A review on hot-spot areas within the Cislunar region and an orbital framework for key regions

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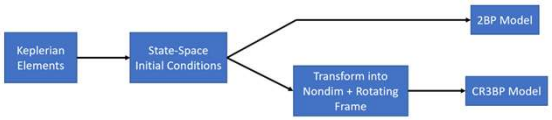
Background

The Cislunar region is becoming a focal point of expansion over upcoming decades. Long-term Lunar infrastructure supporting Cislunar expansion must be located in key regions on the Moon's surface and in space. The purpose of this research is to identify key regions of interest (ROI) on and around the Moon by investigating the location of valuable resources and the destination of future missions. Once key regions are established, low-lunar orbit trajectories are analyzed to enable methods of passive information gain in identified key regions of interest.

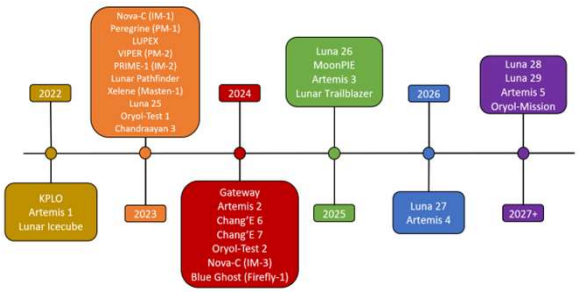


The initial conditions for trajectories used in the research stem from Keplerian elements and are translated to the Two-Body Problem (2BP) and Circular Restricted Three-Body Problem (CR3BP).

Cislunar Missions

The Cislunar region is a focal point of expansion for the space industry, but many areas will be untouched by robotic and manned missions. Therefore, to create an efficient framework to service Cislunar missions, the location of future missions must be investigated to focus coverage about.

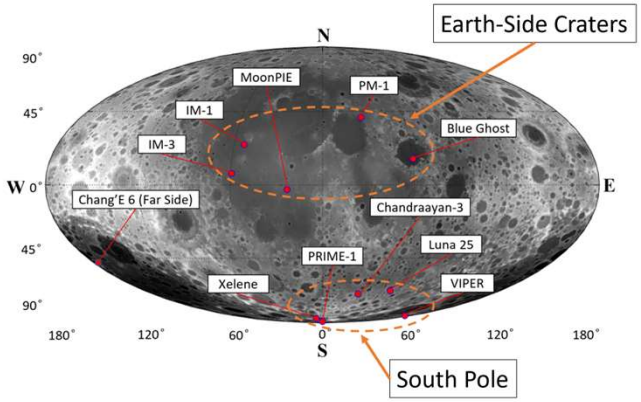
Cislunar Mission Timeline (as of Jan. 2023)



ROI & Framework Analysis

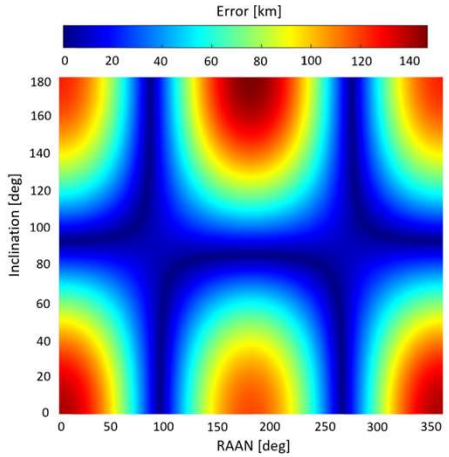
The key regions of interest the proposed framework must reach can be determined through plotting the known landing locations of future Lunar missions:

Lunar Surface Map of Future Missions

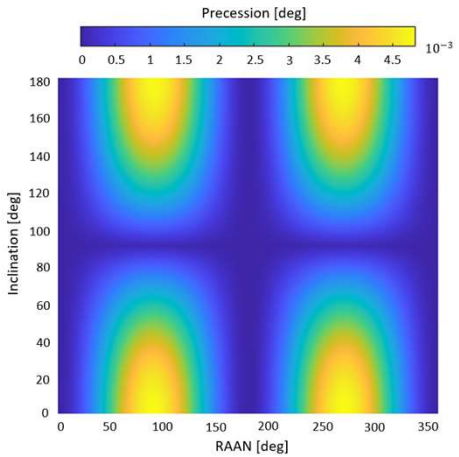


The LLO trajectories are investigated for the proposed framework since the motion is similar to two-body conics, allowing for some trajectories to retain the integrity of the orbit over longer periods of time. The analysis is completed after one orbit period and a) analyzes the difference between the 2BP and CR3BP results and b) the precession of the CR3BP orbit:

a) 2BP to CR3BP Error



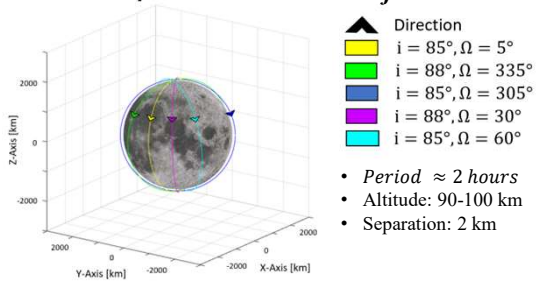
b) CR3BP Orbit Precession



Application

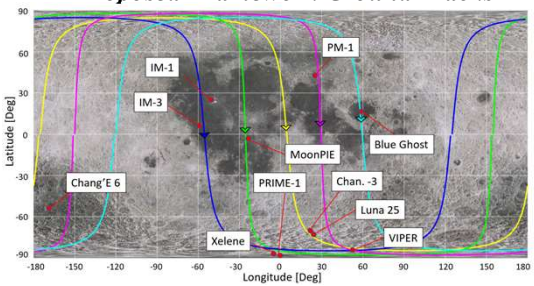
Five orbits are selected from the desired trajectories in the LLO analysis to demonstrate the proposed framework's ability to survey the identified key ROI:

Proposed Framework Trajectories



- *Period* ≈ 2 *hours*
- Altitude: 90-100 km
- Separation: 2 km

Proposed Framework Ground Tracks



References

[1] Baker-McEvilly, B., et. Al., "A review on hot-spot areas within the Cislunar region and upon the Moon surface, and methods to gather passive information from these regions," AAS/AIAA 33rd Space Flight Mechanics Meeting, 2023

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