Design Case Study*

EENG350: Systems Exploration, Engineering, and Design Laboratory

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In this assignment, you will express your current understanding of the important aspects of a successful project through a design exercise based on a past senior design project. Create a 1-2 page response for the design scenario exercise. How would you approach this project? What steps would you take or processes would you use? What challenges would you anticipate? Focus on the describing your general approach, rather than explaining or designing a particular solution. Assume you have two semesters and reasonable resources available to complete the project. Submit your response to the design case study assignment link.

Design Case Study

This senior design project is part of a NASA competition related to space resource extraction. Recent discoveries by NASA missions to Mars such as the Mars Science Laboratory (MSL) rover named “Curiosity" and instruments on orbiting satellites have found large amounts of water in the form of water ice at the higher latitudes and also hydrated minerals globally on Mars. These hydrated minerals are the result of ancient clays and clay-like minerals called phyllosilicates, or other polyhydrated sulfates that formed millions of years ago in wet environments on the surface or underground. Capturing this water is the key to allow humans to “live off the land" or in scientific terms “n- Situ Resource Utilization (ISRU)". The water can be used for human consumption, hygiene, growing plants, providing radiation shielding, and making rocket propellant for the journey home. The minerals and soil are typically in the form of crushed and weathered rock called “regolith", which must be removed to get to the water ice below.

Project Description

This competition is for university-level students to design and build a mining robot that can traverse the challenging, simulated, and chaotic off-world terrain. The mining robot must then excavate the ice simulant (gravel) and return the excavated mass for deposit into the collector bin to simulate an off-world, in situ resource mining mission. The complexities of the challenge include the abrasive characteristics of the regolith simulant, the weight and size limitations of the mining robot and the ability to tele-operate it from a remote Mission Control Center. The on-site mining category will require teams to consider a number of design and operation factors such as dust tolerance and dust projection, communications, vehicle mass, energy/power requirements and autonomy.