2026 RICHARD J. FASENMEYER ENGINEERING DESIGN CONFERENCE

Deployment of Cabling On Hypothesized Surfaces

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Sponsor – NASA Psyche Mission

INTRODUCTION

Discovered in 1852, 16 Psyche is the largest M-type (metallic) asteroid ever found. It is believed to be the exposed core of a shattered planetesimal and grants us the opportunity to investigate how the Earth may have formed. Launched on October 13th, 2023, NASA's Psyche mission will reach 16 Psyche in August 2029.

Anticipating a far future possible mission, the team was tasked to design a cable deployment device to position a 1-kilometer-long fiber optic cable onto the asteroid's surface to set up a low-frequency telescope array. Low-frequency telescopes are used to detect and monitor energetic celestial events that emit long-wavelength, low-frequency waves through space. It is difficult to detect these signals due to Earth's ionosphere, human-made radio frequency interference, and satellites. Therefore, proper deployment of the cable is critical in furthering our expedition into the stars.

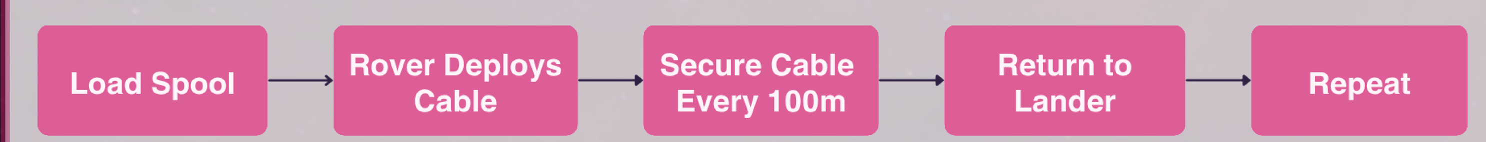

Figure 1. Sequence of Operations

ENVIRONMENTAL CONSTRAINTS

Interplanetary mechanisms face a unique spectrum of environmental conditions due to their travel into deep space. To prioritize reliability and repeatability in the design, the team applied worst-case loading scenarios and boundary conditions across all parameters to ensure the design can function in 16 Psyche's harsh environment.

Environmental Constraints:

- Temperature operating range of -380 F to -10 F
- Fatigue resistance for 252-minute day/night cycle
- Dust resistant for particles ≤ 75 µm
- Iron-nickel surface
- Exact surface conditions unknown

Figure 2. 16 Psyche Rendering

REFERENCES

"Home," *FARSIDE: A Low Radio Frequency Interferometric Array on the Lunar Farside*, 2019. https://www.colorado.edu/project/lunar-farside/home

NASA, "National Aeronautics and Space Administration," NASA,2025. https://www.nasa.gov

Psyche Mission | A Mission to a Metal World," *Psyche Mission*, Sep. 18, 2025. https://psyche.ssl.berkeley.edu/

DISCLAIMER

ABSTRACT

NASA's Psyche Mission was an orbiter mission to the metal-rich asteroid, 16 Psyche, in the Main asteroid belt between Mars and Jupiter. The spacecraft, which will arrive in mid-2029, will study the one-of-a-kind asteroid from orbit and gather scientific data. In the meantime, senior capstone teams from around the country are developing concepts for future missions to 16 Psyche. The objective of this project was to create a design concept for a cable deployment system to deploy a 1-kilometer-long fiber optic cable across 16 Psyche's surface for a hypothesized low-frequency radio telescope array. With a focus on repeatability and longevity in 16 Psyche's extreme environment, the team created a rocker-bogie rover design to carry, lay out, secure, and reload fiber optic cable spools from a surface lander.

ROVER CONCEPT DESIGN

Figure 3. Wheel and Steering Assembly

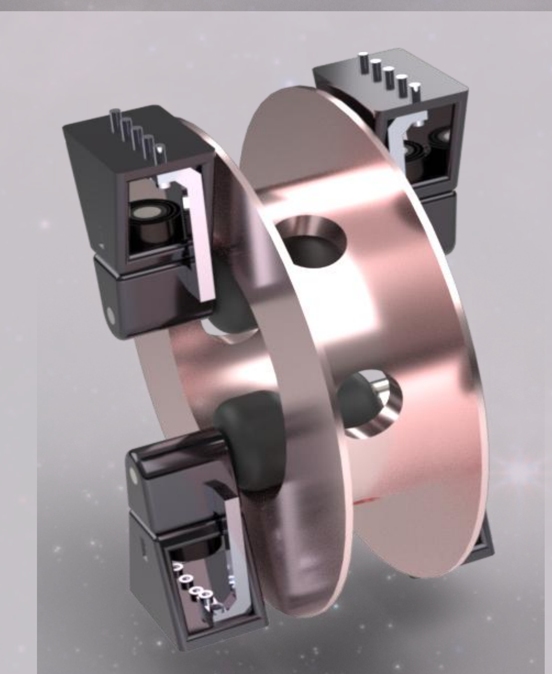

Figure 4. Spooling Mechanism Assembly

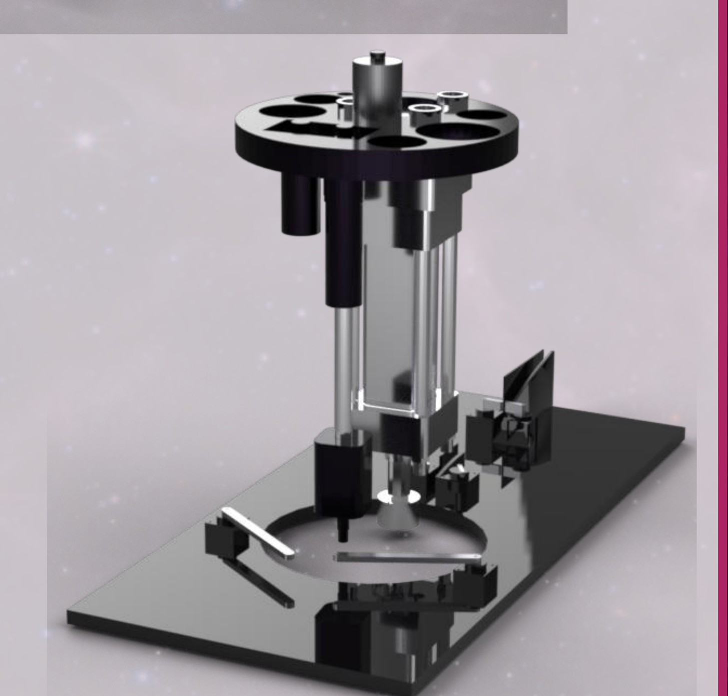

Figure 5. Securing Mechanism Assembly

ANALYSIS

ANSYS was used to analyze the different major structural and mission-critical mechanisms. Each analysis had multiple constraints to imitate a realistic operating loading scenario. Hand calculations were also performed to verify the results of these analyses.

Wheel and Control Arm:

- Weight of the entire rover applied to the steering column connector.
- Max stress: 149.7 MPa

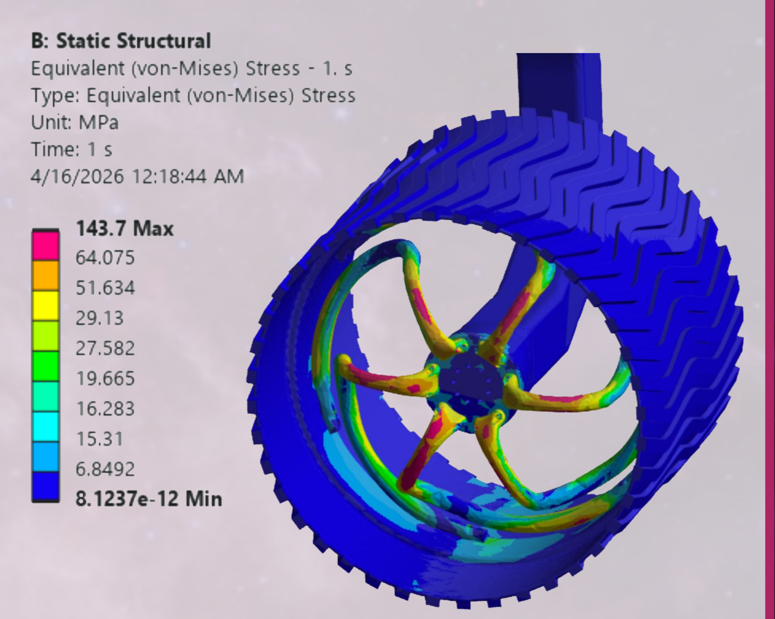

Figure 6. Wheel and Control Arm ANSYS

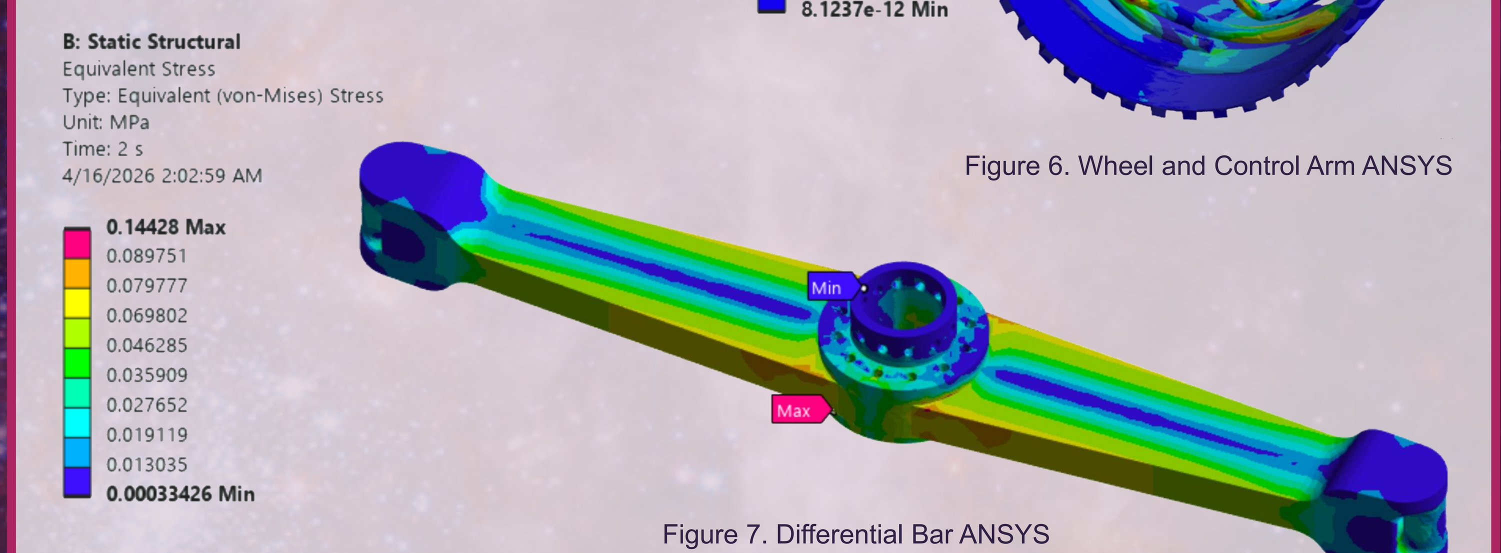

Figure 7. Differential Bar ANSYS

Rocker-Bogie Differential Bar:

- The weight of the rover is applied to each end of the differential bar
- Extremely important, holds the rover chassis up
- Max stress: 0.144 MPa

Differential Lever:

- A lever arm directly connecting the rocker-bogie suspension to the differential bar
- Max stress: 6.91 MPa

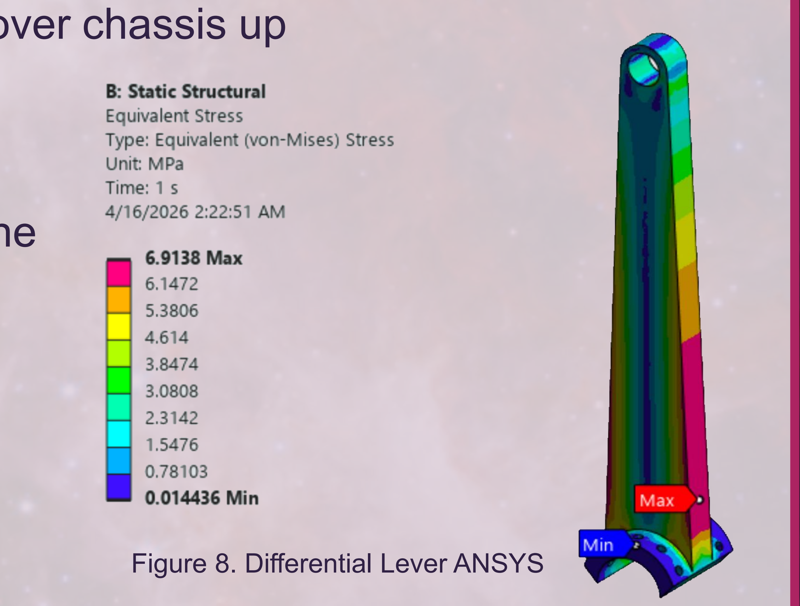

Figure 8. Differential Lever ANSYS

FUTURE WORK

Missions into space typically take hundreds of people and span several years of concepting, development, and testing, so, given more time, the team has outlined a general overview of the next steps in this project's development.

- Wiring harness to connect components
- Computerized program to allow for a fully autonomous device
- Physical prototyping and testing

SOFTWARE

SOLIDWORKS