%UIUC Physics Society, MATLAB Tutorial: The Ball-and-Cliff Problem

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%May be reproduced with credit to the original work

%Description

% This script numerically solves and plots the path of a projectile when

% thrown near earth's surface from a initial height (y0) at an angle

% (theta) with an initial velocity (v0). The script assumes no air

% resistance and inelasic collisions with the ground.

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%clean up workspace

close all %closes any open plots

clear %deletes any (old) variables

clc %clears the screen

%Set initial values

t=0:180; %time (s)

y0=500; %initial height (m)

v0=100; %initial velocity (m/s)

theta=60\*pi/180; %angle of departure

g=-9.81; %gravitational acceleration (m/s)

bounce=0; %how many times the ball has bounced thus far

%The fun stuff

y(1)=y0; %y is the vertical displacement

x=v0\*cos(theta)\*t; %lateral distance travelled

for i=2:length(t)

 if bounce==0 %This part only happens at the start

 y(i)=1/2\*g\*t(i).^2+v0\*sin(theta)\*t(i)+y0;

 end

 if bounce>0 %This part happens after the first bounce

 v=(0.9)^(bounce)\*(-2\*g\*max(y)).^(1/2);

 y(i)=1/2\*g\*t(i-istar+1).^2+v\*t(i-istar+1);

 end

 if y(i)<0 %Checks for bounces (We want a ball, not a drill)

 y(i)=[];

 istar=i; %need to re-index time

 bounce=bounce+1;

 end

 %make some plots

 plot(x(1:length(y)),y,'r');

 axis([0,10000,0,900]);

 ylabel('Height (m)')

 xlabel('Horizontal Distance (m)')

 hold on

 plot(x(length(y)),y(end),'ok') %plot the last point as a circle for fun

 hold off

 getframe; %This is the command really responsible for the "movie".

 %Note that we could move the plot commands outside of the loop for

 %speed, but we're using them here to make this movie.

end