
HW8 Problem 3

```
fprintf('\n');
clearvars -except function_list hw_pub toolsPath
close all
CelestialConstants; % import useful constants

% Orbit normal vector
normal_vec = @(X) cross(X(1:3),X(4:6))/norm(cross(X(1:3),X(4:6)));

% Anonymous function to calculate 2-body accel
two_body = @(t,X) [X(4);X(5);X(6);...
    -Earth.mu*X(1)/norm(X(1:3))^3;...
    -Earth.mu*X(2)/norm(X(1:3))^3;...
    -Earth.mu*X(3)/norm(X(1:3))^3] + 1e-6*[0;0;0;normal_vec(X)];

hp = 400;
ha = 1000;
a = (ha+hp+2*Earth.R)/2;
e = (ha+Earth.R-a)/a;
i = 51.5*pi/180;
RAAN = 0;
w = 60*pi/180;
f = 0;
P = 2*pi*sqrt(a^3/Earth.mu);

[r,v] = OE2cart(a,e,i,RAAN,w,f,Earth.mu);
X0 = [r;v];

tol=1e-12;
options=odeset('RelTol',tol,'AbsTol',[tol tol tol tol tol tol]);

[t_array,X_array]=ode45(two_body,[0 P],X0,options);

OE_array = zeros(6,length(t_array));
di_dt = zeros(length(t_array),1);
dRAAN_dt = zeros(length(t_array),1);
dw_dt = zeros(length(t_array),1);
for ii = 1:length(t_array)
    [OE_array(1,ii),...
     OE_array(2,ii),...
     OE_array(3,ii),...
     OE_array(4,ii),...
     OE_array(5,ii),...
     OE_array(6,ii)] = cart2OE(X_array(ii,1:3)',X_array(ii,4:6)',Earth.mu);

    r = norm(X_array(ii,1:3));
    h = norm(cross(X_array(ii,1:3),X_array(ii,4:6)));
    di_dt(ii) = r*cos(OE_array(5,ii)+OE_array(6,ii))/...
        (sqrt(Earth.mu/OE_array(1,ii)^3)...
         *OE_array(1,ii)^2*sqrt(1-OE_array(2,ii)^2))*1e-6;
    dRAAN_dt(ii) = r*sin(OE_array(5,ii)+OE_array(6,ii))/...
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        (sqrt(Earth.mu/OE_array(1,ii)^3)...
        *OE_array(1,ii)^2*sqrt(1-OE_array(2,ii)^2)*sin(OE_array(3,ii)))...
        *1e-6;
    dw_dt(ii) = r*cot(OE_array(3,ii))*sin(OE_array(5,ii)+OE_array(6,ii))...
        /(h)*1e-6;

end
% plot(t_array,OE_array(3,:));
% figure
% plot(t_array,[OE_array(4,OE_array(4,:)<pi), OE_array(4,OE_array(4,:)>=pi)-2*pi]);
% figure
% plot(t_array,OE_array(5,:));

fprintf(['a) The inclination, RAAN, and argument of periapse are\n'...
        'directly affected by this force, according to Gaussian VOP.\n'])
fprintf(['b) The inclination, RAAN, and argument of periapse will\n'...
        'all experience secular drift because energy is constantly\n'...
        'added to the system.\n'])
fprintf(['c) When the orbit is exaggerated, you can see evidence of\n'...
        'secular drift. The rate of change is biased toward either side\n'...
        'of zero over the course of an orbit.\n'])
figure('Position',[0 0 hw_pub.figWidth hw_pub.figHeight])
subplot(3,1,1)
plot(t_array,di_dt*180/pi*day2sec,'LineWidth',2)
ylabel('$\dot{i}$ (deg/day)','interpreter','latex')
subplot(3,1,2)
plot(t_array,dRAAN_dt*180/pi*day2sec,'LineWidth',2)
ylabel('$\dot{\Omega}$ (deg/day)','interpreter','latex')
subplot(3,1,3)
plot(t_array,dw_dt*180/pi*day2sec,'LineWidth',2)
ylabel('$\dot{\omega}$ (deg/day)','interpreter','latex')
xlabel('Time (sec)')

figure('Position',[0 0 hw_pub.figWidth hw_pub.figHeight])
subplot(3,1,1)
plot(OE_array(6,:),di_dt*180/pi*day2sec,'LineWidth',2)
ylabel('$\dot{i}$ (deg/day)','interpreter','latex')
subplot(3,1,2)
plot(OE_array(6,:),dRAAN_dt*180/pi*day2sec,'LineWidth',2)
ylabel('$\dot{\Omega}$ (deg/day)','interpreter','latex')
subplot(3,1,3)
plot(OE_array(6,:),dw_dt*180/pi*day2sec,'LineWidth',2)
ylabel('$\dot{\omega}$ (deg/day)','interpreter','latex')
xlabel('True Anomaly (deg)')

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a) The inclination, RAAN, and argument of periapse are directly affected by this force, according to Gaussian VOP.

b) The inclination, RAAN, and argument of periapse will all experience secular drift because energy is constantly added to the system.

c) When the orbit is exaggerated, you can see evidence of secular drift. The rate of change is biased toward either side of zero over the course of an orbit.

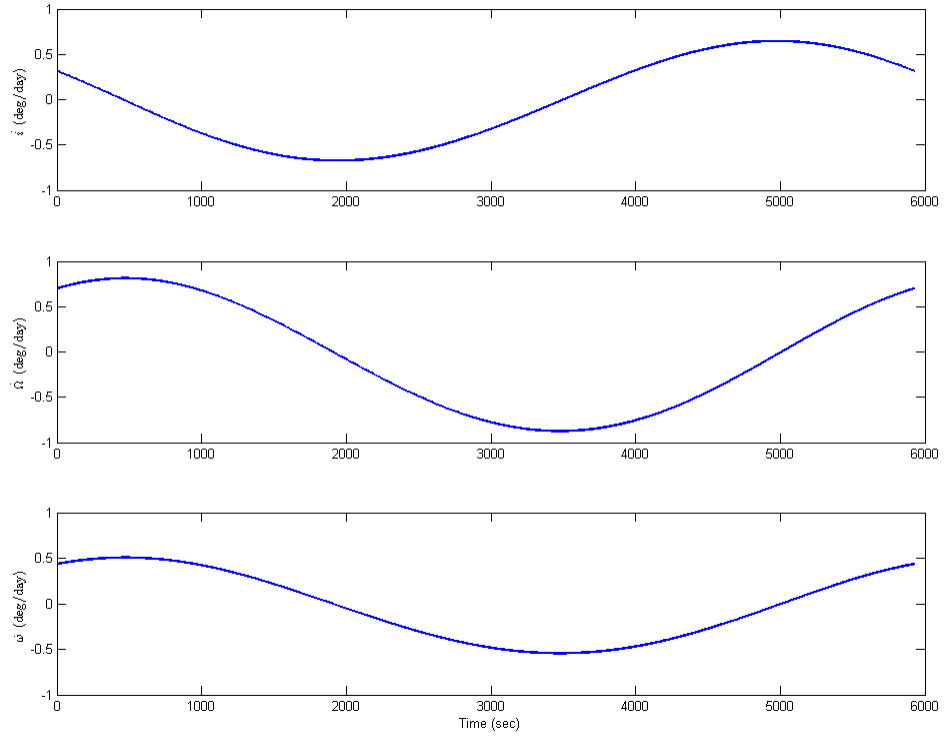
Warning: Imaginary parts of complex X and/or Y arguments ignored

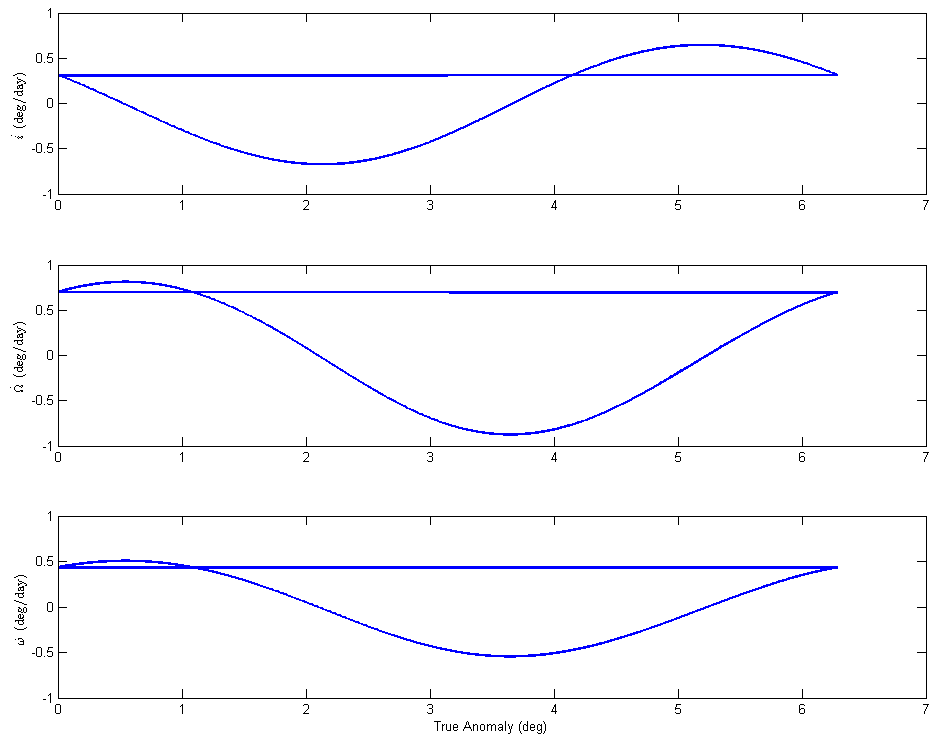
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