

Asteroid 16 Psyche Exploration

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Goals

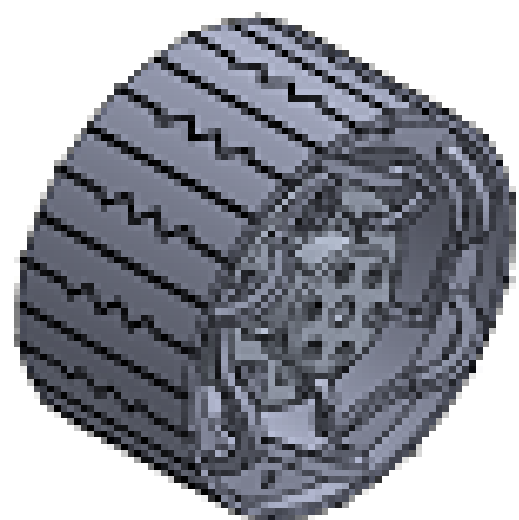
- Research asteroid 16 Psyche, its predicted properties and current exploration efforts
- Research the components used to land upon and navigate celestial bodies
- Design lander legs and rover wheels suitable for Psyche's environment

Research

- Properties of 16 Psyche: theorized to contain 30-60% metal in composition, 4.2 hour day and night cycle, and extreme temperature changes
- Current Exploration Efforts: current imaging and data collection mission launched October 2023
- Other Celestial Exploration Missions: Hayabusa 2, OSIRIS-REx, Opportunity, Spirit, Pathfinder

Rover Wheel

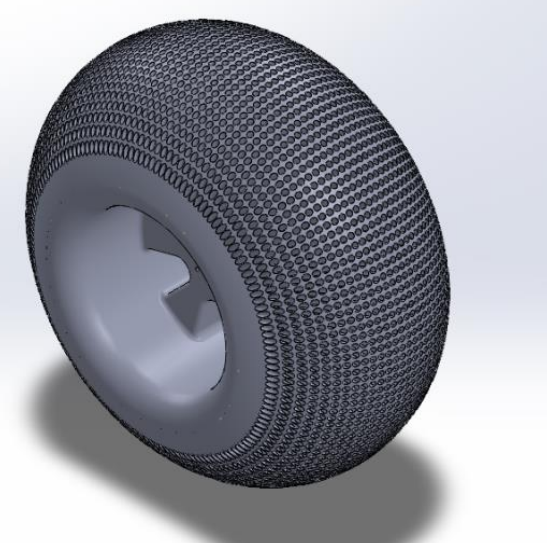
Lunar



Curiosity

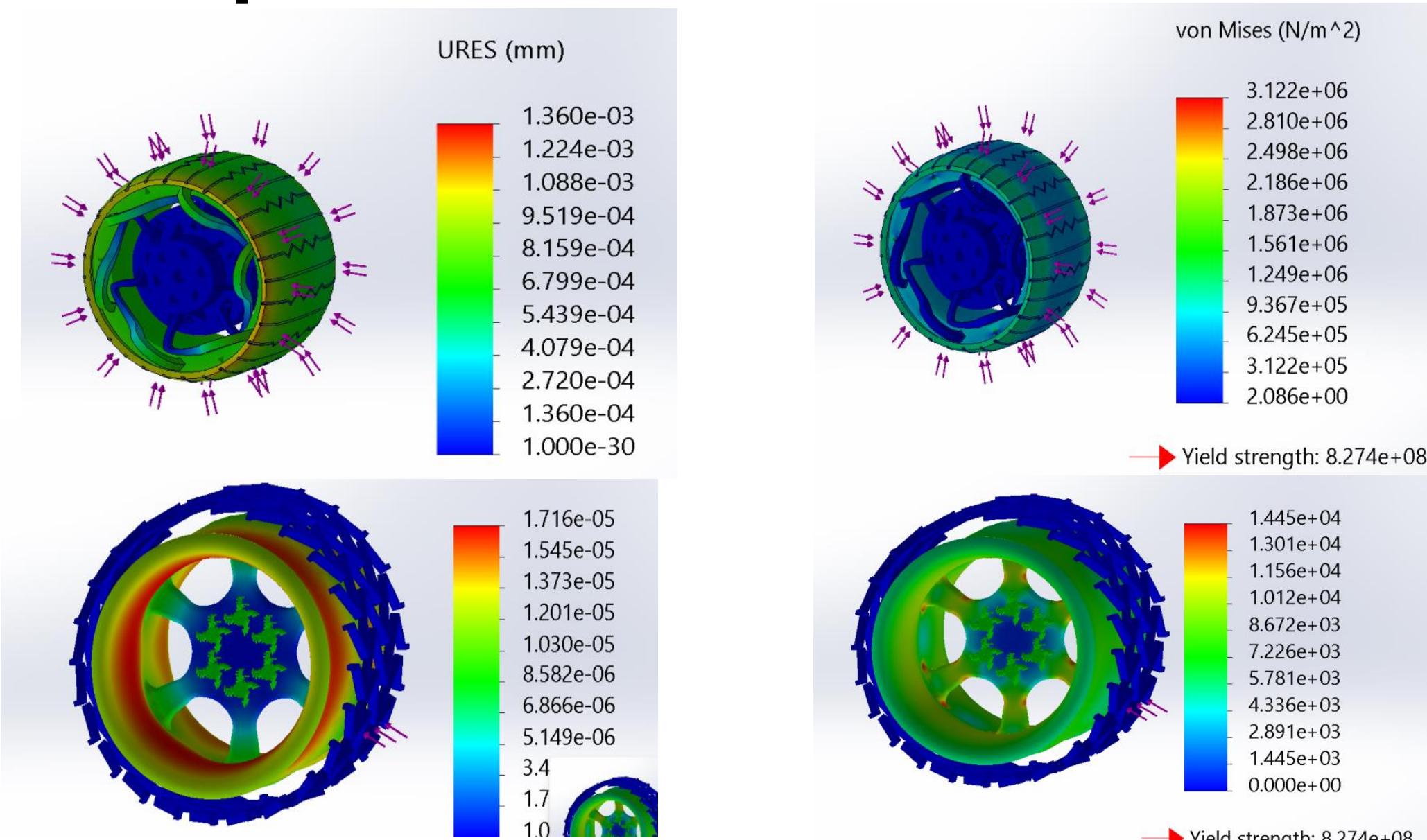


Mesh



Displacement

Von Mises Stress



Possible Future Work

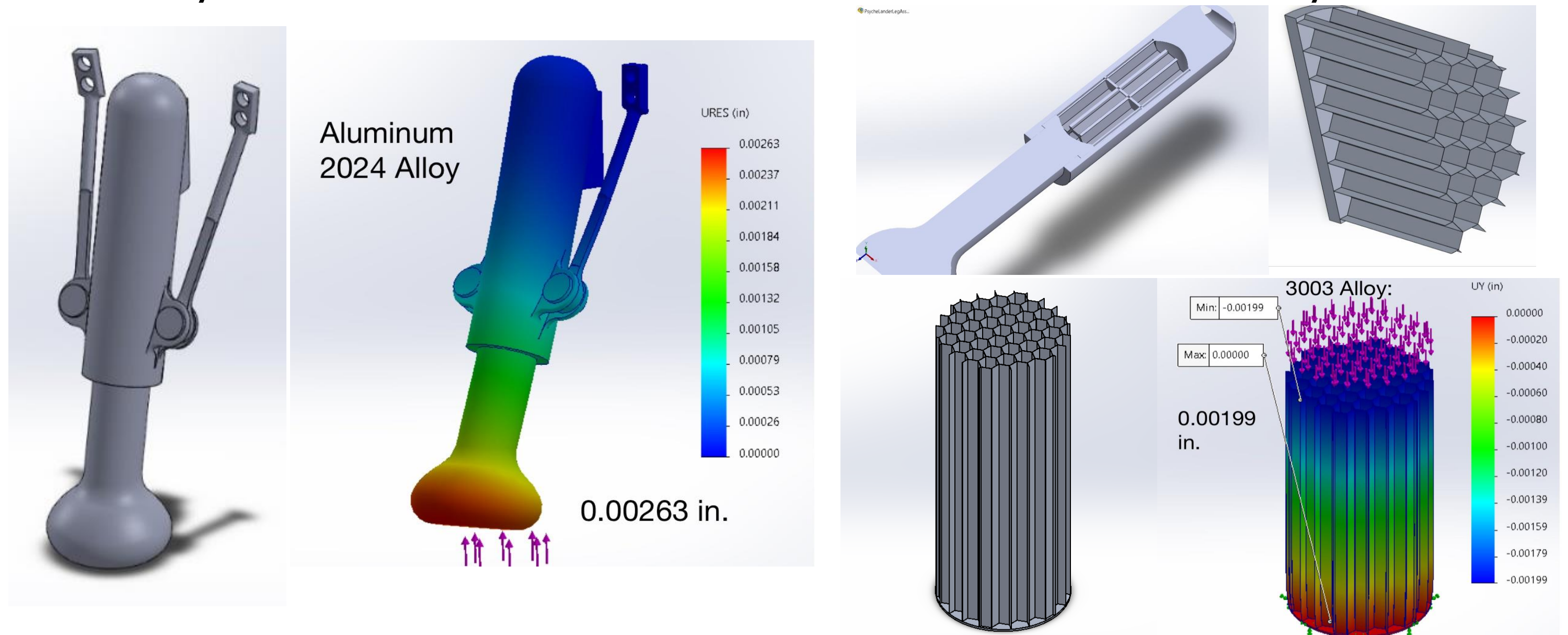
- Produce a full assembly of legs and test multiple angles for stability
- Conduct dynamic impact testing: perform drop tests using prototypes to compare actual energy absorption against FEA models

Development

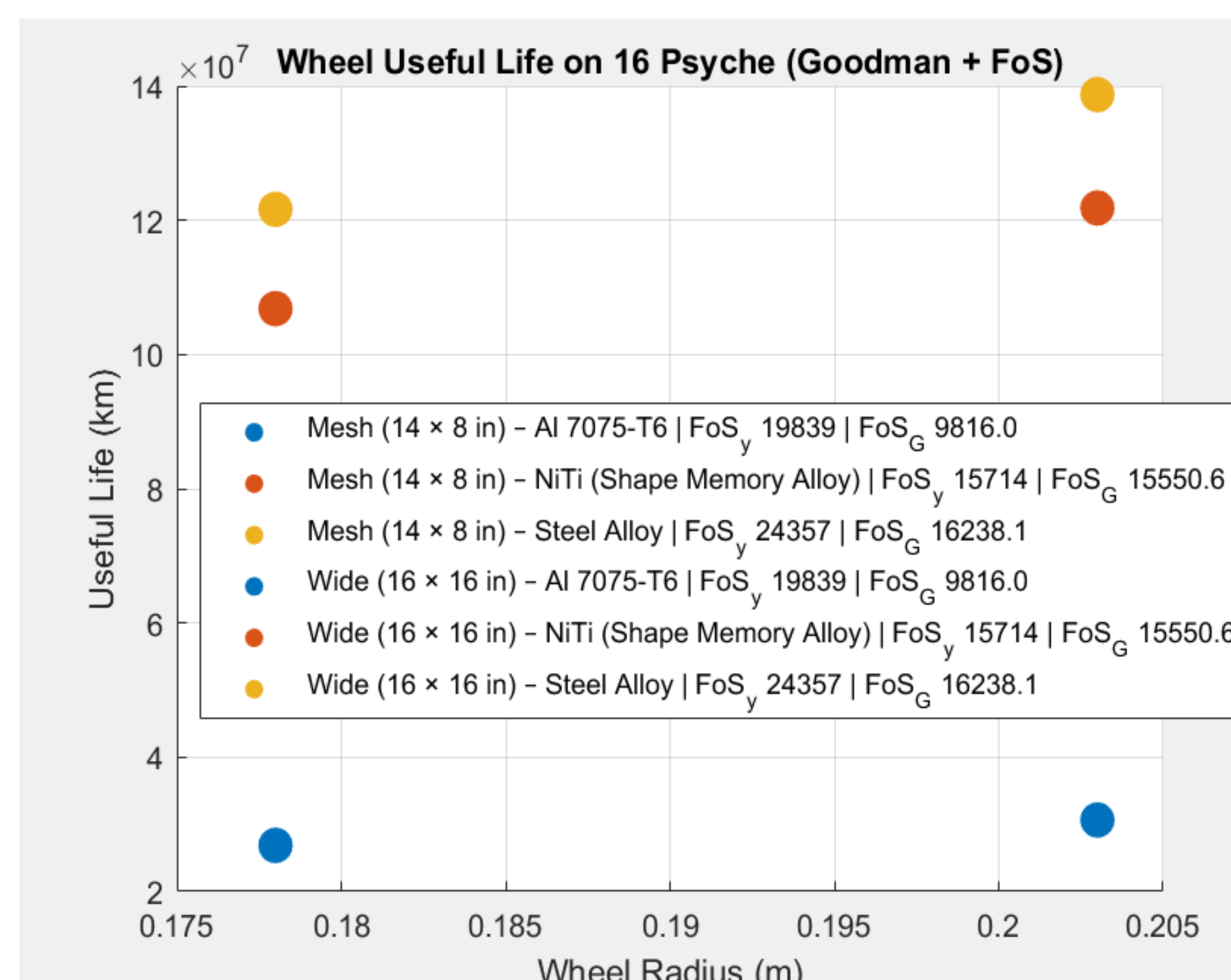
- Engineered specialized struts featuring a honeycomb core to optimize energy absorption and ensure a stable landing
- Executed Finite Element Analysis (FEA) on landing gear and diverse rover wheel geometries to evaluate structural integrity and material performance under high-force conditions
- Determined material compatibility for Psyche's metal-rich environment, identifying nickel-titanium as the optimal wheel material to reduce the risk of cold-welding and fusion

Landing Leg

- Primary strut with supporting arms for stability, tested in SolidWorks simulation using 2024 aluminum with a 500 lb force
- Honeycomb core to absorb impact force and reduce the risk of rebound as the lander collides with surface
- Honeycomb core made of aluminum 3003 and 5052 alloy



Matlab Simulation



- The markers on the plot represent when the wheel has driven enough kilometers to reach the fatigue limit
- The number of cycles was calculated using the Modified Goodman Criteria