Mechanical Drive System of a Planetary Surface Detection Rover

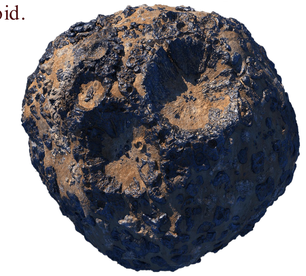
(C.A.T. Crawler)

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PROJECT OVERVIEW

Mission Statement

The C.A.T Crawler team will develop a rover mobility system capable of traversing the uneven, rocky, micro-gravity terrain while maintaining stability and reliable operation under the environmental conditions expected on the Psyche asteroid.



Artist's illustration of asteroid (16) Psyche, a metal-rich asteroid located between Mars and Jupiter.

Associated Project

The TXST Electrical Engineering team is developing a surface detection system to locate ferromagnetic elements on the Psyche asteroid.
The designed mobility system must integrate with the Electrical Engineering team's surface detection system without hindering the capabilities.

BACKGROUND

Psyche is a metal-rich asteroid orbiting the Sun between Mars and Jupiter. Because of it's observed nickel-iron properties, the asteroid is believed to be the core of an early planet.
This poses the opportunity to study and further understand the life cycle of planets as well as have access to rare Earth metals that makeup the asteroid.



NASA's Psyche spacecraft Astrotech Space Operations facility near Kennedy Space Center in Florida. NASA/Frank Michaux (2025)

Current Work

NASA's Psyche Mission, led by Arizona State University, launched in October 2023 and is scheduled to reach the asteroid in August 2029. The spacecraft will orbit Psyche to study its composition, structure, and magnetic properties.

Through the Psyche Student Collaborations program, university engineering teams are developing conceptual technologies to address challenges associated with exploring the asteroid's surface.

SELECTED CONCEPT

IN PROGRESS

The 3D SOLIDWORKS model visualizes the selected rocker-bougie concept. Advantages include:

- Suited for traversing varying obstacle sizes.
- Increased surface contact.
- Tested and verified functionality.

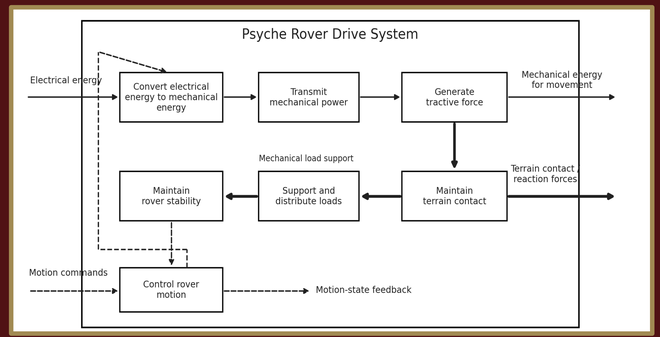
CRITICAL SUBPROBLEMS

Critical Subproblem	Rationale for Selection
Power Transmission	Determines how power is transmitted from the motors to the drive mechanisms, influencing available torque, efficiency, motor placement, and drivetrain configuration.
Suspension	Determines how loads are supported and distributed while maintaining terrain contact, stability, and obstacle traversal capability.
Environment/Protection	Addresses the protection of mechanical components from dust, radiation, temperature variations, and vacuum exposure.
Traction	Determines how the rover generates driving force and maintains surface contact while traversing loose or rocky terrain, slopes, and obstacles under low-gravity conditions.

STAKEHOLDER SPECIFICATIONS

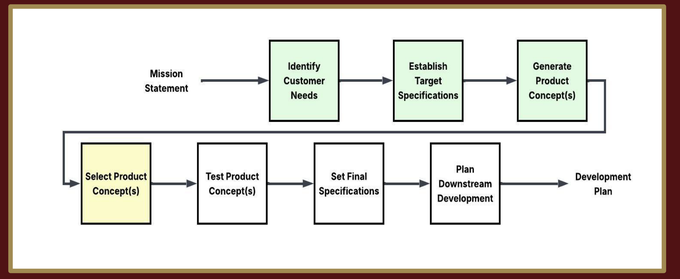
Stakeholder Target Specification	Value	Units
Incline Clearance	30	°
Step Height Clearance	8	in
*Micro-gravity	0.161	ft/s^2

INTERNAL FUNCTIONS



APPROACH

The high-level approach to the drive system design is to closely analyze the customer needs and target specification to drive the concept generation and design. The concept generation and design phases are shown in the graphic below.



Phases of Concept Generation and Design (2026)

FUTURE WORK

Short Term

Following concept selection, the CAD model will be refined through material analysis and simulation testing. Materials will be selected, and a comprehensive bill of materials (BOM) and fabrication plan will be developed.

A test bed will be created to physically test the drive system on varied terrain. Refinements will then be made to improve the design and verify target specifications.

Long Term

- Detection Arm Development: Design a deployable arm to position the electromagnetic surface detection system for improved surveying capabilities.
- Chassis Development: Refine the rover chassis to support additional payloads, instrumentation, and future system integration.
- Magnetic Wheel Integration: Investigate integrating magnets into the wheels to improve traction and stability on potentially ferromagnetic terrain.

PENDING APPROVAL

Layout for Test Bed Fabrication (2026)

AWKNOWLEGEMENTS & CONTACTS

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