential\_rotation([0 0 1],theta2,q2);

% matrix\_3 = convert\_exponential\_rotation([0 0 1],theta3,q3);

% matrix\_4 = convert\_exponential\_transfer(3,theta4);

% gst = matrix\_1 \* matrix\_2 \* matrix\_3 \* matrix\_4 \* g\_st0;

%正确

%%

%读取数据

data = load('Answer of Question\_1.txt');

num = size(data);

%初始化

point = zeros(num(1),3);

norm\_vector = zeros(num(1),3);

theta\_1\_final = zeros(num(1),1);

theta\_2\_final = zeros(num(1),1);

theta\_3\_final = zeros(num(1),1);

theta\_4\_final = zeros(num(1),1);

theta\_5\_final = zeros(num(1),1);

solution = zeros(num(1),5);

o = zeros(1,num(1));

%初始化点

for i = 1 :1:num(1)

point(i,:) = [data(i,1) data(i,2) data(i,3)];

norm\_vector(i,:) = [data(i,4) data(i,5) data(i,6)];

end

%计算平移矩阵

matrix\_transfer\_1 = convert\_exponential\_transfer(1,theta1);

matrix\_transfer\_2 = convert\_exponential\_transfer(2,theta2);

matrix\_transfer\_3 = convert\_exponential\_transfer(3,theta3);

%计算旋转矩阵

w\_4 = [0 0 1];

w\_5 = [0 sqrt(2)/2 sqrt(2)/2];

matrix\_rotation\_1 = convert\_exponential\_rotation(w\_4,theta4,[0 0 0]);

matrix\_rotation\_2 = convert\_exponential\_rotation(w\_5,theta5,[0 0 0]);

%计算g\_st0与g\_st

g\_st0 = [1 0 0 0;...

0 1 0 0;...

0 0 1 0;...

0 0 0 1];

g\_st = matrix\_transfer\_1 \* matrix\_transfer\_2 \* matrix\_transfer\_3 \* matrix\_rotation\_1 \* matrix\_rotation\_2 \* g\_st0;

%计算法向量矩阵

normal\_vector\_matrix= g\_st \* [0 0 1 0]';

transfer\_matrix = g\_st \* [0 0 0 1]';

%使用解方程的方法来验证解析算法是否算对

% eq1 = normal\_vector\_matrix(2,1) - norm\_vector(1,2);

% eq2 = normal\_vector\_matrix(3,1) - norm\_vector(1,3);

% [theta4,theta5] = solve(eq1,eq2,theta4,theta5);

% theta4\_final = theta4(1);

% double(theta4)

% double(theta5)

%%

%计算theta4与theta5

for i = 1 :num(1)

theta5(i,1) = acos(2 \* norm\_vector(i,3) - 1);

sol=solve((2^(1/2)\*sin(theta4)\*sin(theta5(i,1)))/2 - cos(theta4)\*(cos(theta5(i,1))/2 - 1/2),theta4);

o(i) = double(sol(1));

end

%计算theta1、theta2和theta3

for i =1 :num(1)

theta\_1\_final(i,1) = point(i,1);

theta\_2\_final(i,1) = point(i,2);

theta\_3\_final(i,1) = point(i,3);

theta\_4\_final(i,1) = o(i);

theta\_5\_final(i,1) = theta5(i,1);

solution(i,:) = [theta\_1\_final(i,1) theta\_2\_final(i,1) theta\_3\_final(i,1) theta\_4\_final(i,1) theta\_5\_final(i,1)];

end

disp(solution);

%%

%写入文件

fid = fopen('Rotation of Axis.txt','w');

for i=1:num(1)

fprintf(fid,'%f\t%f\t%f\t%f\t%f\n',solution(i,1),solution(i,2),solution(i,3),solution(i,4),solution(i,5));

end

fclose(fid);

计算平移矩阵函数

function matrix\_transfer = convert\_exponential\_transfer(num,theta)

%判断字符串

if num == 1

exponential\_tranfer = [1 0 0 theta;0 1 0 0; 0 0 1 0;0 0 0 1];

end

if num == 2

exponential\_tranfer = [1 0 0 0;0 1 0 theta; 0 0 1 0;0 0 0 1];

end

if num == 3

exponential\_tranfer = [1 0 0 0;0 1 0 0; 0 0 1 theta;0 0 0 1];

end

matrix\_transfer = exponential\_tranfer;

end

计算旋转矩阵函数：

function matrix\_rotation = convert\_exponential\_rotation(w,theta,q)

vos = 1- cos(theta);

%计算旋转矩阵R

exponential\_rotation = [(w(1)^2)\*vos + cos(theta) w(1)\*w(2)\*vos - w(3)\*sin(theta) w(1)\*w(2)\*vos + w(2)\*sin(theta);...

w(1)\*w(2)\*vos + w(3)\*sin(theta) (w(2)^2)\*vos + cos(theta) w(2)\*w(3)\*vos - w(1)\*sin(theta);...

w(1)\*w(3)\*vos - w(2)\*sin(theta) w(2)\*w(3)\*vos + w(1)\*sin(theta) (w(3)^2)\*vos + cos(theta)];

%计算速度

velocity = -cross(w,q);

%e^(epsilon\*theta)

exponential\_epsilon = [exponential\_rotation (eye(3) - exponential\_rotation)\*cross(w,velocity)';0,0,0,1];

%exponential\_epsilon 取消注释以显示输出

matrix\_rotation = exponential\_epsilon;

end

运行结果：（与只取其中一组解）

运行结果数据（部分）： 与单位为弧度

23.206603 19.921211 40.001934 -0.175022 0.490104

23.236618 19.853677 40.002435 -0.165667 0.464383

23.266633 19.808654 40.002924 -0.175336 0.490966

23.296648 19.763632 40.001231 -0.188620 0.527345

23.326663 19.741121 40.003864 -0.202568 0.565360

23.356678 19.718609 40.005945 -0.209371 0.583829

23.386693 19.696098 40.007473 -0.216133 0.602139

23.416708 19.651076 40.000285 -0.221270 0.616014

23.446723 19.628564 40.000151 -0.236045 0.655761

23.506753 19.606053 40.008025 -0.272886 0.753749

23.536768 19.583542 40.006766 -0.249289 0.691177

23.566783 19.561031 40.004946 -0.255785 0.708470

23.596798 19.538519 40.002563 -0.262235 0.725590

23.656828 19.516008 40.008154 -0.301337 0.828242

23.686843 19.493497 40.004631 -0.275134 0.759672

23.716858 19.470985 40.000542 -0.281445 0.776270

23.776888 19.448474 40.004396 -0.322065 0.881830

23.836918 19.425963 40.007661 -0.328962 0.899528

23.866933 19.403452 40.001839 -0.300401 0.825810

23.926963 19.380940 40.003927 -0.342409 0.933837

23.986993 19.358429 40.005419 -0.349129 0.950886

24.047024 19.335918 40.006310 -0.355791 0.967723

24.107054 19.313407 40.006599 -0.362395 0.984348

24.167084 19.290895 40.006283 -0.368940 1.000763

24.227114 19.268384 40.005358 -0.375427 1.016967

24.287144 19.245873 40.003822 -0.381854 1.032961

24.347174 19.223362 40.001672 -0.388225 1.048751

24.437219 19.200850 40.007300 -0.420618 1.128088

24.497249 19.178339 40.003900 -0.400992 1.080214

24.587294 19.155828 40.008245 -0.433680 1.159622

24.647324 19.133317 40.003582 -0.413536 1.110881

24.737369 19.110805 40.006629 -0.446484 1.190273

24.797399 19.088294 40.000688 -0.425858 1.140771

24.887444 19.065783 40.002422 -0.459031 1.220061

24.977489 19.043272 40.003487 -0.465322 1.234904

25.067534 19.020760 40.003876 -0.471551 1.249539

25.157579 18.998249 40.003588 -0.477720 1.263973

25.247624 18.975738 40.002616 -0.483828 1.278205

25.337669 18.953227 40.000957 -0.489876 1.292240

25.457729 18.930715 40.006821 -0.513764 1.347110

25.547774 18.908204 40.003757 -0.502027 1.320262

25.667834 18.885693 40.008171 -0.525916 1.374678

25.757879 18.863182 40.003681 -0.513947 1.347526

25.877939 18.840670 40.006624 -0.537821 1.401462

25.967984 18.818159 40.000690 -0.525640 1.374054

26.088044 18.795648 40.002140 -0.549487 1.427492

26.208104 18.773137 40.002825 -0.555350 1.440496

26.328164 18.750625 40.002741 -0.561156 1.453318

26.448224 18.728114 40.001880 -0.566904 1.465962

26.568284 18.705603 40.000238 -0.572594 1.478429

26.718359 18.683092 40.005810 -0.590702 1.517771

26.838419 18.660580 40.002563 -0.584049 1.503375

26.988494 18.638069 40.006476 -0.602062 1.542198

27.108554 18.615558 40.001599 -0.595283 1.527645

27.258629 18.593047 40.003824 -0.613196 1.565948

27.408704 18.570535 40.005184 -0.618800 1.577832

27.558779 18.548024 40.005669 -0.624351 1.589555

27.708854 18.525513 40.005274 -0.629846 1.601117

27.858929 18.503002 40.003990 -0.635286 1.612518

28.009005 18.480490 40.001810 -0.640673 1.623767

28.189095 18.457979 40.006499 -0.654993 1.653456

28.339170 18.435468 40.002477 -0.651531 1.646306

28.519260 18.412956 40.005258 -0.665728 1.675520

28.699350 18.390445 40.007058 -0.671136 1.686571

28.849425 18.367934 40.000198 -0.667544 1.679235

29.029515 18.345423 40.000037 -0.681554 1.707742

29.239620 18.322911 40.006485 -0.693533 1.731896

29.419710 18.300400 40.004271 -0.692243 1.729305

29.599800 18.277889 40.001030 -0.697392 1.739633

29.809905 18.255378 40.004285 -0.709179 1.763140

30.020010 18.232866 40.006431 -0.714417 1.773526

30.230115 18.210355 40.006773 -0.718659 1.781907

30.440220 18.187844 40.004836 -0.722847 1.790159

30.650325 18.165333 40.000626 -0.726987 1.798294

30.890445 18.142821 40.000856 -0.736115 1.816144

31.160580 18.120310 40.004898 -0.744242 1.831945

31.430715 18.097799 40.005850 -0.748365 1.839928

31.700850 18.075288 40.003731 -0.752425 1.847766

32.001001 18.052776 40.004316 -0.759675 1.861708

32.301151 18.030265 40.001394 -0.763660 1.869344

32.631316 18.007754 40.000233 -0.770261 1.881945

32.991496 17.985243 40.000064 -0.776404 1.893622

33.381691 17.962731 40.000075 -0.782163 1.904527

33.831916 17.940220 40.003713 -0.789039 1.917490

34.282141 17.917709 40.001124 -0.792722 1.924410

34.822411 17.895198 40.003159 -0.799651 1.937382