

**运动控制**

题 目 运动控制作业四报告

专 业 控制科学与工程

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实验代码：

clc

clear

syms x\_center y\_center z\_center;

p0 = [1 0 0];

p1 = [0 0 1];

p2 = [0 1 0];

%在p1p2p3组成的平面上求圆心点

vector\_p0p1 = p0 - p1;

vector\_p2p1 = p2 - p1;

vector\_p0p2 = p0 - p2;

%法向量

norm\_vector = cross(vector\_p0p1,vector\_p2p1);

norm\_vector = norm\_vector/norm(norm\_vector); %µ¥Î»»¯

%求出平面上的圆心

eq1 = norm\_vector(1)\*(x\_center - p0(1)) + norm\_vector(2)\*(y\_center - p0(2)) + norm\_vector(3)\*(z\_center - p0(3)) == 0;

eq2 = norm\_vector(1)\*(x\_center - p2(1)) + norm\_vector(2)\*(y\_center - p2(2)) + norm\_vector(3)\*(z\_center - p2(3)) == 0;

eq3 = (x\_center - p0(1)) - (z\_center - p0(3)) == 0;

eq4 = x\_center + y\_center + z\_center == 1;

eq5 = (y\_center - p2(2))-(z\_center - p2(3)) ==0;

sol = solve(eq1,eq2,eq3,eq4,eq5,x\_center,y\_center,z\_center);

x\_center = sol.x\_center;

y\_center = sol.y\_center;

z\_center = sol.z\_center;

center = [x\_center y\_center z\_center];

disp('The center of the circle:');

disp(center);

%%

%计算向量夹角

theta\_rad = acos(((norm(vector\_p0p1))^2 + (norm(vector\_p2p1))^2 - (norm(vector\_p0p2))^2)/(2\*(norm(vector\_p0p1))^2\*(norm(vector\_p0p2))^2));

disp('The range of radian: ');

disp(theta\_rad);

theta\_degree = 180\* (theta\_rad/pi);

disp('The range of degree: ');

disp(theta\_degree);

%计算基准向量

base\_vector\_1 = p0 - center;

base\_vector\_2 = p2 - center;

%计算半径

radius = norm(base\_vector\_1);

%计算比例因子

i = 1;

%计算圆弧

i = 1;

for theta = 0:0.005:theta\_rad

vector\_theta = (1 - theta/theta\_rad) \* base\_vector\_1 + (theta/theta\_rad) \* base\_vector\_2;

vector\_radius = (vector\_theta/norm(vector\_theta))\*radius;

center\_theta(i,:) = center + vector\_radius;

plot3(center\_theta(i,1),center\_theta(i,2),center\_theta(i,3),'r\*');

hold on

i = i + 1;

end

%表示圆弧轨迹坐标关于theta的表达式

%P = center + radius \* ((1 - theta/theta\_rad) \* base\_vector\_1 + (1 - theta/theta\_rad) \* base\_vector\_2)/norm((theta/theta\_rad) \* base\_vector\_1 + (1 - theta/theta\_rad) \* base\_vector\_2);

%%

%求方向向量关于theta的表达式

n0 = [0 -1 0];

n1 = [0 -sqrt(2)/2 sqrt(2)/2];

n2 = [0 0 1];

%计算圆弧长度

S = theta\_rad \* radius;

%分段计算方向向量

num = 1;

for theta = 0 : 0.005 : theta\_rad

if theta <= (theta\_rad/2)

N\_theta(num,:) = (1 - theta/(theta\_rad / 2)) \* n0 + theta/(theta\_rad/2) \* n1;

N\_theta\_normal(num,:) = N\_theta(num,:)/norm(N\_theta(num,:));

num = num + 1;

end

if theta > (theta\_rad/2)

N\_theta(num,:) = (1 - (theta - theta\_rad/2)/(theta\_rad/2)) \* n1 + (theta - theta\_rad/2) / (theta\_rad/2) \* n2;

N\_theta\_normal(num,:) = N\_theta(num,:)/norm(N\_theta(num,:));

num = num + 1;

end

end

%根据theta表示向量N

%N\_1 = ((1 - theta/(theta\_rad / 2)) \* n0 + theta/(theta\_rad / 2) \* n1)/norm((1 - theta/(theta\_rad / 2)) \* n0 + theta/(theta\_rad / 2) \* n1)

%N\_2 = ((1 - (theta - theta\_rad/2)/(theta\_rad / 2)) \* n1 + (theta - theta\_rad/2)/(theta\_rad / 2) \* n1)/norm((1 - (theta - theta\_rad/2)/(theta\_rad / 2)) \* n0 + (theta - theta\_rad/2)/(theta\_rad / 2) \* n2);

direction\_vector = center\_theta + N\_theta\_normal \* 0.1; %乘以0.1是为了图像更好看

%%

%绘图

for i = 1 : 1 : 264

plot3([direction\_vector(i,1) center\_theta(i,1)],[direction\_vector(i,2) center\_theta(i,2)],[direction\_vector(i,3) center\_theta(i,3)],'o-k');

hold on

end

plot3([p0(1) x\_center],[p0(2) y\_center],[p0(3) z\_center],'o-k');

hold on

plot3([p2(1) x\_center],[p2(2) y\_center],[p2(3) z\_center],'o-k');

hold on

plot3([p0(1) p1(1)],[p0(2) p1(2)],[p0(3) p1(3)],'o-k');

hold on

plot3([p1(1) p2(1)],[p1(2) p2(2)],[p1(3) p2(3)],'o-k');

hold on

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

grid on

xlabel('x');

ylabel('y');

zlabel('z');

%写入文档

fid\_1 = fopen('Points of circle.txt','w');

for i = 1 : 1 : 264

fprintf(fid\_1,'%f\t%f\t%f\n',center\_theta(i,1),center\_theta(i,2),center\_theta(i,3));

end

fclose(fid\_1);

fid\_2 = fopen('Direction vector of points.txt','w');

for i = 1 : 1 : 264

fprintf(fid\_2,'%f\t%f\t%f\n',N\_theta\_normal(i,1),N\_theta\_normal(i,2),N\_theta\_normal(i,3));

end

fclose(fid\_2);

实验结果：

计算得到圆弧的圆心点坐标为：

夹角为：1.318116071652818rad，对应角度为75.522487814070089

路径表达式：

其中：

—— 圆弧圆心点

—— 圆弧半径，计算出来值为0.816496580927726

—— 圆弧基向量

—— 圆弧基向量

—— 圆弧夹角，大小为1.318rad

方向N关于theta的表达式：

其中：

—— 基础方向向量：

—— 基础方向向量：

—— 基础方向向量：

实验图像：

图表, 折线图

描述已自动生成

圆弧轨迹

图表, 折线图

描述已自动生成

圆弧轨迹与方向

在Points of circle.txt和Direction vector of points.txt文档中可以分别查看圆弧空间坐标点和与点对应的方向向量。

查阅表格可以得到原来三个点的坐标和方向向量分别为：

可以看出本实验的大圆插补满足要求。