ASEN 6060
ADVANCED ASTRODYNAMICS
Week 2 Discussion

Objectives:

- Apply theoretical knowledge from Weeks 1 and 2 to scenarios in real celestial systems
- Devise foundational maneuvering heuristics
- Identify implementation challenges and useful questions to ask

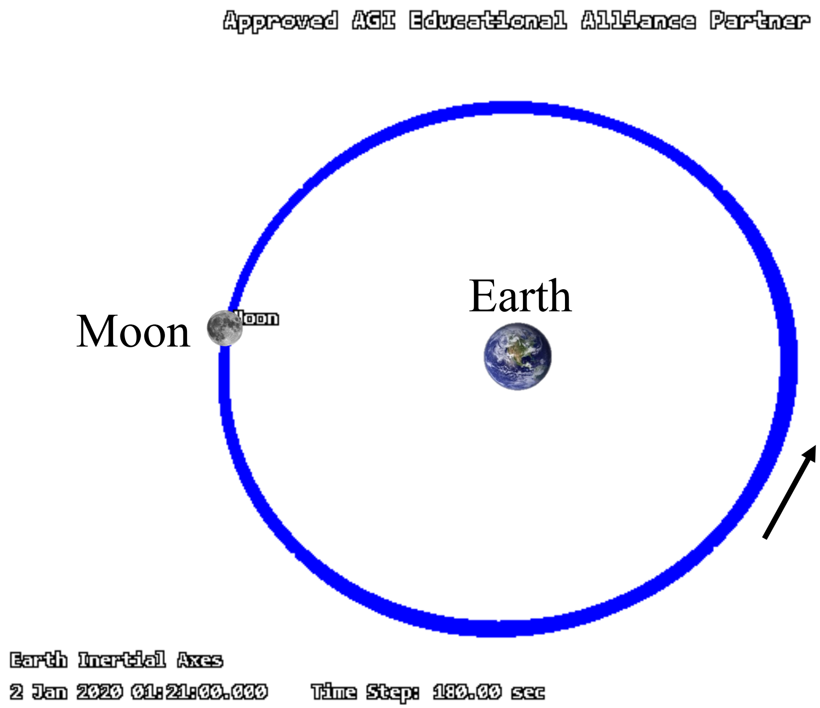
Question 1

Question 1: How would you select appropriate characteristic quantities for nondimensionalization in the Earth-Moon system if we didn't provide an orbital parameters sheet on Canvas?

$$m^* = \tilde{M}_1 + \tilde{M}_2$$

$$l^* = \tilde{R}_1 + \tilde{R}_2$$

$$t^* = \left(\frac{(l^*)^3}{\tilde{G} m^*} \right)^{1/2}$$



* Earth and Moon not to scale!

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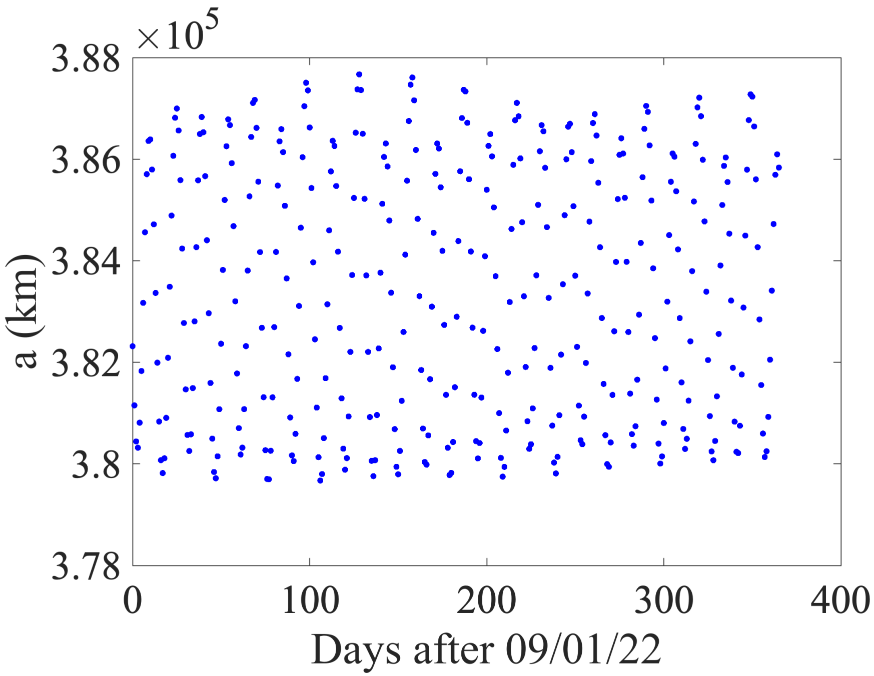
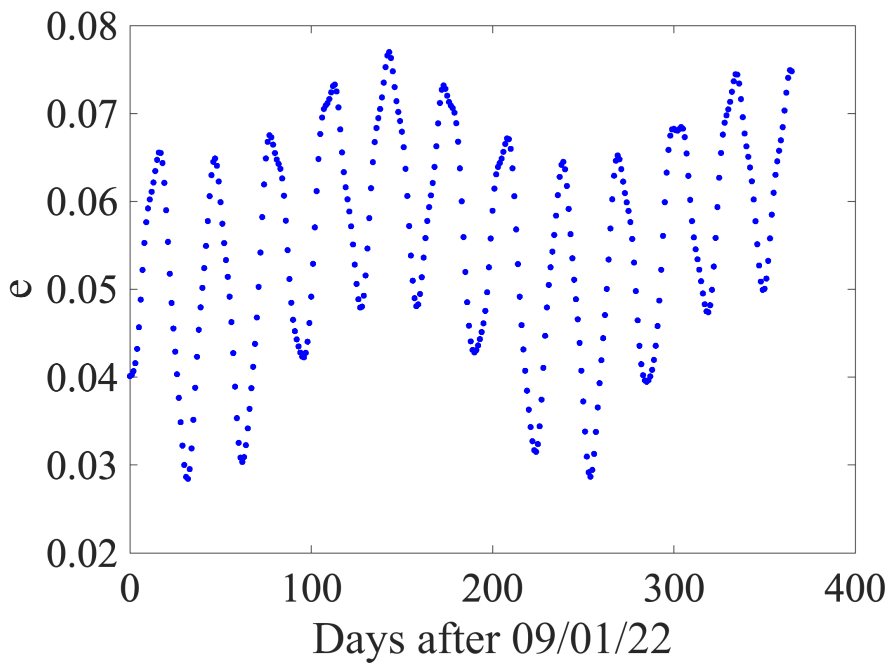
Group Brainstorming:

Question 2

Question 2: Is a circular path of the Moon with a single semi-major axis a ‘good’ approximation of the Moon’s actual path?





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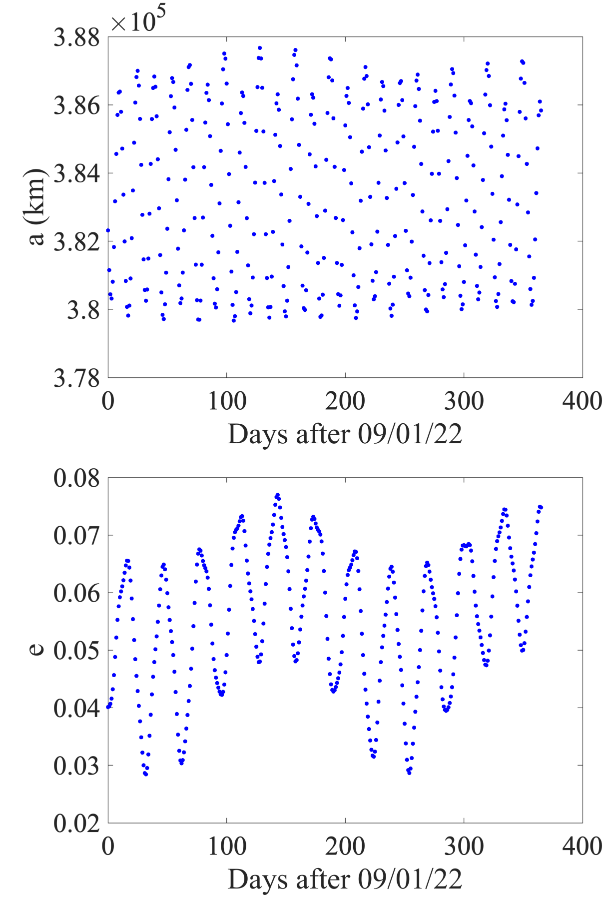
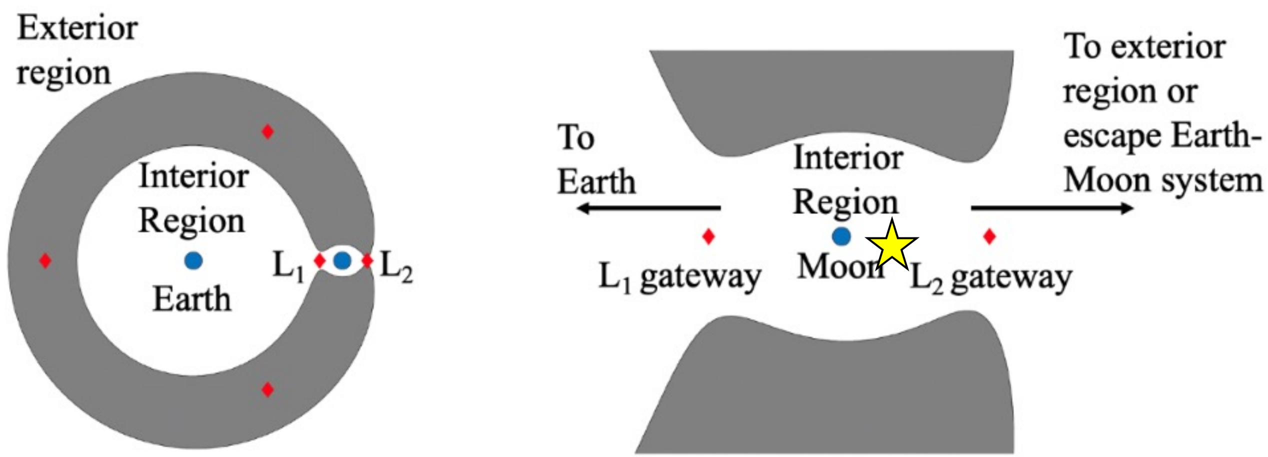


Question 3

A spacecraft is located near the Moon and in the Earth-Moon rotating frame with state vector $[x_0, y_0, 0, \dot{x}_0, \dot{y}_0, 0]^T$

The initial Jacobi constant for this state vector is C_0, producing ZVCs that resemble the following from lecture:



Question 3: Derive an expression for the theoretical minimum magnitude for an impulsive maneuver at ☆ for the spacecraft to be guaranteed to never leave the Moon vicinity in the Earth-Moon CR3BP? List <u>all</u> necessary assumptions.

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Assumptions:

Question 4

Question 4: You have been tasked with designing a maneuver for a planetary defense interceptor mission within the Earth-Moon system. The interceptor spacecraft is currently positioned at L_1 with zero velocity and the goal is for the spacecraft to reach the location of L_4 (with any velocity vector).

A colleague proposes slightly perturbing the state of the spacecraft in manner that does not change the Jacobi constant but would place the spacecraft on a transfer from L_1 to L_4.

Given your initial understanding of motion in the CR3BP and zero velocity curves, do you think your colleague's plan could work and why?

Question 4

Group Brainstorming:

Question 5

Question 5: You and your colleague are each numerically generating a trajectory associated with the same initial state $[x_0, y_0, 0, \dot{x}_0, \dot{y}_0, 0]^T$ and integration time. You are each using your own code or using off-the-shelf software. Do you expect to recover the exact same state as your colleague after the integration time? Why/why not?

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Group Brainstorming:

Question 6

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Group Brainstorming:

Question 7

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General Takeaways

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