John Clouse IMD HW5 problem 3

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Initialize

```
clearvars -except hw_pub function_list
close all;
```

Initial conditions

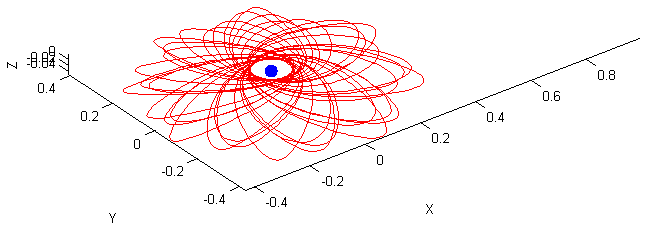
```
IC_set(:,1) = [
    -0.08
-0.03
0.01
3.5
-3.1
-0.1
26];

IC_set(:,2) = [0.05
-0.05
0
4.0
2.6
0
25];

IC_set(:,3) = [0.8300
0
0.114062816271683
0
0.229389507175582
0
15];

IC_set(:,4) = [-0.05
-0.02
0
4.09
-5.27
0
15];

% Constants
```

```
mu = 0.012150585609624;
dunit = 384747.962856037;
```

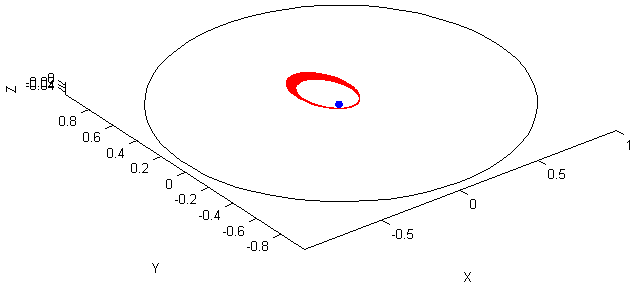
Loop through the conditions

```
for ii = 1:4
    X = IC_set(1:end-1,ii);

    T = 6.192169331319632;

    [T_out,X_out] = ode45(@CRTBP, [0,IC_set(end,ii)], X, odeset(),mu);

    figure('Position', hw_pub.figPosn)
    subplot(2,1,1);
    plot3(X_out(:,1), X_out(:,2), X_out(:,3), 'r')
    hold on
    rad_vec = [0:0.1:2*pi, 2*pi];
    my_circ = [cos(rad_vec); zeros(1, length(rad_vec)); sin(rad_vec)]';
    for ang = rad_vec
        for blah = 1:length(my_circ)
            new_circ(blah,:) = (Euler2DCM('3', ang)*my_circ(blah,:)')';
        end
        earth =  new_circ * 6378.1/dunit;
        moon =  (new_circ * 1737/dunit);
        plot3(earth(:,1) - mu, earth(:,2), earth(:,3))
        plot3(moon(:,1) + 1-mu, moon(:,2), moon(:,3), 'k')
    end
    axis equal; xlabel('X'); ylabel('Y'); zlabel('Z');
    title(['IC ' num2str(ii) ', Rotating Frame'])

    % For the inertial plots
    X_inrt = X_out;
    X_inrt(:,1) = X_inrt(:,1) + mu;
    for jj = 1:length(T_out)
        t = T_out(jj);
        ang = t;
        X_inrt(jj,1:3) = (Euler2DCM('3', -ang)*X_inrt(jj,1:3)')';
    end
    subplot(2,1,2);
    plot3(X_inrt(:,1), X_inrt(:,2), X_inrt(:,3), 'r')
    hold on
    for ang = rad_vec
    for blah = 1:length(my_circ)
        new_circ(blah,:) = (Euler2DCM('3', ang)*my_circ(blah,:)')';
    end
    earth =  new_circ * 6378.1/dunit;
    plot3(earth(:,1) - mu, earth(:,2), earth(:,3))
    end
    plot3(my_circ(:,1), my_circ(:,3), my_circ(:,2), 'k')
    axis equal; xlabel('X'); ylabel('Y'); zlabel('Z');
    title(['IC ' num2str(ii) ', Inertial Frame'])

end
```

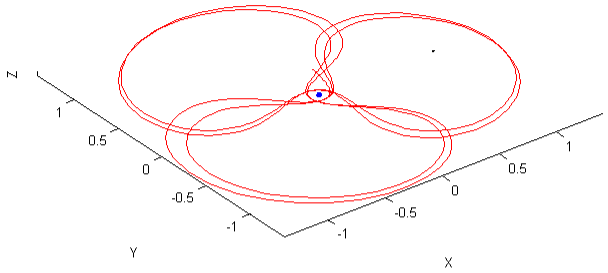
IC 1, Rotating Frame



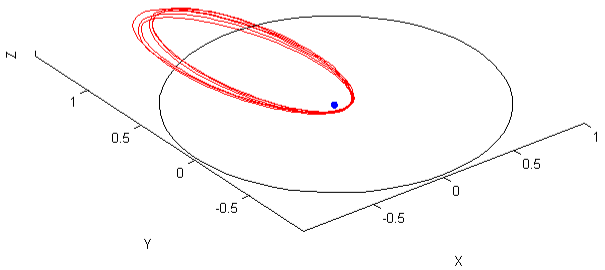
IC 1, Inertial Frame



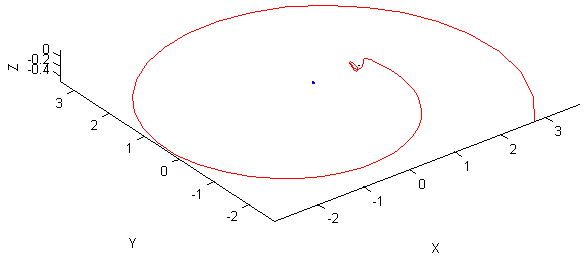
IC 2, Rotating Frame



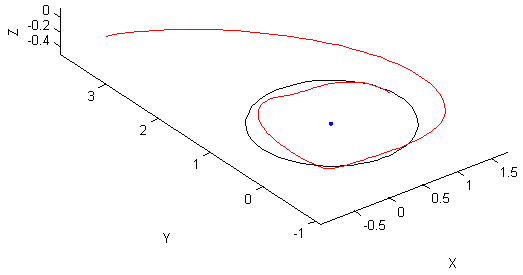
IC 2, Inertial Frame



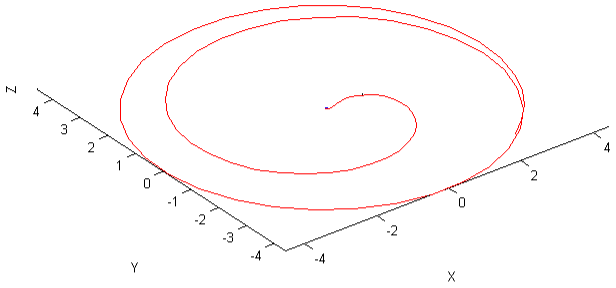
IC 3, Rotating Frame



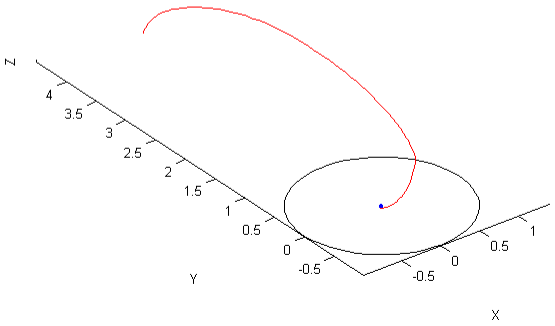
IC 3, Inertial Frame



IC 4, Rotating Frame



IC 4, Inertial Frame



Plot 1 Conclusion

For the first case, a two-body, point-mass propagation would yeild an elliptical (0<e<1) orbit that would follow previous orbit passes exactly, not changing any of the Keplerian orbital elements. The lunar perturbation is evident in the raising of the apogee as time progresses.

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