

Ch_8_Lesson_10_Ex_2.m

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% airplane pitch up
clear

m = 1000;      %kg
l = 20;
I=(1/20)*m*l^2;
DL = 1;
DC = .2;
Db = 0;
s=16;         %sq m.

dt = .2;
n = 250;

px(1) = 0;
py(1) = 1000;
vy(1) = 0;
a(1) = 5*pi/180;
ar(1) = 0;

% compute initial velocity estimate
%CL at 5 deg is 1, lift is 0.5*air*v2*s*CL + T*sin(a), so need v to be
vxest = sqrt(m*10/(.5*1.4*s*1));
%CD at 5 deg is .7, drag is 0.5*air*v2*s*CD, so need T to be
T = 0.5*1.4*vxest^2*s*0.7/cos(a(1));

T=7500

% refine velocity estimate
vx(1) = sqrt((m*10 - T*sin(a(1)))/(.5*1.4*s*1))

thrust=zeros(1,n+1);
elevator=zeros(1,n+1);
t=0;
for i=1:n+1
    thrust(i) = T;
end
for i=100:120
    elevator(i) = 40;
    elevator(i+21) = 0;
end

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for i=2:n+1

    v(i-1) = sqrt(vx(i-1)^2 + vy(i-1)^2);
    vangle(i-1) = asin(vy(i-1)/v(i-1));
    AoA(i-1) = (a(i-1) - vangle(i-1))*180/pi;

    CL(i-1) = 0.5 + 0.1*AoA(i-1);

    if (AoA(i-1) <= 5) CD = (5 - AoA(i-1))*0.1 + 0.7;
    end

    if (AoA(i-1) > 5) CD = (AoA(i-1) - 5)*0.1 + 0.7;
    end

    air(i-1) = (1 - py(i-1)/30000)*1.4;

    lift(i-1)=0.5*air(i-1)*v(i-1)^2*s*CL(i-1);
    drag= Db + 0.5*air(i-1)*v(i-1)^2*s*CD;

    liftx = lift(i-1)*cos(a(i-1) + pi/2);
    lifty = lift(i-1)*sin(a(i-1) + pi/2);

    dragx = drag*cos(vangle(i-1) + pi);
    dragy = drag*sin(vangle(i-1) + pi);

    thrustx = thrust(i-1)*cos(a(i-1));
    thrusty = thrust(i-1)*sin(a(i-1));

    ax(i-1) = (liftx + dragx + thrustx)/m;
    ay(i-1) = (lifty + dragy + thrusty)/m - 10;

    px(i) = px(i-1) + vx(i-1)*dt;
    py(i) = py(i-1) + vy(i-1)*dt;

    vx(i) = vx(i-1) + ax(i-1)*dt;
    vy(i) = vy(i-1) + ay(i-1)*dt;

    a(i) = a(i-1) + ar(i-1)*dt;
    ar(i) = ar(i-1) + elevator(i-1)/I*dt;

end

plot(px,py)

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