
Problem 7

```
clear all; close all; clc

mu = 0.01214;
mu_star = 1-mu;
ic = [1.2 0 0 -1.04935751];
T = 6.19216933;

options = odeset('RelTol',1e-6);
[Time,Z] = ode45('Apollo',[0 3*T],ic,options);

x = Z(:,1);
y = Z(:,2);
L1 = max(x);
L2 = 0.06085;
plot(x,y); hold on;
plot(mu,0,'.b','MarkerSize',20)
plot(mu_star,0,'.k','MarkerSize',15)
plot(L1,0,'.r','MarkerSize',8)
plot(L2,0,'.m','MarkerSize',8)
axis([-1.5 1.5 -1.5 1.5])
legend('Apollo Trajectory','Earth','Moon','L1','L2')
text(L1+.05,0,'L1');
text(L2+.05,.05,'L2');
axis equal; grid on
title('Apollo Trajectory')

hold off;
figure
ic = [1.2 0 0 2*-1.04935751];
options = odeset('RelTol',1e-6);
[Time,Z] = ode45('Apollo',[0 3*T],ic,options);
x = Z(:,1);
y = Z(:,2);
plot(x,y); hold on;
plot(mu,0,'.b','MarkerSize',20)
plot(mu_star,0,'.k','MarkerSize',15)
axis([-1.5 1.5 -1.5 1.5])
axis equal; grid on
legend('Apollo Trajectory','Earth','Moon')
title('Apollo Trajectory with Double Initial Velocity')

hold off;
figure
ic = [1.2 0 0 1/2*-1.04935751];
options = odeset('RelTol',1e-6);
[Time,Z] = ode45('Apollo',[0 3*T],ic,options);
x = Z(:,1);
y = Z(:,2);
plot(x,y); hold on;
plot(mu,0,'.b','MarkerSize',25)
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```
plot(mu_star,0,'.k','MarkerSize',15)
axis([-1.5 1.5 -1.5 1.5])
axis equal; grid on
legend('Apollo Trajectory','Earth','Moon')
title('Apollo Trajectory with Half Inital Velocity')

hold off;
figure
ic = [1.15 0 0 -1.04935751];
options = odeset('RelTol',1e-6);
[Time,Z] = ode45('Apollo',[0 3*T],ic,options);
x = Z(:,1);
y = Z(:,2);
plot(x,y); hold on;
plot(mu,0,'.b','MarkerSize',25)
plot(mu_star,0,'.k','MarkerSize',15)
axis([-1.5 1.5 -1.5 1.5])
axis equal; grid on
legend('Apollo Trajectory','Earth','Moon')
title('Apollo Trajectory with x_o=1.15')

function [vecDeriv] = Apollo(t,z)
mustar = 0.01214;

r1 = sqrt((z(1)+mustar)^2+z(2)^2);
r2 = sqrt((z(1)+mustar-1)^2+z(2)^2);
vecDeriv(1) = z(3);
vecDeriv(2) = z(4);
vecDeriv(3) = -(1-mustar)*(z(1)+mustar)/
(r1^3)-mustar*(z(1)-1+mustar)/r2^3+z(1)
+2*z(4);
vecDeriv(4) = -(1-mustar)*z(2)/r1^3 -
mustar*z(2)/r2^3+z(2)-2*(z(3));
vecDeriv = vecDeriv.';
end
```



