Methods and Design Considerations

- Design goal: Versatile system that can adapt to use different wheels and motors for scientific investigations of rover locomotion
- RIDER provides gravity offloading utilizing a linear actuator system. This will allow the user to apply a custom load onto the wheel to simulate low-gravity environments with a known, controllable applied load (simulated rover weight).
- Safety features include an emergency stop, limit switches, electrical system grounding, overcurrent protection, and dust containment.
- Wheels being tested in the initial development of RIDER are:
  - Astrobotic Technology rover wheel
  - Lunar Roving Vehicle (LRV) replica wheel
  - VIPER-prototype wheel
- Motor speed, wheel linear travel velocity, and simulated rover weight will be monitored and recorded using microcontroller-based data logging and control systems.

Applications

- Testing rover wheel designs for efficiency (e.g., slip and sinkage)
- Testing instrumented rover wheels
- Developing and validating terramechanics models

Introduction

- There is a gap in knowledge of wheel-regolith interactions and scientific studies of the traffickability of lunar regolith using relevant hardware, regolith simulants, and loads.
- Full-scale wheel-regolith interactions will be investigated using the Regolith Interactions for the Development of Extraterrestrial Rovers (RIDER) test bed (Figures 1 and 2)
  - Linear, single-wheel test rig being developed by the Center for Lunar and Asteroid Surface Science (CLASS) Exolith Lab at the University of Central Florida (UCF), in collaboration with the University of Notre Dame (UND).
- RIDER will provide relevant data for the planetary science and engineering communities by directly testing wheel-regolith interactions using rover wheels and high-fidelity lunar regolith simulant produced by Exolith Lab.

Additional Testing and Benefits

- Cone penetrometer, shear vane testing, Particle Size Distribution (PSD), and Particle Shape testing will provide data on the density profile, bearing capacity, and shear strength of the regolith after many repeated back-and-forth wheel passes simulating a roadway and using regolith simulants of the appropriate geotechnical properties [1,2].
- RIDER is also able to verify the results of computational models of wheel-regolith interactions, such as those of the in-development Simulator for Planetary Interactions of Dust and Regolith (SPIDR) [3].

Conclusions

- RIDER will provide quantitative data and information for wheel-regolith interactions and will help extend our current knowledge on how vehicles navigate planetary surfaces by investigating the effects of variable wheels, loads, torque, and speed on wheel-trafficked regolith geotechnical properties.

Acknowledgements

- This work is supported by CLASS under NASA Cooperative Agreement 80NSSC19M0214
- Thanks to Ron Creel for providing the prototype VIPER-like wheel, to Astrobotic Technology for loaning the Astrobotic Technology Rover Wheel, and to NASA Glenn Research Center for providing the LRV Replica wheel.

References