Lunar Personal Electric Vehicle (LPEV)

Tarleton State University | Mayfield College of Engineering | RELLIS Campus
Team Members: Akash Musale, Easton Duplichan, Silas Hill, Swaid Alrashed
Faculty Advisor: Dr. Nourouddin Sharifi | NASA Mentor: Chatwin Lansdowne, Scott Askew
Contact: akash.musale@go.tarleton.edu | Sharifi@tarleton.edu

Background

This project embarks on an ambitious mission: to revolutionize lunar surface travel for astronauts by introducing a Lunar Personal Electric Vehicle (LPEV). The lunar terrain is notably characterized by extreme temperatures, loose abrasive regolith, and 1/6th of Earth's gravity.

Objective

The primary objective of the Lunar Personal Electric Vehicle (LPEV) project is to design and develop a lightweight, durable, and efficient micro-mobility solution tailored for lunar exploration. The aim is to provide astronauts with a reliable mode of transport capable of navigating the Moon's harsh terrain, including rough surfaces and abrasive dust, while minimizing power consumption and adhering to Size, Weight, and Power (SWAP) constraints.

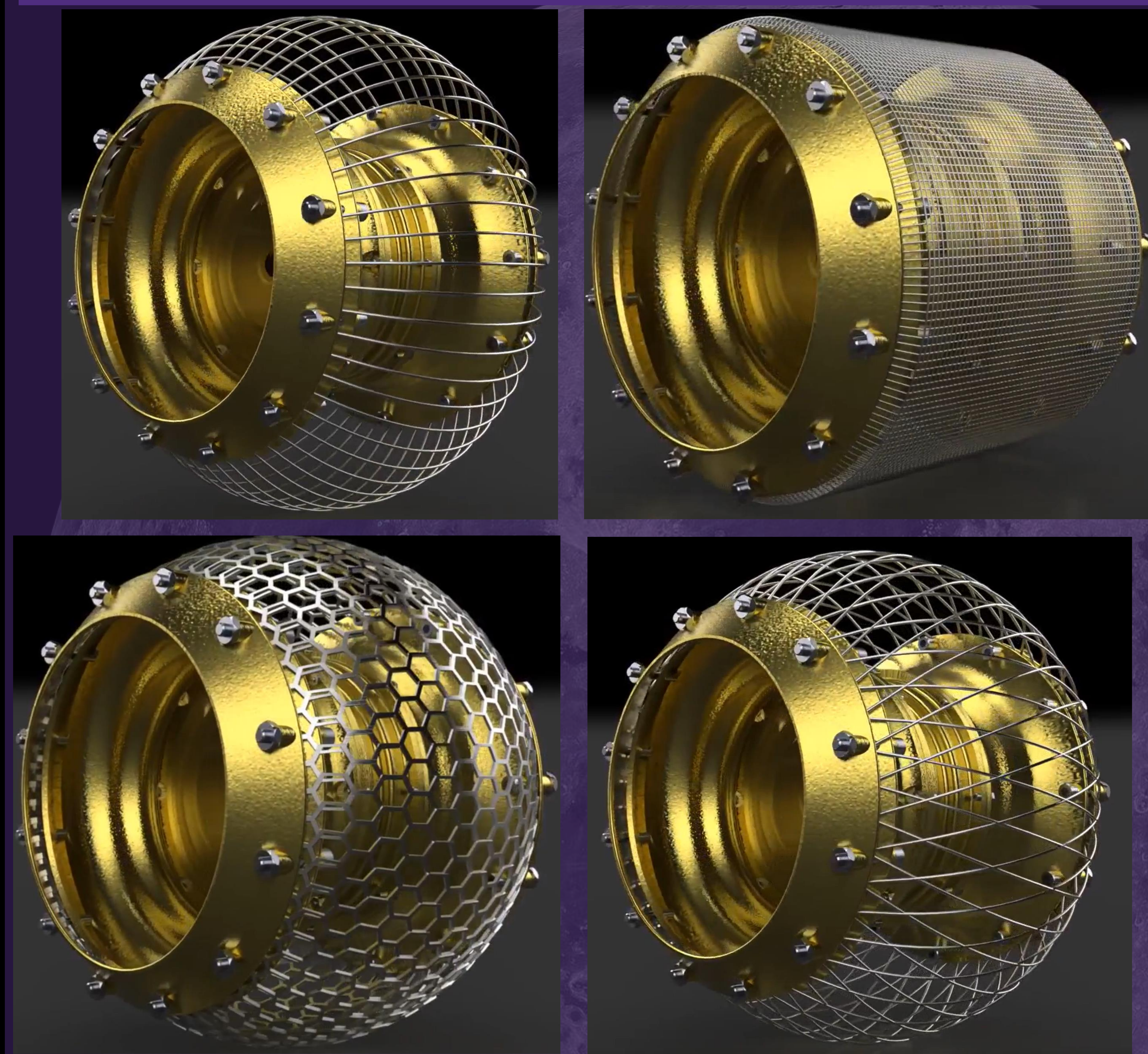
This semester's objective is to focus on the critical design and optimization of the LPEV's wheels, specifically refining the wire mesh design, wire arc height, and wire diameter to ensure optimal traction, durability, and stability. By achieving these targets, the project will lay the foundation for further development and integration of the entire vehicle, with the ultimate goal of delivering a fully functional prototype ready for lunar missions.

Conclusion

The wheel system of the Lunar Personal Electric Vehicle (LPEV) is designed to handle the Moon's challenging terrain with stability and durability. Using Shape Memory Alloy (SMA) for the tires provides a lightweight, self-healing solution, while advanced wire mesh designs maximize traction and prevent slippage on regolith. Extensive testing under simulated lunar conditions allows precise refinement of these design features, positioning the LPEV wheel as a reliable choice for future lunar missions.

Future Considerations:
- Bicycle chain-like gear system for testing of the wheels
- Bigger testing bed and wheels
- Implementation of slopes in the testing bed
- Testing of Honeycomb wheel

New Wheel Designs



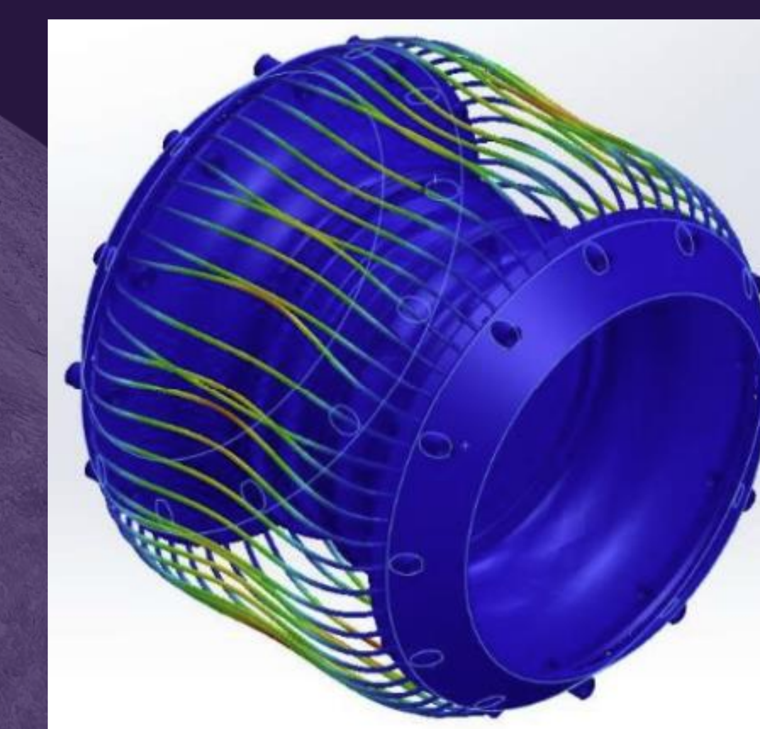
Testing

Straight Mesh friction force = 7.6 N
Criss-Cross friction force = 6.1 N
Solid Wheel friction Force = 8.7 N

Straight Mesh time = 3.89 seconds
Criss-Cross time = 3.63 seconds
Solid Wheel time = Failed

Straight Mesh sinkage = 0.762 in
Cross wire sinkage = 0.592 in
Solid wheel sinkage = 2.240 in

Results – FEA (Finite Element Analysis)



Straight Wire FEA: Downforce @ 316.97 N
(Resulted Displacement shown)

Minimum Displacement – 0.00 mm
Maximum Displacement – 0.04057 mm

Minimum Stress – 54.27 N/m^2

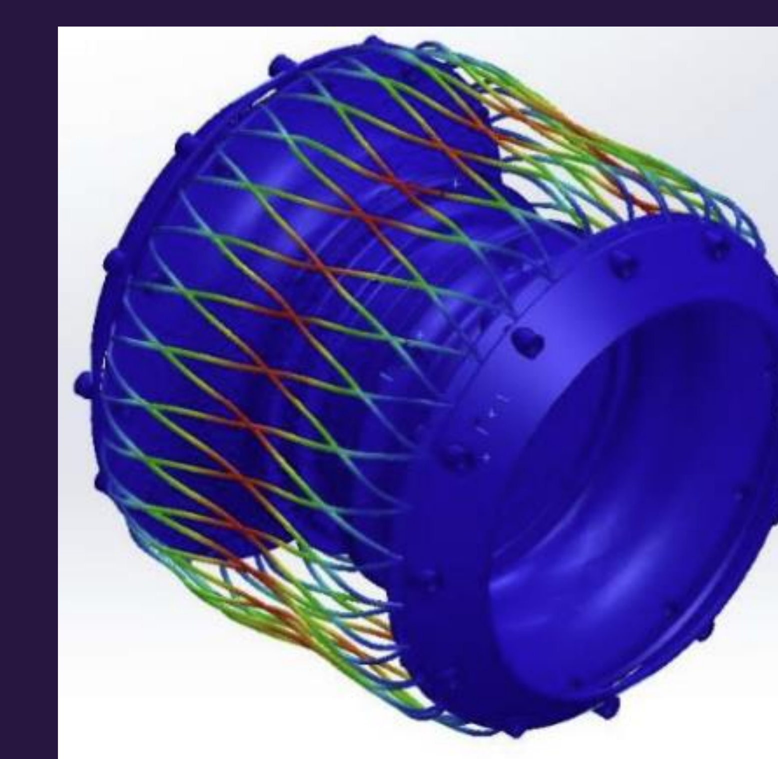
Minimum Equivalent Strain – 3.333 X 10^-10
Maximum Equivalent Strain – 8.898 X 10^-5

Cross Wire FEA: Downforce @ 316.97 N
(Resulted Displacement shown)

Minimum Displacement – 0.00 mm
Maximum Displacement – 0.02705 mm

Minimum Stress – 62.93 N/m^2

Minimum Equivalent Strain – 1.143 X 10^-10
Maximum Equivalent Strain – 9.560 X 10^-5



Honeycomb Wire FEA: Downforce @ 316.97N
(Resultant Displacement shown)

Minimum Displacement – 0.00 mm
Maximum Displacement – 0.003788 mm

Minimum Stress – 0.4235 N/m^2

Minimum Equivalent Strain – 3.9 X 10^-12
Maximum Equivalent Strain – 6.128 X 10^-6

Acknowledgments

- We thank our NASA mentors, Chatwin Lansdowne and Scott Askew, for much needed guidance and feedback. We Thank our Capstone Professor, Dr. Nourouddin Sharifi, for aiding in testing and development of ideas.
- We are grateful to TSGC for sponsoring our project and we appreciate NASA for administering this design challenge.
- We also thank Dr. Landaeta and Dr. Xu for the constant support from Mayfield College of Engineering.