ENAE 404 - 0101

Homework 02: 2BP

Due on February 11th, 2025 at 11:59 PM

Dr. Barbee, 09:30

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Problem 1:

Given the following position and velocity vectors, calculate the Keplerian orbital elements, assuming Earth is the central body. Do not use a computer code to do this. Vectors are in units of km and $\frac{\text{km}}{\text{s}}$.

$$\vec{r} = 3634.1\hat{\boldsymbol{x}} + 5926\hat{\boldsymbol{y}} + 1206.6\hat{\boldsymbol{z}}$$
$$\vec{v} = -6.9049\hat{\boldsymbol{x}} + 4.3136\hat{\boldsymbol{y}} + 2.6163\hat{\boldsymbol{z}}$$

Solution

Problem 2:

1. Write code to convert form Cartesian coordinates to orbital elements.
2. Using subplot, plot the osculating orbital elements for the orbit of Didymos from HW00.
3. Describe why your plots make sense (in reference to both the time variation of the orbital elements as well as the plot of the orbit in 3D space).

Solution

Problem 3:

Given the following orbit: $a = 2 \times 10^4\,\text{km}, e = 0.4, i = 100°, \Omega = 30°, \omega = 15°, \nu = 15°$

1. Write code to convert from orbital elements to Cartesian coordinates.
2. Propogate the orbit (around Earth) for one period.
3. State the period of the orbit.
4. Plot the orbit in 3D (use equal-length axes).
5. Plot the deviation of the energy as compared to the inital energy ($E_i - E_0$).
6. Plot the osculating orbital elements.

Solution

Problem 4:

Sketch the following orbits in 2D and 3D. Assume that none of the spacecraft impact Earth.

- In the 2D orbit, label:
  - periapsis
  - angular momentum vector
  - ascending node
  - descending node
  - spacecraft location
  - portion of the orbit in the southern hemisphere
- In the 3D orbit, label:
  - angular momentum vector
  - ascending node
  - periapsis

Spacecraft ID	e	i (°)	Ω (°)	ω (°)	ν (°)
A	0.3	60	30	160	30
B	0.3	60	330	90	10
C	0.5	120	30	30	180

Solution