UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	UNCC/NC Space Grant	**Date Submitted**	7/31/17
Project Title	Off-world Robotic Mining (UNCC_ASTR2)	**Planned Starting Semester**	Fall 2017

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person. Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	3
Computer	3	Systems	1
Other ( )			

Project Overview:

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. They are the result of ancient clays and clay-like minerals called phyllosilicates, or other poly-hydrated 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 “In-Situ Resource Utilization (ISRU)”. The water can be used for human consumption, hygiene, to make rocket propellant for the journey home, grow plants, to provide radiation shielding and for various manufacturing processes. Before the water can be used in a human Mars station, the granular minerals which contain the water must be mined, or the soil overburden must be removed, to expose the water ice. The minerals and soil are typically in the form of crushed and weathered rock called “regolith”.

Initial Project Requirements:

Off-world robotic mining ... icy-regoltih ... this is the prize for RMC 2018. Competition Teams will be required to perform two official competition attempts (10 minutes allowed for each competition attempt) to mine gravel in the Caterpillar Mining Arena. The mining area will contain BP-1 up to a depth of approximately 30 cm. Below the BP-1 there will be approximately 30 cm depth of gravel with a mean particle size diameter of ~ 2 cm which simulates icy regolith buried in the Martian regolith. Larger rocks may also be mixed in with the gravel and BP-1 in a random manner. Note that gravel may be mixed in with the BP-1, but the bulk of it will be in the bottom 30 cm of the mining area only. Three obstacles will be randomly placed and create two craters on each side of the Arenas. The mining robot will be placed

in the arena in a randomly selected starting position. Each competition attempt will occur with two teams competing at the same time, one on each side of the Arena. After each competition attempt, the gravel will be returned to the lower 30 cm of the mining area and the BP-1 will be returned to the top 30 cm in a compacted state, and the obstacles and craters will be re-set in the arena.

The mining rover should be able to complete all tasks autonomously; enhancement of previous year's rover's is the preferred approach.

Expected Deliverables/Results:

(1) A Systems Engineering Paper, (2) An Outreach Project Report, (3) A slide presentation and demonstration to NASA judges at the 9th NASA Robotic Mining Competition at Kennedy Space Center May 14-18, 2018. (4) A fully functioning design by March 15, 2018. (5) A thorough test program beginning March 15 through April 30, 2018.

Disposition of Deliverables at the End of the Project:

The University maintains ownership of the rover.

List here any specific skills, requirements, knowledge needed or suggested (If none please state none):

Interface and logic design • Labview • Communications 2 • Robot control and systems • Programming • Circuit design • Communication and wireless • Power systems and power management • Robot control and systems • Programming • Computer Aided Modeling • Machine dynamics or design

Special Skills desired: • Experience with remote controlled vehicles or machinery. • Control Systems or Robotics (including PID control and path planning) • Experience with positional sensing and/or navigation • Knowledge of Labview and RIO based control

This is a competition based project, and travel to the competition at Kennedy Space Center (May 2018) is a planned for students that demonstrate exemplary work ethic in the course of the project.