DEVELOPMENT OF A FULL-SCALE ROVER WHEEL TESTING PLATFORM AT THE COLORADO SCHOOL OF MINES

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Motivation

- Understanding variation in the geotechnical properties of lunar regolith and its corresponding simulants is essential for future rover operations and *in situ* resource utilization (ISRU) to support long-term lunar infrastructure [1]

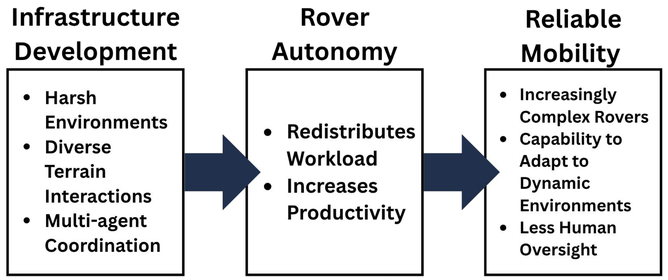

Figure 1: Mobility needs stemming from infrastructure development and increasing autonomy in rovers.

A critical gap in terramechanics currently exists: robotic systems cannot reliably predict how unknown lunar terrain will respond to wheel forces in real time [2]

Wheel Testing

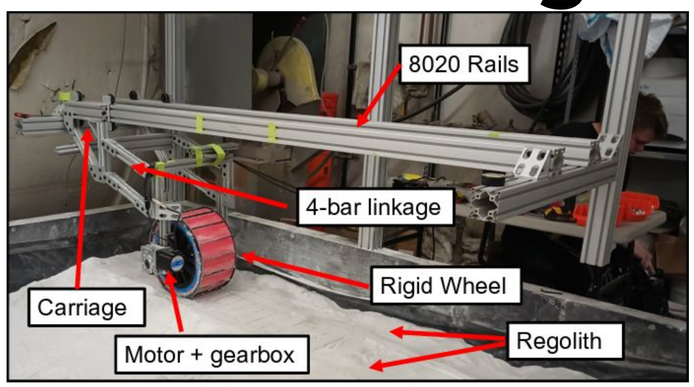

Figure 2: Original Wheel Testing Platform (WTP) designed for the ASPECT rover [3].

- Single-wheel testbeds provide the measurement capabilities necessary to develop wheel-terrain interaction mappings and to enable terramechanics modeling (Fig. 2)
- However, they are often tailored to specific parameters, resulting in numerous facilities that provide varying capabilities

Design Methodology

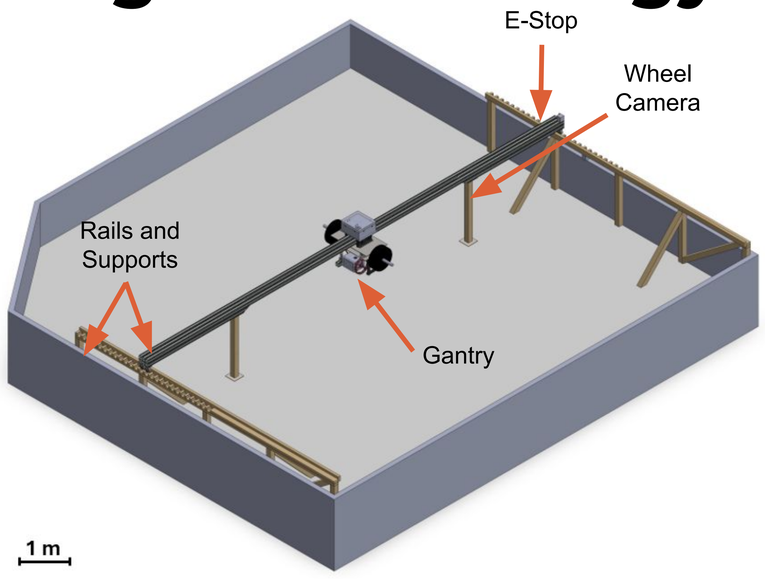

Figure 3: Current system design for a new, large-scale Wheel Testing Platform that will be implemented into the Mines Lunar Surface Simulator.

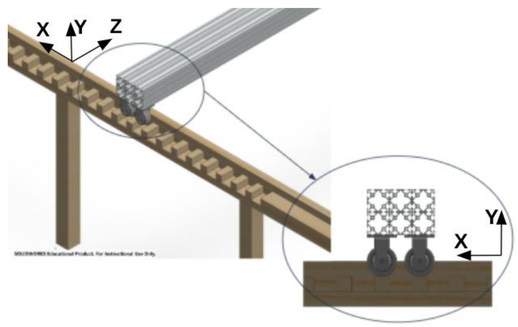

Figure 4: CAD model of the WTP system's indexing notches.

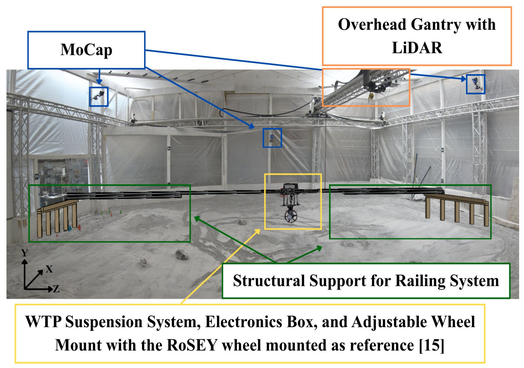

Figure 5: Working location of the WTP with key components labeled.

- **Can accommodate wheel diameters from 30 to 100 cm**
- **Nominal loads up to 200 kg, critical impact loads up to 300 kg**
- **5 meters, bi-directional traversal distance**
- **Access to LiDAR and MoCap systems**
- **Adaptable for suspension/ non-suspension configurations**

Timeline

June 2026

- **Component Acquisition**
- **Final Design Report Submitted**

July 2026

- **Build Start Date**

August 2026

- **50% Construction Completion**

September 2026

- **Construction Complete**
- **Initial Validation Test Campaign**

Conclusion

The design and ongoing development of the WTP at Colorado School of Mines provide a critical tool for bridging the current gap in real-time terramechanics predictions. This work will enable future rovers to autonomously and more effectively navigate unseen hazards, ensuring the safety and efficiency of ISRU on the Moon and beyond.

References

[1] Dotson et al. (2024) 55th LPSC Abstract #1726. [2] Lamarre O. & Kelly J. (2024) Proc. i-SAIRAS. [3] Dreyer C. (2023) Proc. LSIC Excavation & Construction.

Acknowledgements

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