College of Engineering
UNIVERSITY OF GEORGIA

Capstone Design Project Abstract

Project Title: NASA Psyche Asteroid Rover

Sponsor: Arizona State University School of Earth and Space Exploration
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The NASA Psyche Asteroid Rover project focuses on the design and development of a specialized mobility system capable of traversing the unknown and extreme varying terrain of the metallic asteroid Psyche. NASA is currently sending a spacecraft to study this asteroid so little is known about its surface conditions, creating a need for a rover system that can adapt to a wide range of environments including uneven, low-traction, and irregular terrain. The project aimed specifically to design a mobility system capable of changing its mobility system while on surface to best adapt to the terrain it was currently operating on. This project specifically addresses that challenge by developing a hybrid mobility solution that increases the versatility and reliability of surface exploration systems.

The proposed rover design integrates two distinct mobility methods into a single system: a tracked drive system for efficient rolling motion and a walking mechanism that allows the rover to step over obstacles and adjust its center of mass as needed. By varying the center of mass and motion the rover can adjust its position in order to best optimize the traction on an asteroid surface lacking sufficient gravity. This multi-function capability differentiates the design from traditional rover systems, which typically rely on a single mode of mobility. By combining these approaches, the rover can maintain traction, stability, and maneuverability across a wider variety of surface conditions than the current NASA rover designs.

Key engineering features of the system include the integration of both mobility modes into a compact structure and the ability to transition between driving and walking behaviors depending on terrain demands. The design process has involved the development of a full 3D CAD model, followed by the creation of a scaled physical prototype to validate functionality. The prototype is designed to both drive using its track system so it can maneuver around in the same way as a tank and walk using its step like mobility system. In addition to physical testing, computational tools have been used to approximate scaling effects such as weight distribution and motor torque to ensure the prototype accurately reflects the intended full-scale behavior.

The significance of this project lies in its potential to expand the capabilities of future planetary rovers. By enabling reliable traversal across uncertain and diverse terrain conditions, this hybrid mobility system contributes to the advancement of extraterrestrial exploration technology. The project is currently in the physical prototyping phase, with an estimated total cost of approximately $250, demonstrating a cost-effective approach to developing and testing innovative mobility solutions.

Overall, this work represents a step toward more adaptable and resilient rover systems that can support future missions to environments where terrain conditions are largely unknown.
