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#2

```
clear;clc;close all
r_ijk = [8228 389 6888];
v_ijk = [-0.7 6.6 -0.6];
[a, ecc, i, Omega, omega, theta] = ijk2keplerian(r_ijk, v_ijk)
```

a =

1.3361e+04

ecc =

0.1376 0.1284 0.1149

i =

0.6970

Omega =

4.7099

omega =

2.1943

theta =

5.6978

#3

```
clear;clc;close all
r_ijk = [8228 389 6888]';
v_ijk = [-0.7 6.6 -0.6]';
x = [r_ijk; v_ijk];

[t, x] = ode45(@fun, [0 2*60*60], x);
plot3(x(:,1),x(:,2),x(:,3))
grid()

function [a, ecc, i, Omega, omega, theta] = ijk2keplerian(r, v)
    GM = 3.986e5;
    ui = [1 0 0];
    uk = [0 0 1];

    mag_r = norm(r);
    mag_v = norm(v);
```

```

Ener = mag_v^2/2 - GM/mag_r;
a = -GM/(2*Ener);

h = cross(r,v)/norm(cross(r,v));
i = acos(dot(h,uk));

ecc = -(cross(cross(r,v),v)/GM + r/mag_r);
mag_ecc = norm(ecc);

N = cross(uk,h);
mag_N = norm(N);

cos_Omega = dot(ui,N)/mag_N;
sin_Omega = cross(ui,N)/mag_N;

Omega = atan2(sin_Omega(3), cos_Omega);
if Omega<0
    Omega = Omega+2*pi();
end

cos_omega = dot(N,ecc)/(mag_N*mag_ecc);
sin_omega = dot(cross(N,ecc)/(mag_N*mag_ecc), h);
omega = atan2(sin_omega, cos_omega);
if omega<0
    omega = omega+2*pi();
end

cos_theta = dot(ecc,r)/(mag_ecc*mag_r);
sin_theta = dot(cross(ecc,r)/(mag_ecc*mag_r), h);
theta = atan2(sin_theta,cos_theta);
if theta<0
    theta = theta+2*pi();
end

E = 2*atan(sqrt((1-mag_ecc)/(1+mag_ecc))*tan(theta/2));
M = E-mag_ecc*sin(E);
%     sqrt(a^3/GM)*M

end

function dxdt = fun(t, x)
    GM = 3.986e5;
    mag_r = norm(x);
    %     A = [ 0 1
    %           -GM/r^3 0];
    r = x(1:3);
    v = x(4:6);

    dxdt = zeros(6,1);
    dxdt(1:3) = v;
    dxdt(4:6) = -GM/mag_r^3*r;
end

```

