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- **#**2
- **#**3

#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

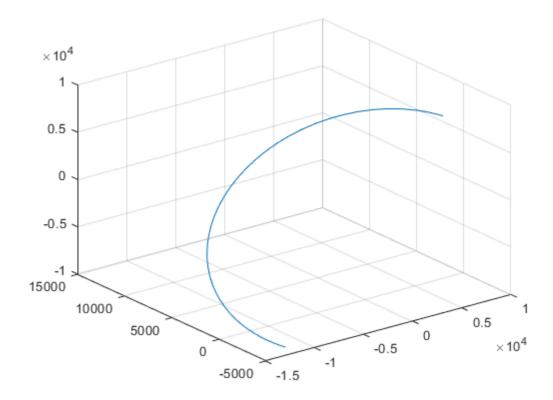
```
clear;clc;close all
r_ijk = [8228 389 6888]';
v_ijk = [-0.7 6.6 -0.6]';
x = [r_ijk; v_ijk];

[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</pre>
        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</pre>
        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</pre>
        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
```



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