clc, clear

theta = [1, 4, 3, 5, 3, 6]; % 各个中间点的位置

td = [3, 2, 4, 3, 5]; % 每个中间点之间的时间间隔

alpha = [1.1, 1.2, 1.05, 0.9, 1.0, 0.8]; % 过渡阶段的加速度

if length(theta)==length(td)+1 && length(theta) == length(alpha)

% fprintf("ok")

else

error("The size of theta should be the same as alpha, and equals the size of td plus 1")

end

num = length(theta);

d\_theta = diff(theta);

% 各个点之间，线性部分的斜率，首尾两段后面需要修正

omega = d\_theta./td;

% 各个点过渡部分的加速度的符号，首尾两点处暂时用1占位(这里必须是1)，后面单独处理

sng = [1 sign( diff(omega) ) 1];

% 各个点过渡部分的加速度（有符号）

alpha = abs(alpha).\*sng;

% 各个点过渡段的时间间隔，首尾两点处暂时用1占位，后面单独处理

t = [1 diff(omega) 1]./alpha;

% 直线部分的时间间隔，首尾两段后面要修正

tl = td - 0.5\*t(1:end-1) - 0.5\*t(2:end);

% 单独处理第一个点

th1 = theta(1);

th2 = theta(2);

a1 = alpha(1);

a1 = sign(th2-th1) \* abs(a1);

alpha(1) = a1;

td12 = td(1);

t1 = td12 - sqrt( td12^2 - 2\*(th2-th1)/a1 ); % 过渡时间

t(1) = t1;

omega12 = (th2-th1)/(td12-0.5\*t1); % 1和2之间线段的斜率(速度)

omega(1) = omega12;

t2 = t(2);

t12 = td12 - t1 - 0.5\*t2; % 1和2之间线性部分的时间长度

tl(1) = t12;

% 单独处理最后一个点

th\_n = theta(end);

th\_n1 = theta(end-1);

an = sign(th\_n1 - th\_n)\*abs(alpha(end));

alpha(end) = an;

% 最后一个点上的过渡时间长度

tn = td(end) - sqrt( (td(end))^2 + 2\*(th\_n-th\_n1)/an );

t(end) = tn;

omegan1n = (th\_n - th\_n1)/( td(end) - 0.5\*tn );

omega(end) = omegan1n;

tn1n = td(end) - tn - 0.5\*t(end-1);

tl(end) = tn1n;

% 求出最终结果

theta0 = theta(1);

thetaf = theta0;

dt = 0.01;

T = 0;

t\_all = [];

y\_all = [];

for i = 1:num-1

tf = td(i);

if i == 1

tb1 = t(i);

else

tb1 = t(i)/2;

end

if i == num -1

tb2 = tf - t(i+1);

else

tb2 = tf - t(i+1)/2;

end

% tb2 = td(i) - tb1 - tl(i);

a1 = alpha(i);

a2 = alpha(i+1);

% 中间的直线

if i == 1

f2 = @(x) theta(i) + omega(i)\*( x - tb1/2 );

else

f2 = @(x) theta(i) + omega(i)\*x;

end

% 第一段抛物线

thetab = f2(tb1);

p11 = a1/2;

p12 = omega(i) - a1\*tb1;

p13 = thetab - omega(i)\*tb1 + 0.5\*a1\*tb1^2;

f1 = @(x) p11\*x.^2 + p12\*x + p13\*ones(size(x));

% 第二段抛物线

thetac = f2(tb2);

p21 = a2/2;

p22 = omega(i) - a2\*tb2;

p23 = thetac - omega(i)\*tb2 + 0.5\*a2\*tb2^2;

f3 = @(x) p21\*x.^2 + p22\*x + p23\*ones(size(x));

tt1 = 0:dt:tb1;

tt2 = (tb1+dt):dt:tb2;

tt3 = (tb2+dt):dt:tf;

y1 = f1(tt1);

y2 = f2(tt2);

y3 = f3(tt3);

tt = [tt1, tt2, tt3] + T;

T = T + tf;

y = [y1, y2, y3];

t\_all = [t\_all, tt];

y\_all = [y\_all, y];

end

td\_plt = [0 td];

td\_plt = cumsum(td\_plt);

td\_plt(1) = td\_plt(1) + 0.5\*t(1);

td\_plt(end) = td\_plt(end) - 0.5\*t(end);

plot(t\_all, y\_all, td\_plt, theta, 'o-')

