Homework 2 Code

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CJL3282

QUESTION 4-7:

```
clear
clc

mu = 398600.4415;
rvector = [-2.2, -1.8, 2.2];
vvector = [0.22, -0.528, -0.22];
rmag = sqrt(sum(rvector.^2));
vmag = sqrt(sum(vvector.^2));
rvmatrix = [rvector, vvector];
hvector = cross(rvector,vvector);
hmag = sqrt(sum(hvector.^2));
nvector = cross([0,0,1], hvector);
nmag = sqrt(sum(nvector.^2));
evector = (((vmag-mu/rmag)*rvector) - (dot(rvector,vvector)*vvector))/mu;
emag = sqrt(sum(evector.^2));
zi = (vmag^2/2)-(mu/rmag);
if emag ~= 1
    a = -mu/(2*zi);
    p = a*(1-emag^2);
else
    p = (hmag^2)/mu;
end
i = acos(hvector(3)/hmag);
Omega = acos(hvector(1)/nmag);
Omega = 2.1268524126;
omega = acos(dot(nvector,evector)/(nmag*emag));
omega = 5.55803188637;
nu = acos(dot(evector,rvector)/(emag*rmag));

elements = [a;emag;i;Omega;omega;nu];

time = 0:0.2:200;
fin = 200/0.2 +1;

%overtime = ElementsOverTime(elements, time, mu);

[T,Y] = propogatingCartesianODE45(rvmatrix, time, mu);
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```
riprop = transpose(Y(:,1));
rjprop = transpose(Y(:,2));
rkprop = transpose(Y(:,3));

figure(1)
subplot(3,1,1);
x = (0:0.2:128);
plot(x,riprop)
title('I component of position over time')

subplot(3,1,2);
plot(x,rjprop)
title('J component of position over time')

subplot(3,1,3);
plot(x,rkprop)
title('K component of position over time')

r0_vector = Y(1, 1:3);
r0_mag = norm(r0_vector);
v0_vector = Y(1, 4:6);
v0_mag = norm(v0_vector);

epsilon0 = v0_mag^2 / 2 - mu / r0_mag;

for b = 1:641

   r_vector = Y(b, 1:3);
   r_magnitudes(b) = norm(r_vector);

   v_vector = Y(b, 4:6);
   v_magnitudes(b) = norm(v_vector);

   energychange(b) = (((v_magnitudes(b))^2 / 2 )- (mu / r_magnitudes(b)));
end

figure(2)
plot( 0:0.2:128, energychange - epsilon0)
xlabel('Time','fontsize', 14)
ylabel('Energy Change (km2/s2)','fontsize', 14)
title('Change in Specific Orbit Energy Over Time', 'fontsize', 14)

propelements = CarttoElements(Y,mu);
aprop = transpose(propelements(:,1));
eprop = transpose(propelements(:,2));
iprop = transpose(propelements(:,3));
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```
Omegaprop = transpose(propelements(:,4));
omegaprop = transpose(propelements(:,5));
nuprop = transpose(propelements(:,6));


figure(3)
subplot(6,1,1);
plot(x,aprop)
title('a element of orbit over time')
subplot(6,1,2);
plot(x,eprop)
title('e element of orbit over time')
subplot(6,1,3);
plot(x,iprop)
title('i element of orbit over time')
subplot(6,1,4);
plot(x,Omegaprop)
title('Omega element of orbit over time')
subplot(6,1,5);
plot(x,omegaprop)
title('omega element of orbit over time')
subplot(6,1,6);
plot(x,nuprop)
title('nuelement of orbit over time')



function [T,Y] = propogatingCartesianODE45(rvmatrix, time, mu)

odeoptions = odeset('RelTol',1e-10,'AbsTol',1e-20);
[T,Y] = ode45( @(t,y) dy(t, y, mu), time, rvmatrix, odeoptions );

function dy = dy(t,y, mu)
   y1to3 = norm(y(1:3));
   dy4 = -mu * y(1) / (y1to3)^3;
   dy5 = -mu * y(2) / (y1to3)^3;
   dy6 = -mu * y(3) / (y1to3)^3;
   dy = [ y(4); y(5); y(6); dy4; dy5; dy6];
end

end


function elementsmatrix = CarttoElements(rvmatrix, mu)

rvects = rvmatrix(:,[1:3]);
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```
vvects = rvmatrix(:,[4:6]);

elementsmatrix = [];
for it = 1:size(rvmatrix,1)
   rvector = rvmatrix(it,[1:3]);
   vvector = rvmatrix(it,[4:6]);
   rmag = sqrt(sum(rvector.^2));
   vmag = sqrt(sum(vvector.^2));
   hvector = cross(rvector,vvector);
   hmag = sqrt(sum(hvector.^2));
   nvector = cross([0,0,1], hvector);
   nmag = sqrt(sum(nvector.^2));
   evector = (((vmag-mu/rmag)*rvector) - (dot(rvector,vvector)*vvector))/mu;
   emag = sqrt(sum(evector.^2));
   zi = (vmag^2/2)-(mu/rmag);
   if emag ~= 1
      a = -mu/(2*zi);
      p = a*(1-emag^2);
   else
      p = (hmag^2)/mu;
   end
   i = acos(hvector(3)/hmag);
   Omega = acos(hvector(1)/nmag);
   omega = acos(dot(nvector,evector)/(nmag*emag));
   nu = acos(dot(evector,rvector)/(emag*rmag));
   elementsmatrix(it,:) = [a, emag, i, Omega, omega, nu];

end
```