# ROVER DESCRIPTION

THE ROBOTICS INSTITUTE

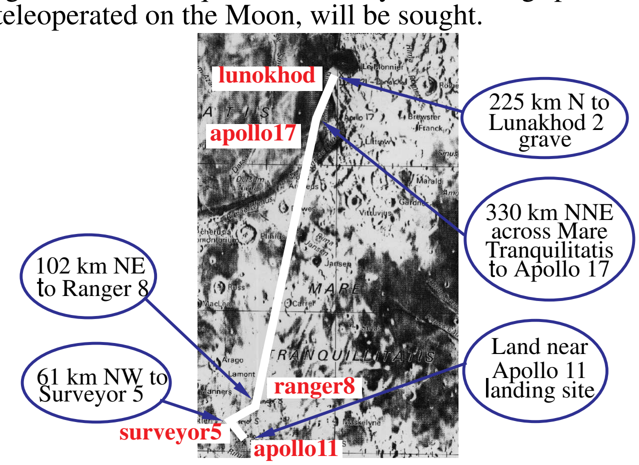
Lunar Rover Initiative

Nearly a quarter century has passed since the last lunar landing, and much about the Moon remains unknown. As rekindling lunar exploration with manned missions are too costly and missions which explore areas around a lander do not survey enough territory, Carnegie Mellon University has proposed a commercial, edutainment-based teleoperated lunar traverse. The mission will last two years (over 25 lunar days) and cover 1000km and revisit several historic sites.

The primary purpose of the mission is to entertain and educate. Therefore, the return of imagery which excites and intrigues is the major product. Rather than limiting audiences to one narrow view, the rover will return omnidirectional information so that each viewer can personally choose where to look. In addition, a small science payload when combined with the imagery and rover sensor data will yield the most comprehensive survey of the lunar terrain to date.

The project is currently nearing the end of a two year survey and configuration phase and begins a year of design, prototyping, and evaluation in September 1995. The mission is scheduled for launch in late 1998 on board a Russian Proton vehicle and will continue operations into 2000. The complete costing for the mission is near $150M with nearly 30% dedicated to rover development.

The landing will occur a few days after lunar dawn near the Apollo 11 site. Two fairly short traverses allow visitation of the Ranger 8 and Surveyor 5 sites. Apollo 17 is the next site on the tour following a lengthy trek along the edge of Mare Tranquilitatis. Finally, the landing spot and the "grave" of Lunakhod 2, the last vehicle to be teleoperated on the Moon, will be sought.




**Proposed Route of Lunar Traverse**

## Current Operation Scenario

To increase overall mission redundancy and to provide off-board views of a rover crossing the terrain, the current scenario involves two identical rovers (except with differing science payloads). At any time, one rover is traversing and the other us stationary, with a "leap-frog" occurring about every 250 meters or 15-20 minutes.

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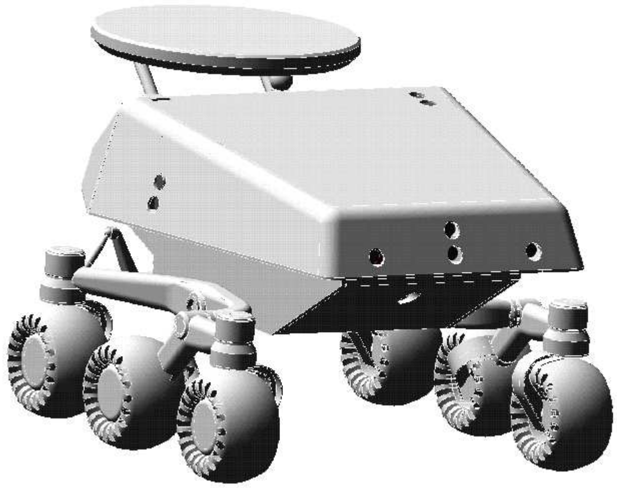
Each rover has a mass of 250kg, a 2m x 2m footprint and stands 1.5m tall with 0.5m underbody clearance. Power demands are nearly 400W split evenly among locomotion, image compression, communication, and computing/sensing. The rover will travel at a leisurely 0.3m/sec with a top speed of 1.0m/sec



**Configuration of Lunar Rover**

The locomotion chassis consists of six independently driven wheels with explicit steering at each corner. The passive suspension uses a rocker-bogie system and connects to the body at only three points. Direct communication to earth is accomplished using an X-band radio-frequency link and a phased-array antenna with electronic steering for fine pointing and mechanical coarse pointing.

Rather than restricting operation of the rovers to a select few trained operators, amateur drivers are able to control the direction and speed of the rover. While increasing education and excitement, this feature requires the rover to perform autonomous safeguarding. The maximum speed is adjusted dependent upon the terrain conditions, and the rover will not take a route which endangers itself. Safeguarding is extremely important since a 5 second round-trip time-delay is expected during operations.

With several months until the project undergoes a Preliminary Design Review, most of the key technologies have been narrowed down to two options. The "primary" provided development can be accomplished within the required time-frame, and the "back-up" which is the baseline if construction of the flight system had to start tomorrow. At this time, Panospheric Imaging is the primary technology for lunar rover visualization, and a radial array of cameras is the back-up technology. The most recent configuration reviewed to date addressed the issue of operation during the lunar night using a Krypton85 heat source[1]. The latest design, historical versions, and project info are on-line[2].

1. Whittaker, William L. et al. "Design of a Day/Night Lunar Rover", Tech Report - Carnegie Mellon University, The Robotics Institute CMU-RI-TR-95-24.
2. Lunar Rover Initiative World Wide Web Information. From Field Robotics Center page: *http://www.frc.ri.cmu.edu*

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