

**NASA's Moon Trek Portal: New Capabilities Supporting Mission Planning and Engagement.**  
B. H. Day<sup>1</sup>, E. S. Law<sup>2</sup>, and the NASA Solar System Treks Team<sup>2</sup> <sup>1</sup>NASA Solar System Exploration Research Virtual Institute, NASA Ames Research Center, <sup>2</sup> NASA Jet Propulsion Laboratory, California Institute of Technology

**Introduction:** NASA's Moon Trek (<https://trek.nasa.gov/moon/>) is one of a growing number of interactive, browser-based, online portals for planetary data visualization and analysis produced by NASA's Solar System Treks Project (SSTP). Moon Trek continues to be enhanced with new data and new capabilities enabling it to facilitate the planning and conducting of upcoming lunar missions by NASA, its commercial partners, and its international partners, as well as advancing its role as a valuable outreach tool.

**A Comprehensive Online Web Portal:** Developed at NASA's Jet Propulsion Laboratory (JPL) and managed as a project of NASA's Solar System Exploration Research Virtual Institute (SSERVI) at NASA Ames Research Center, Moon Trek is a browser-based web portal. The portal provides easy-to-use tools for browsing, data layering, data product blending, and feature search among thousands of data products covering topography, mineralogy, elemental abundance, geology, and much more. Visualizations are provided in various map projections, interactive 3D viewing, and in virtual reality. Using an in-house stereo workflow, SSTP is able to produce new NAC-based high-resolution mosaics and DEMs.

**Diverse Applications for Lunar Exploration:** Baseline analytic tools available to all users include distance measurement, elevation profiling, sun angle calculation, and 3D print file generation. More advanced account-level tools allow users to perform more computationally intensive analyses. These include ray-traced lighting analysis for user-specified areas over user-specified time/date ranges and time intervals, electrostatic surface potential analysis, subsetting of large data products, slope analysis, and Lunar Laser Ranging geometry calculation. Artificial intelligence (AI) and machine learning (ML) based tools have been implemented for crater detection and hazard analysis, boulder detection and hazard analysis, and rockfall detection.

**New Tools Facilitating Exploration:** Additional, new tools have recently been added and others are in development, offering even greater functionality in conducting analyses of potential landing sites and areas of surface operations. The new Line-of-Sight tool facilitates communications planning between locations on the lunar surface, between any given site on the lunar surface and a specified ground station on the Earth, and between a site on the lunar surface and a relay asset in lunar orbit, all taking into account local lunar topography. The new Data Plotter tool provides both tabular and graphical representations of pixel values along a

user specified path for a growing number of data products. The new NAC Finder tool will identify and provide access to NAC images that intersect a user-defined path or bounded area. The SSTP development team is looking to leverage the capabilities of its existing AI and ML crater, boulder, and rockfall detection and analysis tools, and extend that technology to a generalized feature detector that can be trained on instances of specific types of landforms and then search the lunar surface for more examples of such features. New traverse planning tools are being developed with use cases in generalized concept studies and specific mission planning in mind. These will facilitate finding optimal traverse paths based on constraints such as slope, lighting, hazard avoidance, and communications. These will be complemented by new traverse visualization capabilities. Users will be able to interactively ride along with a rover, examining 3D views of the terrain while adjusting camera height and viewing angle along with selecting different data layer overlays to drape across the terrain.

**Engaging the Public:** The capabilities being developed for mission planning are being leveraged to further enhance Moon Trek's proven utility as a valuable public outreach resource. This includes providing multiple levels of engagement with different points of entry. At its simplest level, promoting understanding through visualization, media and the public will be able to easily visualize and conduct their own exploration of lunar sites targeted by NASA and its partners. For a more in-depth experience, we are working with our stakeholders to promote understanding through interaction by extending our current landing site and traverse analysis capabilities, making simplified access to these tools available to those who want to explore more deeply key factors in planning a mission through interactive and possibly even gamified experiences. The highest degree of public outreach, focusing on engagement through scientific participation, could be achieved through our work with missions and the NASA Office of the Chief Scientist on Moon Trek's extension as a tool with specialized capabilities for facilitating citizen science. In such scenarios, participants become members of extended mission science teams, using dedicated and integrated interfaces to analyze mission data to help answer questions key to lunar science and exploration. We are working with NASA's Office of Communications, museums, planetariums, and the media to help them easily integrate accurate, detailed visualizations of NASA's lunar destinations and exploration into their content/productions and to engage diverse audiences in diverse venues.