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%ORBITAL MECHANICS
%HOMEWORK 2
%Exercise 1

%earth gravitational parameter
mu=398600; %km^3/s^2

%CIRCULAR ORBIT
%initial conditions

r0=[39470;15939;9203]; %km
v0=[-1.279; 2.375;1.371];%km/s
v=norm(v0);
r=norm(r0);
T=2*pi*sqrt(r^3/mu);%orbit time

tspan=[0 T]; %sec
y0=[r0;v0];

%solving the differential equation of motion
[t,y]=ode45(@orbitfun,tspan,y0);

PlotEarth
plot3(y(:,1),y(:,2),y(:,3))

%ELLIPTICAL ORBIT
r0=[ -3859; 18952; 10942];%km
v0=[-5.16;-0.263;-0.152];%km/s
v=norm(v0);
r=norm(r0);

h=cross(r0,v0); %angular momentum vector and magnitude
hn=norm(h);
e=0.5; %eccentricity
a=(hn^2/mu)*(1/(1-e^2)); %semi-major axis
T=2*pi*sqrt(a^3/mu); %orbit time

y0=[r0;v0];
tspan=[0 T];
[t,y]=ode45(@orbitfun,tspan,y0);

figure(2)
PlotEarth
plot3(y(:,1),y(:,2),y(:,3))

%HYPERBOLIC ORBIT
r0=[13015;986;569];
v0=[-0.73;7.227;4.172];
v=norm(v0);
r=norm(r0);

y0=[r0;v0];

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tspan=[0 T/3];
[t,y]=ode45(@orbitfun,tspan,y0);

figure(3)
PlotEarth
plot3(y(:,1),y(:,2),y(:,3))
hold on
plot3(y(:,1),-y(:,2),-y(:,3))

%--comments
%{
In order to know which conic section we have based on our initial
conditions we need to analyze different properties of the orbit such
as
eccentricity (e), semi mayor axis (a), energy(E) and how velocity is
related to position. Each conic section has specific ranges/equations
to
define such parameters and if we put them all together we can find a
proper
guess for our initial position and velocity vectors.

In this problem, to make it easier and more accurate, an orbit online
simulator which will give a position and velocity vectors based on the
orbital elements. In order to obtain the requested conic sections, the
eccentricity value was changed. Credits http://en.homasim.com/orbitsimulation.php
%}

ans =

Figure (1) with properties:

    Number: 1
    Name: ''
    Color: [0 0 0]
    Position: [488 342 560 420]
    Units: 'pixels'

Use GET to show all properties

ans =

Figure (5) with properties:

    Number: 5
    Name: ''
    Color: [0 0 0]

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Position: [488 342 560 420]  
Units: 'pixels'
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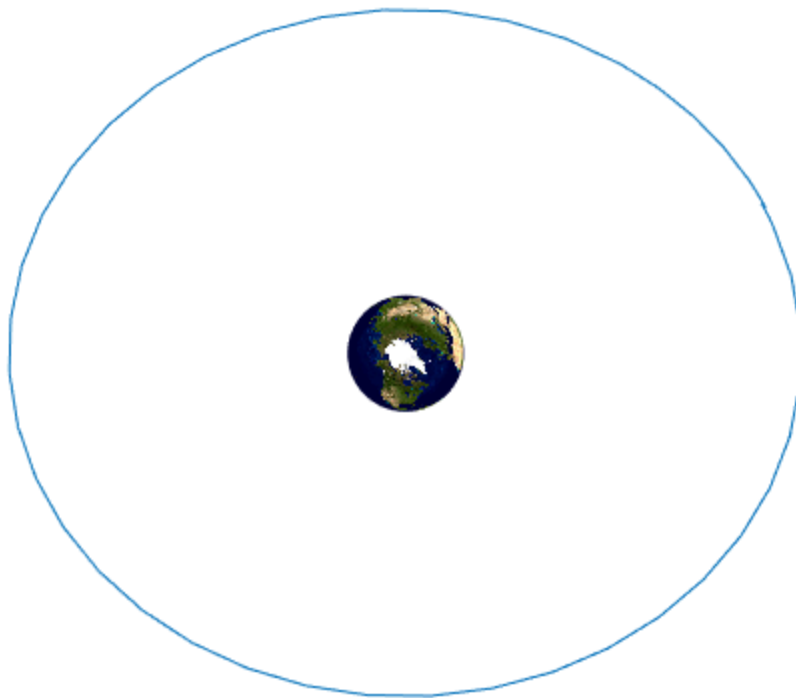
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Use GET to show all properties
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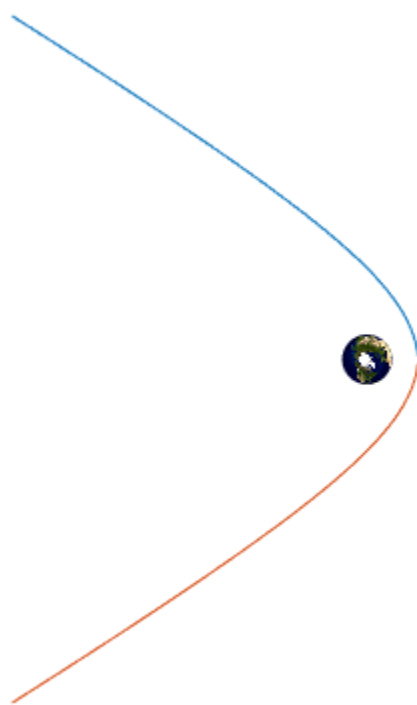
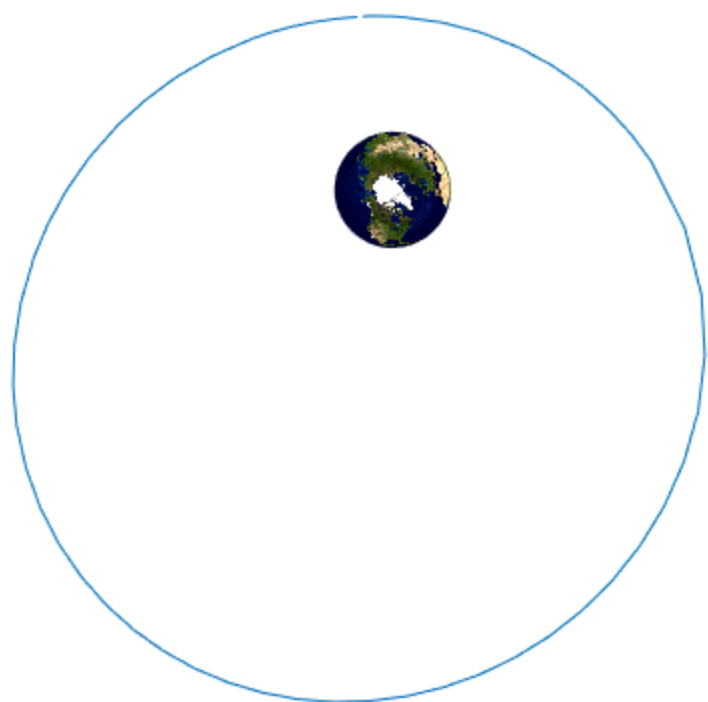
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ans =
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Figure (6) with properties:
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Number: 6  
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Color: [0 0 0]  
Position: [488 342 560 420]  
Units: 'pixels'
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Use GET to show all properties
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