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## 2.1

%

% without resistance

% by CHT,

% based on 'Computational Physics' book by N Giordano and H Nakanishi

% Section 2.1 p24

%

clear;clc;

k=6;%精英选手功重比可达6

x=0:0.1:5;

y=sqrt(2\*k\*x);

plot(x,y)

xlabel('Time(s)');

ylabel('Velocity(m/s)')



## 2.2

%

% with resistance, consider the difference caused by area and power

% by CHT,

% based on 'Computational Physics' book by N Giordano and H Nakanishi

% Section 2.2 p24

%

v=13;

S=0.33;

k1=v^2\*S;

k2=v^2\*0.7\*S;

k1

k2

%可见速度相等时面积正比于输出功率

k1 =

55.7700

k2 =

39.0390

## 2.3

%

% viscous drag 粘滞阻力

% by CHT,

% based on 'Computational Physics' book by N Giordano and H Nakanishi

% Section 2.3 p24

%

%因此飞机要到高空飞行，就是为了减小空气阻力（误）

%不完全，还为了减少环境污染和减少大气层中气体运动对航行的影响

## 2.4

%

% down hill @ 70mph

% by CHT,

% based on 'Computational Physics' book by N Giordano and H Nakanishi

% Section 2.4 p24

%

%可以通过计算得出，若想达到v=112km/h(70mph)的速度，

%mgdh\*0.1/dt=1/2\*m\*v^2/dt+1/2CpAv^2\*dh\*cot(arctan0.1)/dt

%其中m=70kg,A=0.33m^2,C=1,p=1.29

%总之结论就是下坡时尽量减小受风面积以达到更高速度

clc;clear;

t(1)=0;

dt=0.05;

v(1)=4;

vv(1)=4;

density=1.29;

pmax=400;

mass=70;

area=0.33;

c=0.5;

eta=2\*1e-5;

h=1.4;

for i = 2:1000

t(i) = t(i-1) + dt;

v(i) = v(i-1)+(dt\*pmax/(mass\*v(i-1)))-(c\*density\*area\*v(i-1)^2\*dt/mass)-eta\*area\*v(i-1)/h;

vv(i)=vv(i-1)+(dt\*pmax/(mass\*vv(i-1)));

end

plot(t,v);

hold on;

plot(t,vv,'.-');

xlabel('Time(s)');

ylabel('Velocity(m/s)')

text(40,5,'有空气阻力')

text(40,20,'无空气阻力')



## 2.5

%

% 0 start

% by CHT,

% based on 'Computational Physics' book by N Giordano and H Nakanishi

% Section 2.5 p24

%

clc;clear;

t(1)=0;

dt=0.05;

v(1)=0;

density=1.29;

F0=400/7;

pmax=400;

mass=70;

area=0.33;

c=0.5;

eta=2\*1e-5;

h=1.4;

for i = 2:1000

t(i) = t(i-1) + dt;

v(i) = v(i-1)+(dt\*F0/(mass))-(c\*density\*area\*v(i-1)^2\*dt/mass)-eta\*area\*v(i-1)/h;

if v(i)>7

break;

end

end

for i = i:1000

t(i) = t(i-1) + dt;

v(i) = v(i-1)+(dt\*pmax/(mass\*v(i-1)))-(c\*density\*area\*v(i-1)^2\*dt/mass)-eta\*area\*v(i-1)/h;

end

plot(t,v);

xlabel('Time(s)');

ylabel('Velocity(m/s)')

grid on;

title('静力匀加速到风阻变加速')



## 2.6

E2\_6(30,'r');

E2\_6(35,'g');

E2\_6(40,'b');

E2\_6(45,'c');

E2\_6(50,'m');

E2\_6(55,'y');

title('trajectory of canon shell')

text(45,15,'No drag')



## 2.7

clear

t=zeros(1,2201);

B=zeros(1,2201);

vx=zeros(1,2201);

vy=zeros(1,2201);

v=zeros(1,2201);

x=zeros(1,2201);

y=zeros(1,2201);

alfa=2.5;

T0=300;

a=0.0065;

dt=0.05;

v(1)=700;

B(1)=0.00004;

g=9.8;

theta=pi/4;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(i)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g\*dt-B(i)\*v(i)\*vy(i)\*dt;

B(i+1)=B(i)\*(1-a\*y(i+1)/T0)^alfa;

t(i+1)=t(i)+dt;

else

break

end

end

plot(x,y,'r')

axis([0 4.6e4 1000 12000]);

title('the trajecctory of the bomb')



## 2.8

clear

t=zeros(1,2201);

B=zeros(1,2201);

vx=zeros(1,2201);

vy=zeros(1,2201);

v=zeros(1,2201);

x=zeros(1,2201);

y=zeros(1,2201);

g=zeros(1,2201);

y0=10000;

dt=0.05;

v(1)=700;

B(1)=0.00004;

g(1)=9.8;

theta=pi/4;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(i)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g(i)\*dt-B(i)\*v(i)\*vy(i)\*dt;

B(i+1)=B(i)\*exp(-y(i+1)/y0);

g(i+1)=g(1)\*6371000^2/(6371000+y(i+1))^2;

t(i+1)=t(i)+dt;

else

break

end

end

plot(x,y)

axis([0 4.6e4 1000 12000]);

title('the trajecctory of the bomb')



## 2.9

clear

t=zeros(1,2201);

B=zeros(1,2201);

vx=zeros(1,2201);

vy=zeros(1,2201);

v=zeros(1,2201);

x=zeros(1,2201);

y=zeros(1,2201);

dt=0.05;

v(1)=700;

B(1)=0.00004;

g=9.8;

theta=pi/4;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(1)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g\*dt-B(1)\*v(i)\*vy(i)\*dt;

t(i+1)=t(i)+dt;

else

break

end

end

hold on

plot(x,y)

theta=pi/3;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(1)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g\*dt-B(1)\*v(i)\*vy(i)\*dt;

t(i+1)=t(i)+dt;

else

break

end

end

plot(x,y)

clear

t=zeros(1,2201);

B=zeros(1,2201);

vx=zeros(1,2201);

vy=zeros(1,2201);

v=zeros(1,2201);

x=zeros(1,2201);

y=zeros(1,2201);

y0=10000;

dt=0.05;

v(1)=700;

B(1)=0.00004;

g=9.8;

theta=pi/4;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(i)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g\*dt-B(i)\*v(i)\*vy(i)\*dt;

B(i+1)=B(i)\*exp(-y(i+1)/y0);

t(i+1)=t(i)+dt;

else

break

end

end

plot(x,y,'r')

clear

t=zeros(1,2201);

B=zeros(1,2201);

vx=zeros(1,2201);

vy=zeros(1,2201);

v=zeros(1,2201);

x=zeros(1,2201);

y=zeros(1,2201);

y0=10000;

dt=0.08;

v(1)=700;

B(1)=0.00004;

g=9.8;

theta=pi/3;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(i)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g\*dt-B(i)\*v(i)\*vy(i)\*dt;

B(i+1)=B(i)\*exp(-y(i+1)/y0);

t(i+1)=t(i)+dt;

else

break

end

end

plot(x,y,'r')

axis([0 4.6e4 10 18000]);

title('the trajecctory of the bomb')

box on

grid on



## 2.10

%

## 2.11

clear

t=zeros(1,2201);

B=zeros(1,2201);

vx=zeros(1,2201);

vy=zeros(1,2201);

v=zeros(1,2201);

x=zeros(1,2201);

y=zeros(1,2201);

alfa=2.5;

T0=300;

a=0.0065;

dt=0.05;

v(1)=700;

B(1)=0.00004;

g=9.8;

theta=pi/4;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(i)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g\*dt-B(i)\*v(i)\*vy(i)\*dt;

B(i+1)=B(i)\*(1-a\*y(i+1)/T0)^alfa;

t(i+1)=t(i)+dt;

else

break

end

end

hold on

plot(x,y,'r')

clear

t=zeros(1,2201);

B=zeros(1,2201);

vx=zeros(1,2201);

vy=zeros(1,2201);

v=zeros(1,2201);

x=zeros(1,2201);

y=zeros(1,2201);

alfa=2.5;

T0=300;

a=0.0065;

dt=0.05;

v(1)=710;

B(1)=0.00004;

g=9.8;

theta=pi/4;

vx(1)=v(1)\*cos(theta);

vy(1)=v(1)\*sin(theta);

for i=1:1:2200

if y(i)>=-0

v(i)=sqrt(vx(i)\*vx(i)+vy(i)\*vy(i));

x(i+1)=x(i)+vx(i)\*dt;

y(i+1)=y(i)+vy(i)\*dt;

vx(i+1)=vx(i)-B(i)\*v(i)\*vx(i)\*dt;

vy(i+1)=vy(i)-g\*dt-B(i)\*v(i)\*vy(i)\*dt;

B(i+1)=B(i)\*(1-a\*y(i+1)/T0)^alfa;

t(i+1)=t(i)+dt;

else

break

end

end

plot(x,y,'b')

text(41000,6000,' \leftarrow 710');

text(33000,6000,' 700 \rightarrow ');

axis([0 4.6e4 1000 12000]);

title('the change of the trajecctory of the bomb')

grid on

box on



## 2.12

%

## 2.13

clear all

g=9.8;

L(1)=0;

k=1;

for theta=0:pi/500:pi/2

vx1(1)=49\*cos(theta);

vy1(1)=49\*sin(theta);

x1(1)=0;

y1(1)=0;

dt=1;

i=2;

while y1(i-1)>=0

x1(i)=x1(i-1)+vx1(i-1)\*dt;

vx1(i)=vx1(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx1(i-1)^2+vy1(i-1)^2)-35)/5)))\*vx1(i-1)\*(sqrt(vx1(i-1)^2+vy1(i-1)^2))\*dt;

y1(i)=y1(i-1)+vy1(i-1)\*dt;

vy1(i)=vy1(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt(vx1(i-1)^2+vy1(i-1)^2)-35)/5)))\*vy1(i-1)\*(sqrt(vx1(i-1)^2+vy1(i-1)^2))\*dt;

i=i+1;

end

L(k)=x1(i-2);

k=k+1;

end

subplot(2,2,1)

hold on

box on

k=1;

Lmax=L(k);

for theta=0:pi/500:pi/2

plot(theta,L(k),'b.','MarkerSize',4)

if Lmax<L(k)

Lmax=L(k);

end

k=k+1;

end

xlabel('theta')

ylabel('x\_m(m)')

title('Range of different angles')

ss=mod(Lmax,1);

zs=Lmax-ss;

while mod(ss,1)>0

ss=ss\*10;

end

disp(['a) The maximal distance is',int2str(zs),'.',int2str(ss),'(m)'])

hold off

L2(1)=0;

k=1;

for theta=0:pi/500:pi/2

vx2(1)=49\*cos(theta);

vy2(1)=49\*sin(theta);

x2(1)=0;

y2(1)=0;

dt=1;

i=2;

while y2(i-1)>=0

x2(i)=x2(i-1)+vx2(i-1)\*dt;

vx2(i)=vx2(i-1)-(0.0039+0.0058/(1+exp((sqrt((vx2(i-1)+11.14)^2+vy2(i-1)^2)-35)/5)))\*(vx2(i-1)+11.14)\*(sqrt((vx2(i-1)+11.14)^2+vy2(i-1)^2))\*dt;

y2(i)=y2(i-1)+vy2(i-1)\*dt;

vy2(i)=vy2(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt((vx2(i-1)+11.14)^2+vy2(i-1)^2)-35)/5)))\*vy2(i-1)\*(sqrt((vx2(i-1)+11.14)^2+vy2(i-1)^2))\*dt;

i=i+1;

end

L2(k)=x2(i-2);

k=k+1;

end

subplot(2,2,2)

hold on

box on

k=1;

L2max=L2(k);

for theta=0:pi/500:pi/2

plot(theta,L2(k),'r.','MarkerSize',4)

if L2max<L2(k)

L2max=L2(k);

end

k=k+1;

end

xlabel('theta')

ylabel('x\_m(m)')

title('Range with wind of different angles')

ss=mod(L2max,1);

zs=L2max-ss;

while mod(ss,1)>0

ss=ss\*10;

end

disp(['b1) The maximal distance with tailwind is ',int2str(zs),'.',int2str(ss),'(m)'])

L3(1)=0;

k=1;

for theta=0:pi/500:pi/2

vx3(1)=49\*cos(theta);

vy3(1)=49\*sin(theta);

x3(1)=0;

y3(1)=0;

dt=1;

i=2;

while y3(i-1)>=0

x3(i)=x3(i-1)+vx3(i-1)\*dt;

vx3(i)=vx3(i-1)-(0.0039+0.0058/(1+exp((sqrt((vx3(i-1)-11.14)^2+vy3(i-1)^2)-35)/5)))\*(vx3(i-1)-11.14)\*(sqrt((vx3(i-1)-11.14)^2+vy3(i-1)^2))\*dt;

y3(i)=y3(i-1)+vy3(i-1)\*dt;

vy3(i)=vy3(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt((vx3(i-1)-11.14)^2+vy3(i-1)^2)-35)/5)))\*vy3(i-1)\*(sqrt((vx3(i-1)-11.14)^2+vy3(i-1)^2))\*dt;

i=i+1;

end

L3(k)=x3(i-2);

k=k+1;

end

k=1;

L3max=L3(k);

for theta=0:pi/500:pi/2

plot(theta,L3(k),'k.','MarkerSize',4)

if L3max<L3(k)

L3max=L3(k);

end

k=k+1;

end

ss=mod(L3max,1);

zs=L3max-ss;

while mod(ss,1)>0

ss=ss\*10;

end

disp(['b2) The maximal distance with headwind is ',int2str(zs),'.',int2str(ss),'(m)'])

hold off

L4(1)=0;

k=1;

for theta=0:pi/500:pi/2

vx4(1)=53.45\*cos(theta);

vy4(1)=53.45\*sin(theta);

x4(1)=0;

y4(1)=0;

dt=1;

i=2;

while y4(i-1)>=0

x4(i)=x4(i-1)+vx4(i-1)\*dt;

vx4(i)=vx4(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx4(i-1)^2+vy4(i-1)^2)-35)/5)))\*vx4(i-1)\*(sqrt(vx4(i-1)^2+vy4(i-1)^2))\*dt;

y4(i)=y4(i-1)+vy4(i-1)\*dt;

vy4(i)=vy4(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt(vx4(i-1)^2+vy4(i-1)^2)-35)/5)))\*vy4(i-1)\*(sqrt(vx4(i-1)^2+vy4(i-1)^2))\*dt;

i=i+1;

end

L4(k)=x4(i-2);

k=k+1;

end

subplot(2,2,3)

hold on

box on

k=1;

L4max=L4(k);

for theta=0:pi/500:pi/2

plot(theta,L4(k),'b.','MarkerSize',4)

if L4max<L4(k)

L4max=L4(k);

end

k=k+1;

end

xlabel('theta')

ylabel('x\_m(m)')

title('Range of with different initial velocities of different angles')

ss=mod(L4max,1);

zs=L4max-ss;

while mod(ss,1)>0

ss=ss\*10;

end

%disp(['c1) The maximal distance with a initial speed of 120mph is ',int2str(zs),'.',int2str(ss),'(m)'])

L4(1)=0;

k=1;

for theta=0:pi/500:pi/2

vx4(1)=44.55\*cos(theta);

vy4(1)=44.55\*sin(theta);

x4(1)=0;

y4(1)=0;

dt=1;

i=2;

while y4(i-1)>=0

x4(i)=x4(i-1)+vx4(i-1)\*dt;

vx4(i)=vx4(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx4(i-1)^2+vy4(i-1)^2)-35)/5)))\*vx4(i-1)\*(sqrt(vx4(i-1)^2+vy4(i-1)^2))\*dt;

y4(i)=y4(i-1)+vy4(i-1)\*dt;

vy4(i)=vy4(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt(vx4(i-1)^2+vy4(i-1)^2)-35)/5)))\*vy4(i-1)\*(sqrt(vx4(i-1)^2+vy4(i-1)^2))\*dt;

i=i+1;

end

L4(k)=x4(i-2);

k=k+1;

end

k=1;

L4max=L4(k);

for theta=0:pi/500:pi/2

plot(theta,L4(k),'r.','MarkerSize',4)

if L4max<L4(k)

L4max=L4(k);

end

k=k+1;

end

ss=mod(L4max,1);

zs=L4max-ss;

while mod(ss,1)>0

ss=ss\*10;

end

%disp(['c2) The maximal distance with a initial speed of 100mph is',int2str(zs),'.',int2str(ss),'(m)'])

hold off

theta=pi/4;

vx5(1)=44.55\*cos(theta);

vy5(1)=44.55\*sin(theta);

x5(1)=0;

y5(1)=0;

dt=0.01;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vx5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vy5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

if x5(i)>=18.4404\*0.9925 &&x5(i)<=18.4404\*1.0075

v=sqrt(vx5(i)^2+vy5(i)^2);

ss=mod(v,1);

zs=v-ss;

while mod(ss,1)>0

ss=ss\*10;

end

%disp(['d) The velocity with a initial speed of 100mph when it crosses the home plate is ',int2str(zs),'.',int2str(ss),'(m/s)'])

end

i=i+1;

end

subplot(2,2,4)

hold on

box on

plot(x5,y5,'b.','MarkerSize',4)

xlabel('x(m)')

ylabel('y(m)')

title('Trajectory of a batted baseball')

a) The maximal distance is137.16714824767575464(m)

b1) The maximal distance with tailwind is 116.5981130833609426(m)

b2) The maximal distance with headwind is 163.6744936540115132(m)



## 2.14

%2-14

clear all

g=9.8;

theta=pi/4;

vx5(1)=44.55\*cos(theta);

vy5(1)=44.55\*sin(theta);

x5(1)=0;

y5(1)=0;

dt=0.01;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vx5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vy5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

i=i+1;

end

vx(1)=44.55\*cos(theta);

vy(1)=44.55\*sin(theta);

x(1)=0;

y(1)=0;

dt=0.01;

i=2;

while y(i-1)>=0

x(i)=x(i-1)+vx(i-1)\*dt;

vx(i)=vx(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx(i-1)^2+vy(i-1)^2)+4.45-35)/5)))\*(vx(i-1)+4.45\*cos(theta))\*(sqrt(vx(i-1)^2+vy(i-1)^2)+4.45)\*dt;

y(i)=y(i-1)+vy(i-1)\*dt;

vy(i)=vy(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt(vx(i-1)^2+vy(i-1)^2)+4.45-35)/5)))\*(vy(i-1)+4.45\*sin(theta))\*(sqrt(vx(i-1)^2+vy(i-1)^2)+4.45)\*dt;

i=i+1;

end

hold on

box on

plot(x5,y5,'b.','MarkerSize',4)

plot(x,y,'r.','MarkerSize',4)

xlabel('x(m)')

ylabel('y(m)')

title('trajectory of a batted baseball')

text(40,20,'with a tailwind of 10mph')

text(80,30,'no wind')

grid on

box on

axis tight



## 2.15

%

## 2.16

clear all

g=9.8;

theta=pi/4;

for v=44.55:0.5:84.55

vx5(1)=v\*cos(theta);

vy5(1)=v\*sin(theta);

x5(1)=0;

y5(1)=0;

dt=0.01;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vx5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vy5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

i=i+1;

end

if x5(i-2)>167.64

break

end

end

ss=mod(v,1);

zs=v-ss;

while mod(ss,1)>0

ss=ss\*10;

end

box on

plot(x5,y5,'b.','MarkerSize',4)

xlabel('x(m)')

ylabel('y(m)')

title('trajectory of a batted baseball')

axis tight

grid on



## 2.17

clear all

g=9.8;

v=31.18;

vx5(1)=v;

vy5(1)=0;

vz5(1)=0;

x5(1)=0;

y5(1)=1;

z5(1)=0;

phi(1)=0;

omega=2;

dt=0.01;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2+vz5(i-1)^2)-35)/5)))\*vx5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2+vz5(i-1)^2))\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt;

phi(i)=phi(i-1)+omega\*dt;

z5(i)=z5(i-1)+vz5(i-1)\*dt;

vz5(i)=vz5(i-1)+omega\*vx5(i-1)\*0.5\*(sin(2\*phi(i-1))-0.25\*sin(8\*phi(i-1))+0.08\*sin(12\*phi(i-1))-0.025\*sin(16\*phi(i-1)))\*dt;

i=i+1;

end

hold on

box on

plot(x5,y5,'-b')

plot(x5,z5,'--r')

xlabel('x(m)')

ylabel('y or z(m)')

title('Trajectories of knuckleballs')

axis tight

legend('vertical deflection(y)','horizontal deflection(z)')



## 2.18

clear all

g=9.8;

v=31.18;

vx5(1)=v;

vy5(1)=0;

x5(1)=0;

y5(1)=1.0668;

phi(1)=0;

omega=1000/120/pi;

dt=0.01;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vx5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt+omega\*vx5(i-1)\*4.1\*10^(-4)\*dt;

i=i+1;

end

hold on

box on

plot(x5,y5,'-b')

xlabel('x(m)')

ylabel('y(m)')

title('Trajectories of fastballball')

axis tight

legend('vertical deflection(y)')



## 2.19

clear all

g=9.8;

v=31.18;

vx5(1)=v;

vy5(1)=0;

x5(1)=0;

y5(1)=1.0668;

phi(1)=0;

omega=2000/120/pi;

dt=0.01;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2)-35)/5)))\*vx5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2))\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt+omega\*vx5(i-1)\*4.1\*10^(-4)\*dt;

i=i+1;

end

hold on

box on

plot(x5,y5,'--b')

xlabel('x(m)')

ylabel('y(m)')

title('Trajectories of batted ball')

axis tight



## 2.20

%

## 2.21

%

## 2.22

%

## 2.23

%

## 2.24

clear all

g=9.8;

rho=1.205;

A=1.2\*10^(-5);

m=0.01;

v=3;

vx5(1)=v;

vy5(1)=0;

x5(1)=0;

y5(1)=0.5;

hold on

box on

for omega=1:5:20

dt=0.01;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-0.5\*rho\*A\*vx5(i-1)\*sqrt(vx5(i-1)^2+vy5(i-1)^2)\*dt-0.04\*omega\*vy5(i-1)\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt+omega\*vx5(i-1)\*0.04\*dt-0.5\*rho\*A\*vy5(i-1)\*sqrt(vx5(i-1)^2+vy5(i-1)^2)\*dt;

i=i+1;

end

plot(x5,y5,'-','color','r')

end

xlabel('x(m)')

ylabel('y(m)')

axis tight

title('Trajectories of Ping-pong ball')



## 2.25

clear all

g=9.8;

v=31.18;

theta=9/360\*2\*pi;

vx5(1)=v\*cos(theta);

vy5(1)=v\*sin(theta);

vz5(1)=0;

x5(1)=0;

y5(1)=1.0668;

z5(1)=0;

phi(1)=0;

omega=30/2/pi;

dt=0.1;

i=2;

while y5(i-1)>=0

x5(i)=x5(i-1)+vx5(i-1)\*dt;

vx5(i)=vx5(i-1)-(0.0039+0.0058/(1+exp((sqrt(vx5(i-1)^2+vy5(i-1)^2+vz5(i-1)^2)-35)/5)))\*vx5(i-1)\*(sqrt(vx5(i-1)^2+vy5(i-1)^2+vz5(i-1)^2))\*dt;

y5(i)=y5(i-1)+vy5(i-1)\*dt;

vy5(i)=vy5(i-1)-g\*dt;

phi(i)=phi(i-1)+omega\*dt;

z5(i)=z5(i-1)+vz5(i-1)\*dt;

vz5(i)=vz5(i-1)+omega\*vx5(i-1)\*0.04\*dt;

i=i+1;

end

hold on

box on

plot(x5,y5,'-b')

plot(x5,z5,'--r')

xlabel('x(m)')

ylabel('y or z(m)')

title('Sidespin of golf')

legend('vertical deflection(y)','horizontal deflection(z)')



## 2.26

%

## 2.27

%