



Lunar Browser trajectory tool

A NASA Ames Flight Dynamics team tool

Anthony Genova
Dylan Morrison-Fogel
Paul Levinson-Muth
Andres Dono Perez
Regina Blue

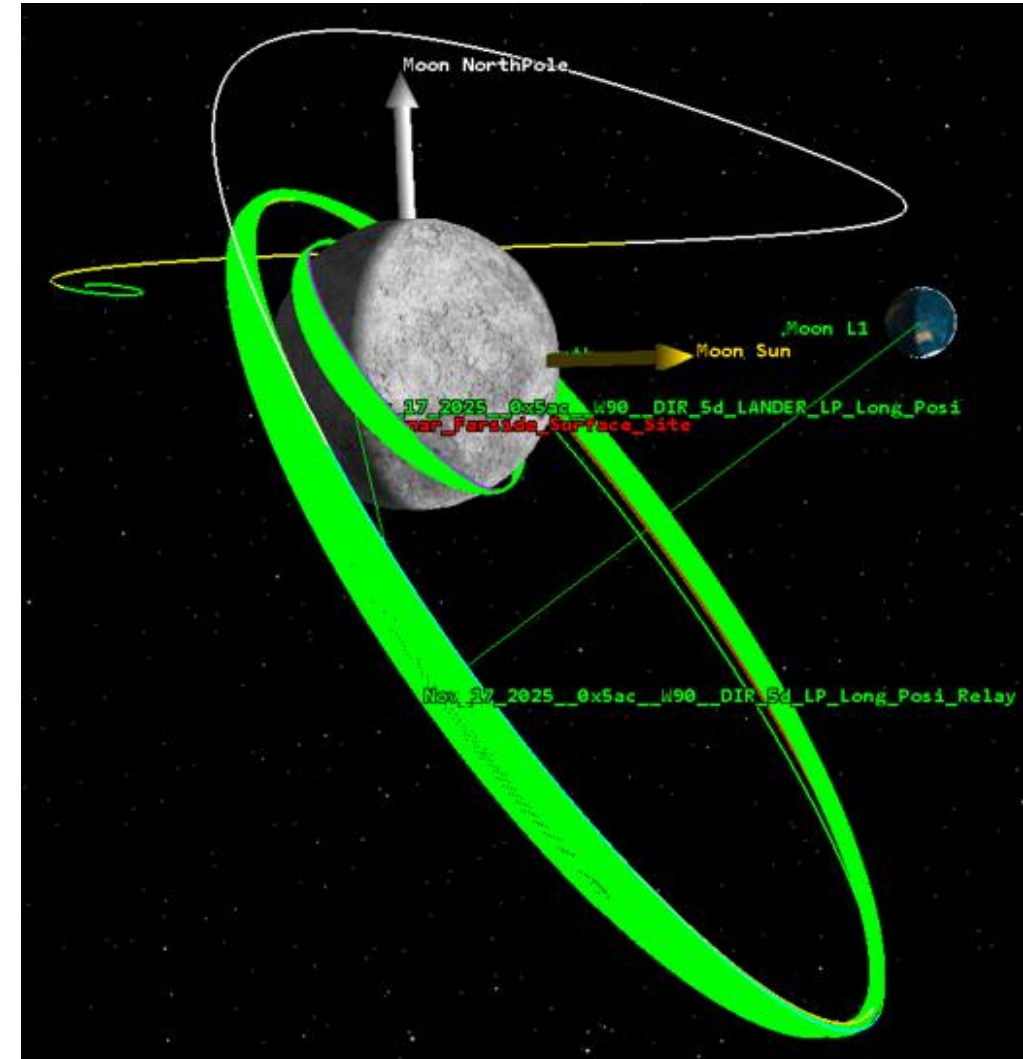
*For more detailed information on
the Lunar Browser tool, see this
AIAA SciTech paper:*

[Transfers from TLI to Lunar Frozen
Orbits with Applications to NASA's
CLPS & ARTEMIS Programs \(aiaa.org\)](#)



*To learn more about the NASA
Ames Flight Dynamics Team:*

[Ames Flight Dynamics \(FD\) - NASA](#)



Genova, A. L., Morrison-Fogel, D., & Levinson-Muth, P., “Transfers from TLI to Lunar Frozen Orbits with Applications to NASA’s CLPS & Artemis Programs,” AAS/AIAA Space Flight Mech. Mtg., Orlando, FL, Jan. 8-12, 2024



NASA Ames Flight Dynamics Team



Full mission lifecycle support

Flight heritage

Four Main Core Areas

Innovative in-house tools

NASA Life-Cycle Phases	Approval for Formulation		Approval for Implementation		IMPLEMENTATION		
Project Life-Cycle Phases	Pre-Phase A: Concept Studies	Phase A: Concept and Technology Development	Phase B: Preliminary Design and Technology Completion	Phase C: Final Design and Fabrication	Phase D: System Assembly, Integration & Test, Launch & Checkout	Phase E: Operations and Sustainment	Phase F: Closeout

Credits: Adapted from NASA NPR 7120 SE



HelioSwarm

HelioSwarm will unlock the mystery of how turbulence heats space plasma, which is matter that makes up key elements in the Universe, like the Sun, stars, solar wind and even the Earth's upper atmosphere.



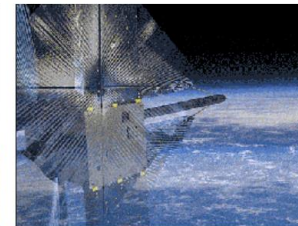
BioSentinel

Launched on Artemis-1, BioSentinel is a 6U CubeSat that carries a biology experiment into deep space for the first time in 50 years.



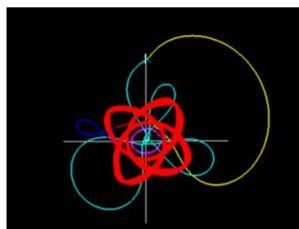
Starling

Starling will demonstrate technologies to enable multipoint science data collection by several small spacecraft flying in swarms.



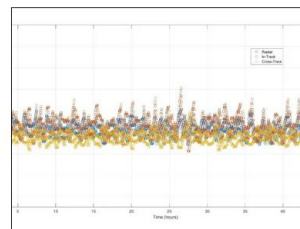
Advanced Composite Solar Sail System (ACS3)

ACS3, technology demonstration uses composite materials in its novel, lightweight booms that deploy from a Cubesat.



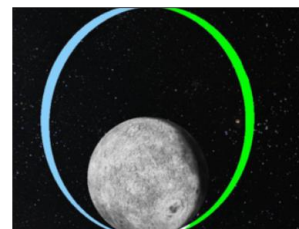
Trajectory Design

Trajectory design is one of the main activities performed by the Ames Flight Dynamics team. Trajectories are designed by capitalizing on the fundamental laws of orbital mechanics to achieve a given set of mission objectives.



Navigation

The Ames Flight Dynamics team supports space missions from early concept studies through flight operations. In our most recent past mission support activity, Starling's and Biosentinel's mission operations ran from 2023.



Orbit Analysis

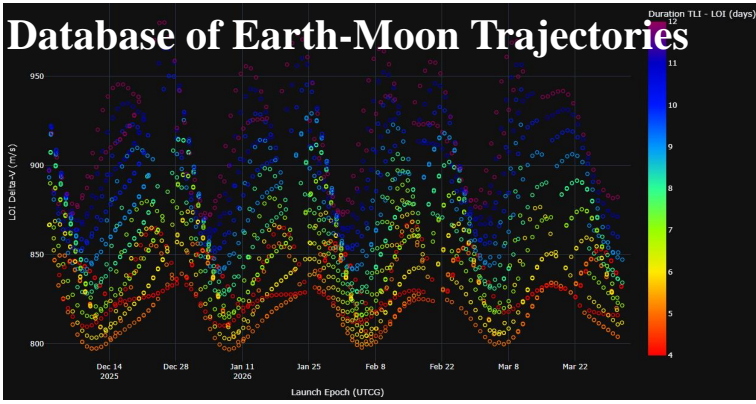
The FD team conducts all the analysis related to any spacecraft mission requirements. This includes producing valuable data for other subsystems, and studying the orbit evolution and payload performance with high fidelity propagations.



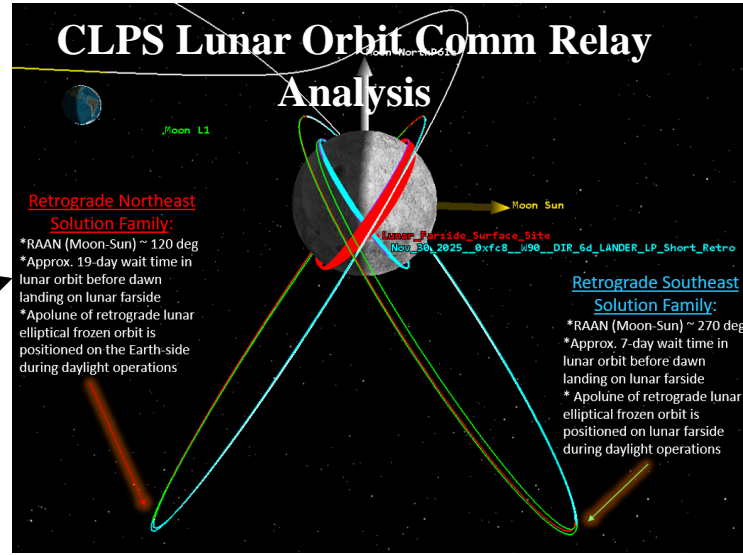
Formation Flying

The focus of formation flying is to maintain a targeted orbit configuration of various spacecraft. Having multiple satellites fly in a specific geometry avoids the technical and financial challenge of building one satellite of equivalent size.

- Trajectory Browser
- Mauna
- Vector Analysis Tool
- Flite
- ROMA
- Lunar Browser



Earth-to-Moon transfer trajectory visualizations & animations



Lunar Browser can be operated via GUI with filters & logic control

Filter Window

Directory: \\librarian\flightdynamics\Flight Dynamics Tools\LunarBrowser\direct_transfers Set Defaults

Source File: /Source/ lb_direct_transfer_set.xlsx Load

Output File: /Outputs/ lb_RAAN_filter_example.xlsx

Preset: full_set Save Preset Load Preset

1	Coast Duration (min)	> 35
2	TLI RAAN (deg)	> 340
3	TLI RAAN (deg)	< 20

Logic Control: 1&2/3 Debug

Sort Along: click to select

Filter Add Row Remove Row Close



Lunar Landing Windows

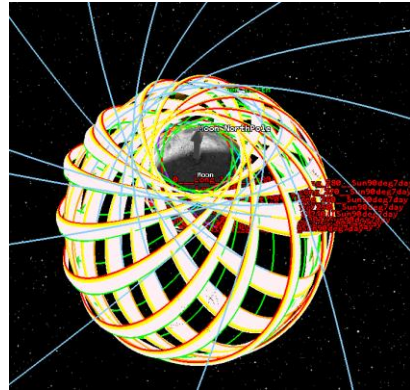
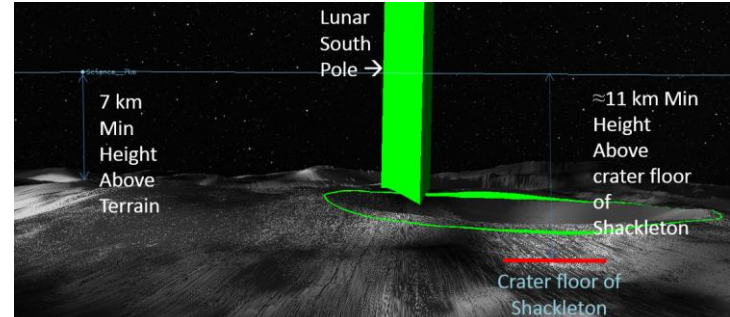
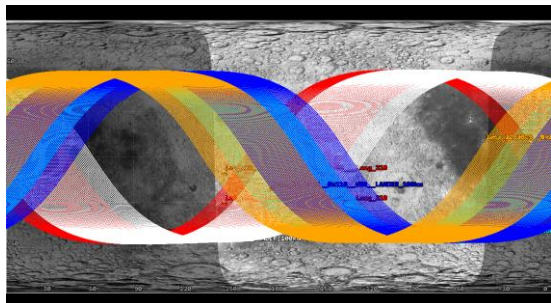
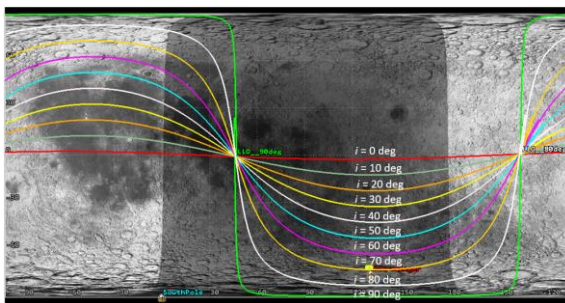
Extended solutions with high-fidelity phasing lunar orbits preceding lighting-constrained landings

Lunar Terrain Analysis

Highest resolution data available used with lighting, timing, & other constraints

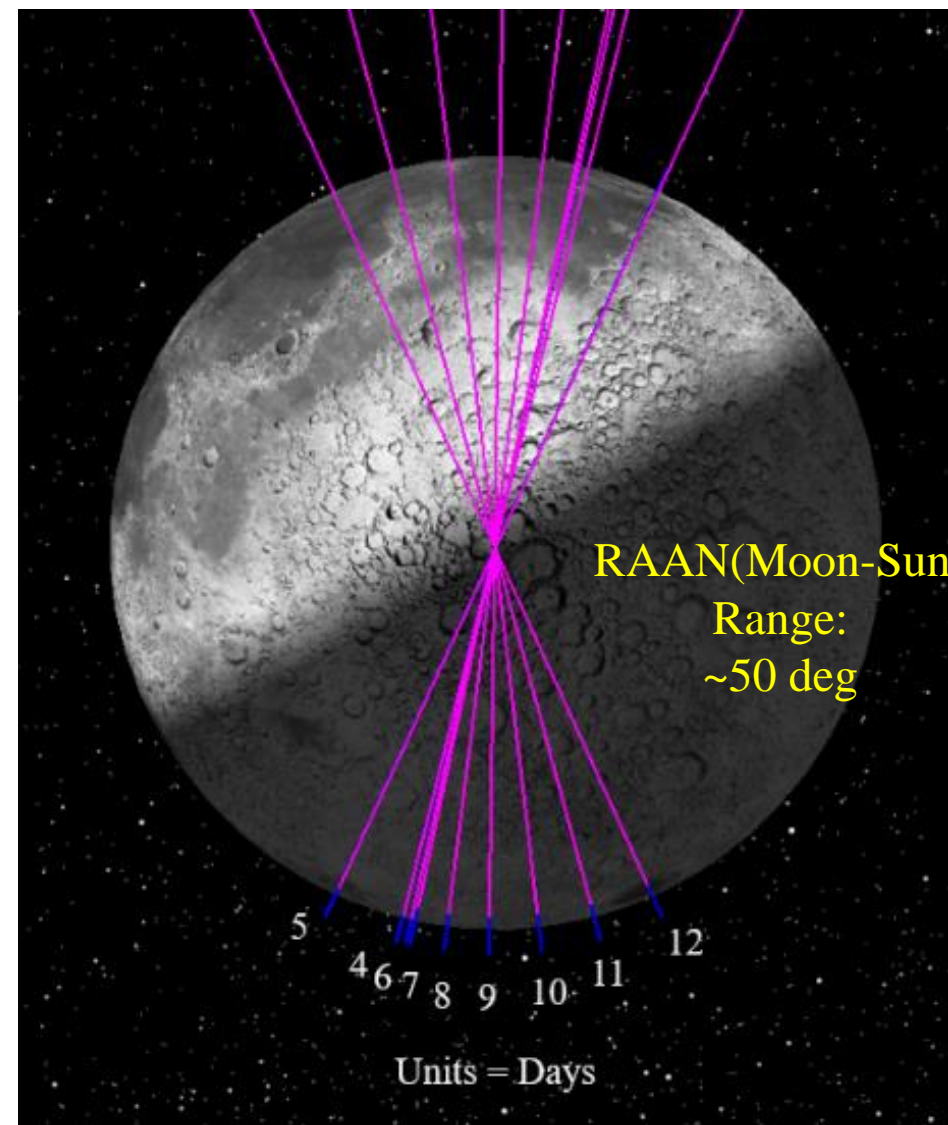
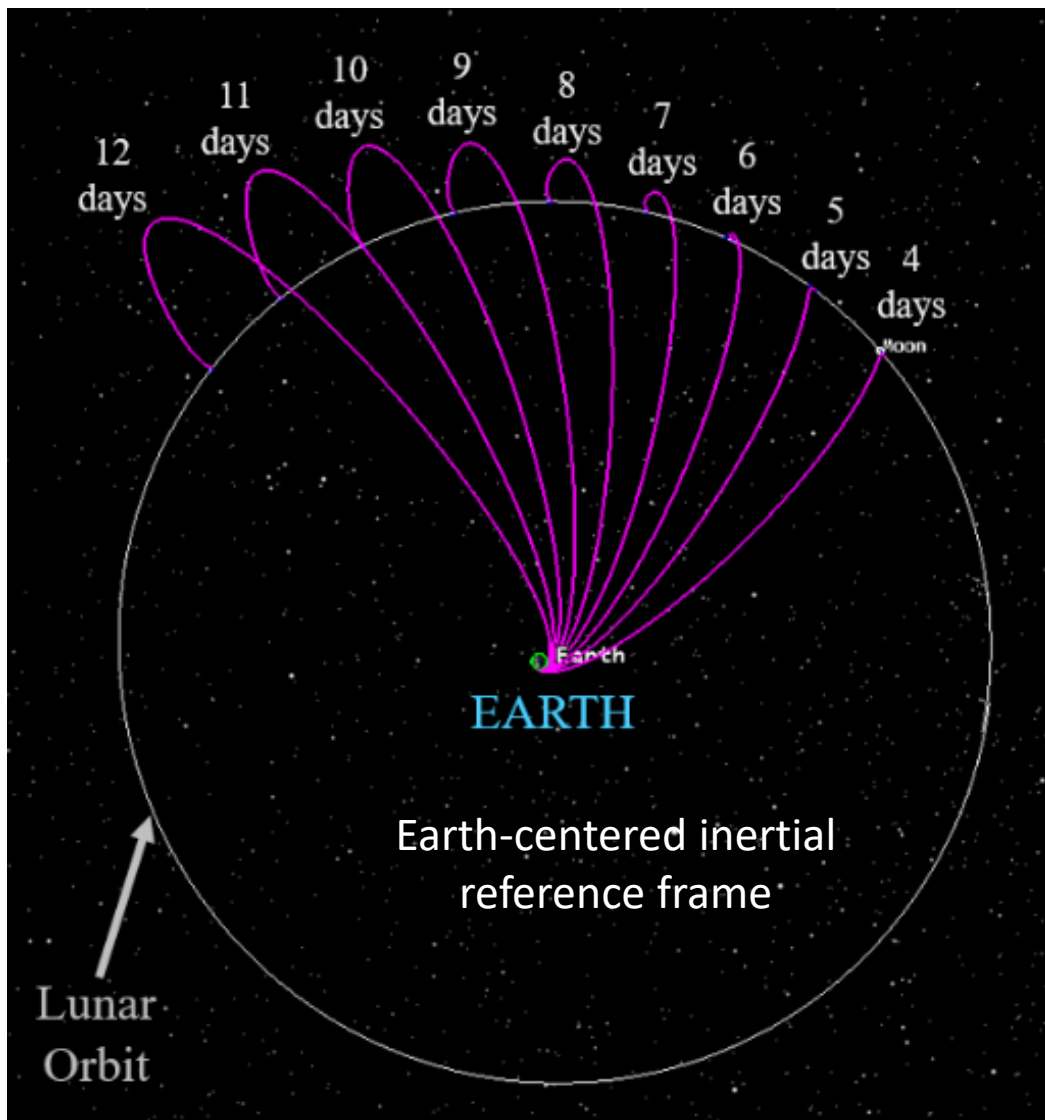
Relative Motion

collision assessment & prevention





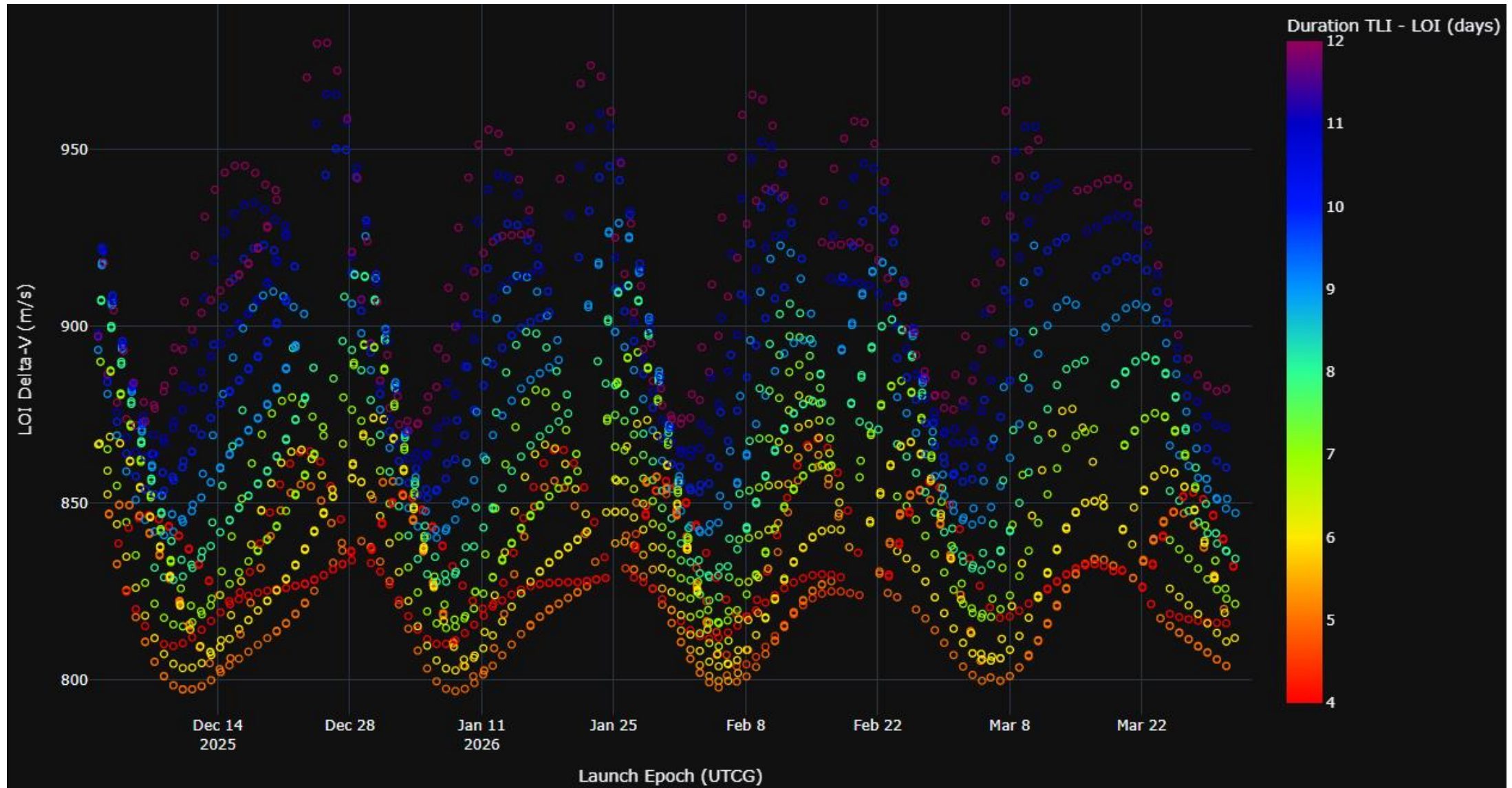
TLI to LOI transit duration range



Genova, A. L., Morrison-Fogel, D., & Levinson-Muth, P., "Transfers from TLI to Lunar Frozen Orbits with Applications to NASA's CLPS & Artemis Programs," AAS/AIAA Space Flight Mech. Mtg., Orlando, FL, Jan. 8-12, 2024



LOI ΔV vs. Launch Epoch, from December 2025 to March 2026



Genova, A. L., Morrison-Fogel, D., & Levinson-Muth, P., “Transfers from TLI to Lunar Frozen Orbits with Applications to NASA’s CLPS & Artemis Programs,” AAS/AIAA Space Flight Mech. Mtg., Orlando, FL, Jan. 8-12, 2024