

# Ground Control to Major Tom

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## Introduction

The growing interest in lunar exploration is transforming the space between Earth and the Moon into a busy and complex area. Upcoming missions, like the Lunar Gateway, will add more spacecraft to this region, but the unique gravitational forces make managing space traffic challenging. Traditional tracking systems struggle due to vast distances and slower orbits, making it essential to develop advanced monitoring systems to prevent collisions and ensure the safety of future missions.

## Methods

To evaluate optimal orbits for observation in cislunar space, key steps must be done:

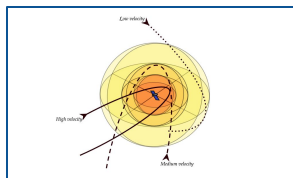
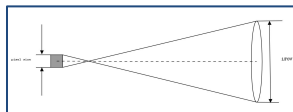
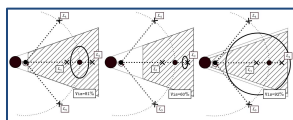
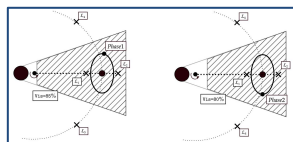
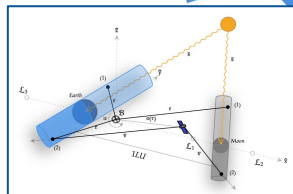
1. Line of sight & shadow conditions of the observer-target
2. Select [orbit family -> Orbit number -> Orbit phase] and evaluate the Observation Accessibility Measure ( $M_{\text{obs}}$ )
3. Calculate the telescope limiting magnitude parameters (the ability to detect faint objects)
4. Calculate the minimum signal required for a successful detection w.r.t. relative velocity between the telescope boresight view and object
5. Calculate the minimum time required to achieve the detection

## Main Findings

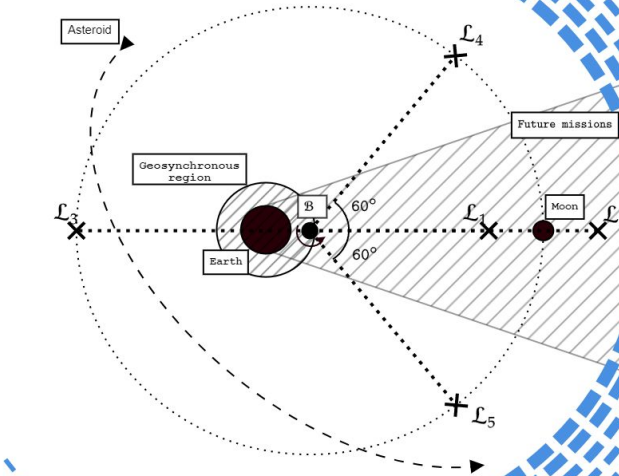
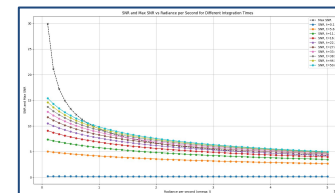
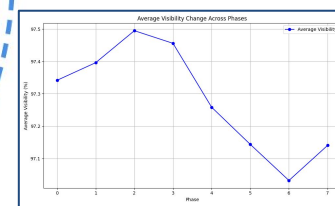
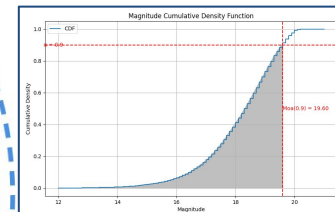
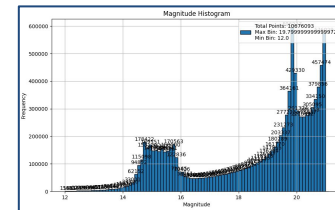
- Limiting Magnitude per Orbit Family
- Optimal phase per Orbit
- Initial essential telescope parameters:
  - Aperture diameter
  - Focal number
  - CCD pixel size
- Minimum time required for a successful detection ( $\text{SNR} > 4$ )

# Design Optimization Process

## Inputs



## Outputs



## Cislunar Environment