



# Needs Assessment and Project Scope

Lunar Regolith Excavator Student Competition  
ME Team #8 / ECE Team #1

## **FAMU-FSU College of Engineering**

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## **Needs Assessment**

The National Aeronautics and Space Administration is holding a competition in May 2010 for the primary purpose of idea generation and robotic platform synthesis. The competition is designed to solicit robotic platforms from Universities across the country to excavate 150 kg of Regolith in 30 minutes while not weighing more than 80 kg. The goal of the competition is to have teams design compact, light-weight, mechatronic systems for Lunar regolith excavation and transportation.

# Project Scope

## Problem Statement

The primary emphasis in this design project is to create a robotic platform capable of meeting and exceeding all required functions as set forth by NASA for the competition. These functions include excavating 150 kg of regolith in 30 minutes, remaining under 80 kg, and performing telerobotic operations.

## Justification & Background

The motivation for the project is for lunar exploration and colonization. NASA's Constellation Mission Program is designed to return humans to the moon within the next 20 years. As part of the Constellation Program, human settlements will be set up creating a permanent moon base. Autonomous, telerobotic, and direct control excavation and construction vehicles will be necessary for moon colonization. Lunar regolith, or top soil, can be utilized for many uses including resources, construction, and protection.

The focus for a Lunar Excavating robot will be to excavate regolith for use in construction and resource mining. The construction of layers of regolith over living quarters adds a layer of protection against solar radiation and micro-meteorites. Other construction uses for regolith include creating blast burms for landing pads. Lunar regolith also has a very important role in creating oxygen and water, as lunar regolith has a high percentage of oxides that can be extracted and converted to useable resources.

## Objective

The primary objective of this project is to design and build a telerobotic system capable of exceeding competition requirements to allow a solid win at the Exploration Systems Mission Directorate Lunar Regolith Excavator Student Competition at Kennedy Space Center in May 2010. The secondary objective of the project is to create a useful robotic system that can easily be implemented for lunar excavation, exploration, and construction.

## **Methodology**

The methodology to be used in this design project will be a feedback methodology from each step to allow the team to revisit earlier stages to allow for fine tuning of the final product. Designing, testing, re-designing, and re-testing will be critical in the development of a successful robotic system. The constraints as set forth by the NASA competition rules place specific requirements for each robotic function, thus testing will be extremely important. The methodology will follow the following form.

1. Requirements Analysis
2. System Design
3. Detailed (block) design and test
4. System integration and test

Each step will be able to revisit the earlier step to assess and fix any design problems encountered. The final step of the methodology will deliver a properly functioning system that meets all requirements as set forth by NASA.

## **Expected Results**

The expected results of this project will be to deliver a properly functioning, optimized robotic system to the competition in May and to be able to outperform every other team competing as well as meeting every requirement described in competition rules and regulations. The final design will not only perform well at the competition, but also serve as a stepping block for final designs of lunar excavators for the Constellation lunar missions.

The tangibles delivered at the conclusion of the project, other than the final robot, will include circuit schematics, systems engineering paper, systems engineering presentation, all deliverables as outlined by the Senior Design curriculum at the FAMU-FSU College of Engineering, and outreach curriculums centered on space exploration and engineering.

## **Constraints**

The constraints of the project include money and time but also the rules and regulations given by NASA for the competition. These constraints include a robot weight of less than 80 kg, power shall not exceed 40.0 V, a delay of at least 2 seconds in the telerobotic operation, and cannot use ordinance, gases, or suction. There are secondary constraints listed in the Regolith Competition rule book, but are not primary focuses for the project.

The current budget for the project is \$6,500 including \$5,000 from the National Space Grant Foundation and \$1,500 from the FAMU-FSU College of Engineering Mechanical Engineering Department. The team is currently looking for more sponsors to enable a more robust, intelligent design. Current estimates for the desired robotic platform place the necessary budget in the vicinity of \$10,000.