ASEN 6060
ADVANCED ASTRODYNAMICS
Week 3 Discussion

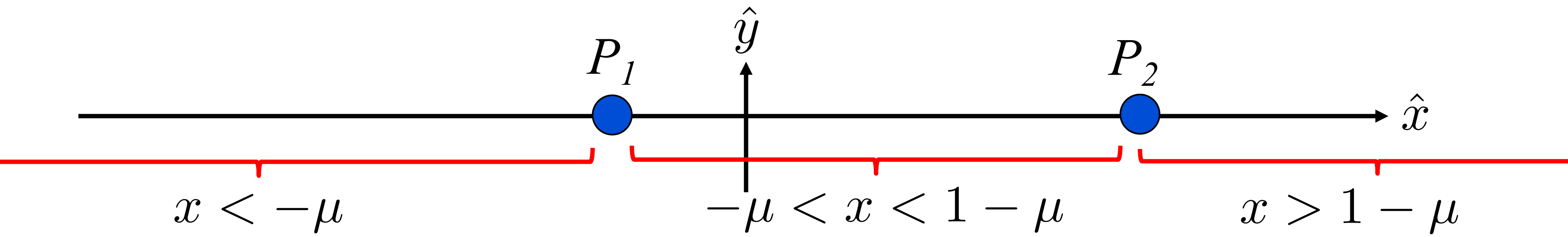
Objectives:

- Understand important considerations in numerically calculating equilibrium point locations
- Connect the evolution of ZVCs as a function of Jacobi constant to the itinerary and maneuvers performed along a trajectory

Questions 1 and 2

Numerically calculating the *x*-coordinates of the collinear equilibrium points

$$x - \frac{(1-\mu)(x+\mu)}{(|x+\mu|)^3} - \frac{\mu(x-1+\mu)}{(|x-1+\mu|)^3} = 0$$



Question 1: How do you select a suitable initial guess along each of the three intervals?

Question 2: How do you verify if your solution corresponds to an equilibrium point?

Questions 1 and 2

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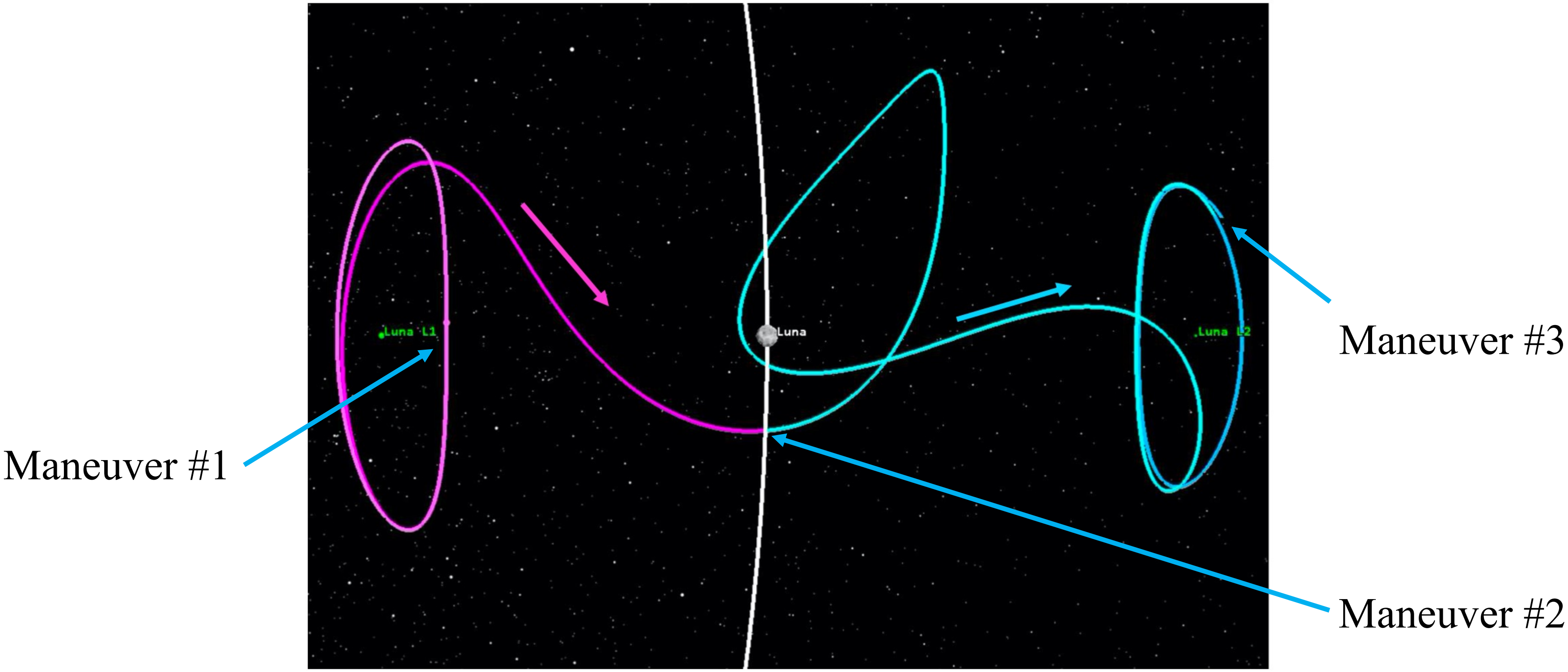
Group Brainstorming:

Question 2: How do you verify if your solution corresponds to an equilibrium point?

Group Brainstorming:

Transfer Example in Earth-Moon CR3BP



(a) Transfer from L_1 Lyapunov to L_2 Lyapunov orbit

Question 3: Based on your knowledge of the CR3BP, what are the constraints on the value of *C* along the arcs comprising this transfer?

Image credit: Short, Haapala, Bosanac, 2020, "Technical Implementation of the Circular Restricted Three-Body Model in STK Astrogator", AAS/AIAA Astrodynamics Specialist Conference.

Question 3

Question 3: Based on your knowledge of the CR3BP, what are the constraints on the value of *C* along the arcs comprising this transfer? What does this tell you about the solution space in general?

Group Brainstorming:

Question 4

Question 4: 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?

Question 4

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Question 5

Question 5: I would like to design a trajectory for a new spacecraft to leave a low Earth orbit (LEO) and rendezvous with another spacecraft in orbit near L_2. For a spacecraft in LEO,

$C > C(L_1)$

Use your knowledge of the ZVCs to describe a variety of possible itineraries for this trajectory and implications for any required maneuvers.

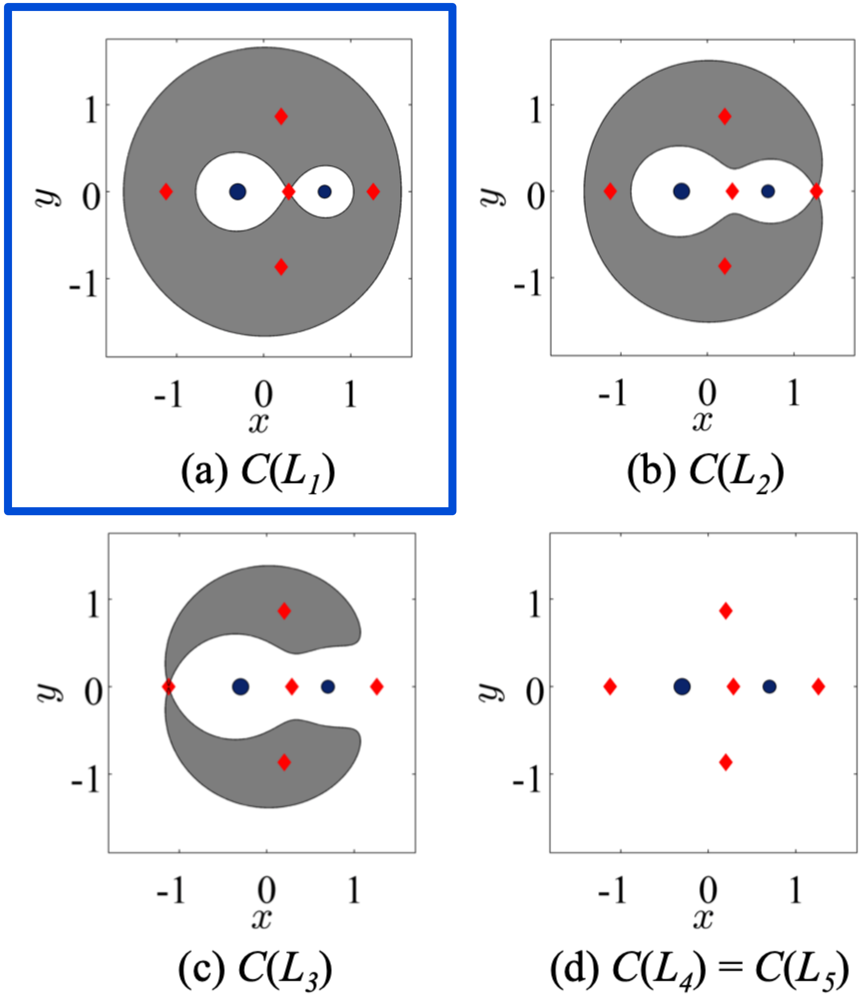

Image credit:
Bosanac, 2016

Question 5

Question 5: I would like to design a trajectory for a new spacecraft to leave a low Earth orbit and rendezvous with the original spacecraft in its final orbit near L_2.

Use your knowledge of the ZVCs to describe possible itineraries for this trajectory and implications for any required maneuvers.

Group Brainstorming: