LUNA_COMP3: NASA LUNABOTICS COMPETITION 2022

Senior Design 2 – Spring 2022

Faculty Mentors: Dr. Aidan Browne & Dr. Michael Smith

Team: Josh Cooley, Tyler Chapin, Anjila Bista, Jared Jackowitz, Jason Easterling, Dipal Shah, Cramer Ward-Collings, Charles Roberts, Angel Romero Avalos

jcooley4@uncc.edu, tchapin1@uncc.edu, abista1@uncc.edu, jjackowi@uncc.edu, jeaster6@uncc.edu, dshah30@uncc.edu, cwardcol@uncc.edu, crobe110@uncc.edu, aromeroa@uncc.edu

NASA Robotic Competition Overview

NASA Artemis Competition to design and build prototype rover to operates lunar environments. Rover must navigate, mine, and deposit autonomously.

Design it: Plan & provide new design implementations using previous rover

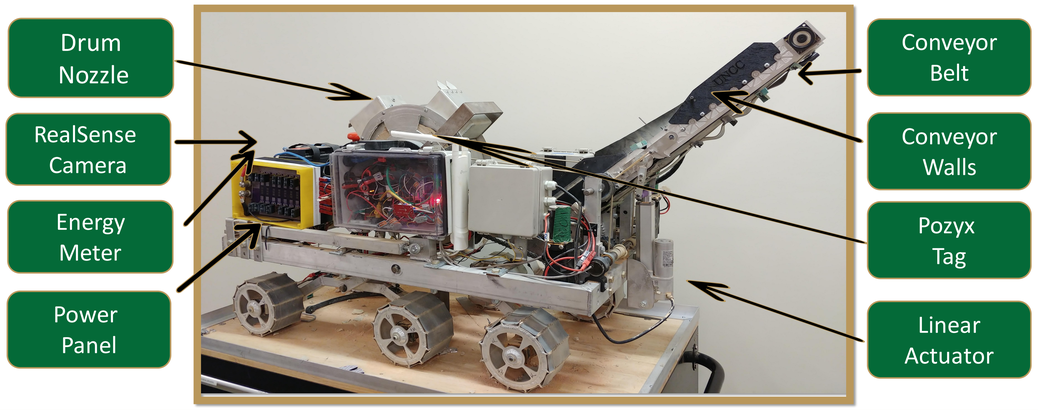
Build It: Manufacture & implement new design changes to create efficient operational rover

Dig it: Compete at Kennedy Space Center in May 2022

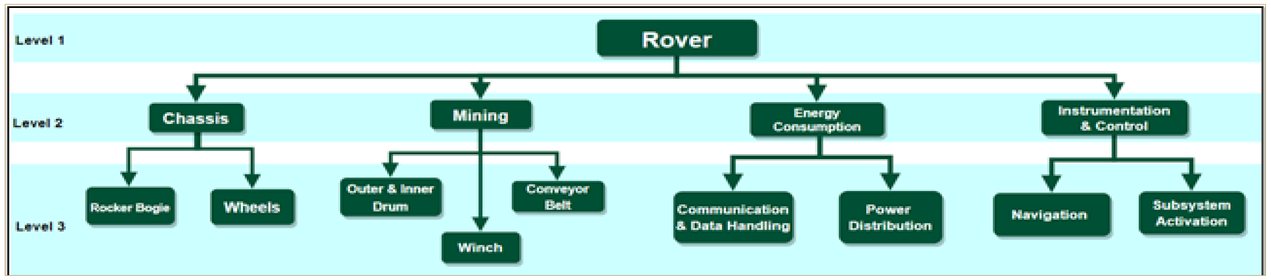
Design Specifications

Current Rover Specifications:

1. Payload undeployed volume:
   1.04 m length x 0.516 m width x 0.572 m height
2. Payload deployed volume:
   1.32 m length x 0.516 m width x 0.728 m height
3. Mass: 56.73 kg



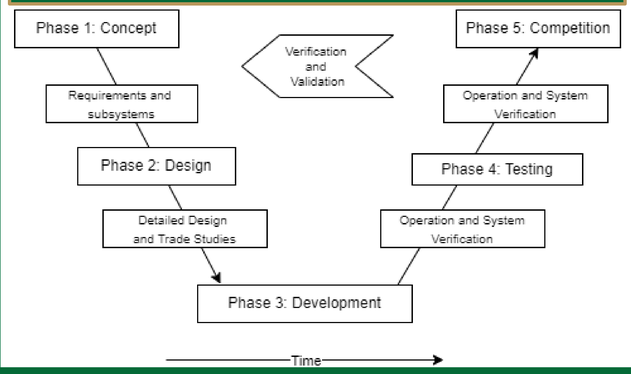
System Hierarchy



Concept of Operations

1. Rover placed randomly in arena
2. Rover travels through obstacle zone
3. Rover mines in excavation zone & collect regolith
4. When full, rover navigates to collector (same path)
5. Drum fully deploys & deposits on conveyor belt
6. Deposits to collector & repeats for 15 min.

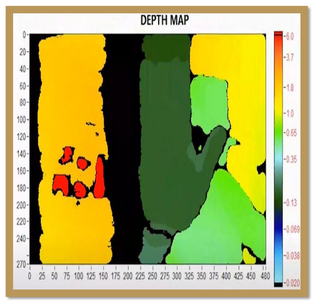
Design Process

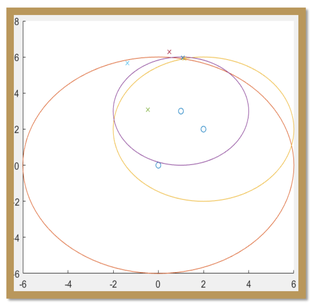


Implementation and Results

Autonomy

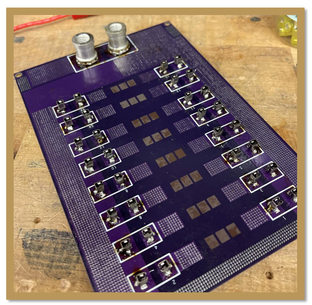
- Navigation, mining, digging, and deposition
- Intel RealSense camera detects obstacles

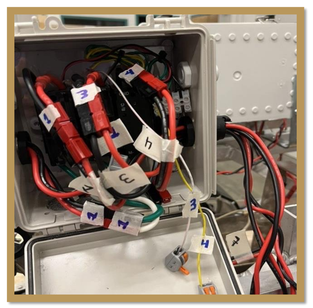




Power Distribution

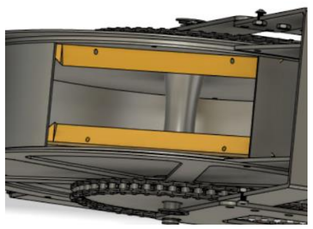
- 12 Volt paired outputs rated for 40 Amps
- Complete rewiring of rover





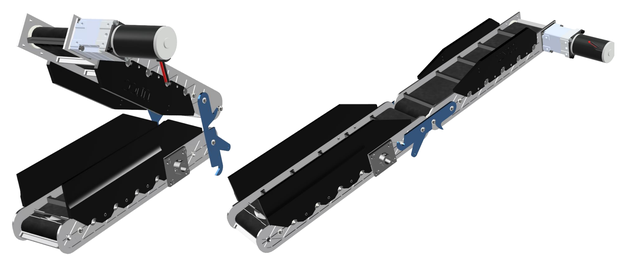
Drum Nozzle

- Optimized flow direction
- Ability to flow icy regolith without jamming



Conveyor Belt

- Transport regolith into collector
- Folds to meet size constraints



Testing problems and resolutions

Rock Binding Prevention

- Rock reliefs
- Belt Brush
- Winged conveyor pulley
- Rubber back on mining buckets

Power Distribution

Problem: Power and signal dropping out

Solution: Buck converters incorporated

Autonomy

Problem: Operational Jams

Solution: encoder redundancies

Conclusion

Spring 2022 Major Milestones

Phase 3: Development (12/9/22 - 3/1/22)

- Order Parts
- Implement Designed Builds

Phase 4: Testing (3/1/22 - 4/19/22)

- Test all rover operations
- Submit all NASA require documentation

Phase 5: Competition (5/23/22 - 6/1/22)

- Competition Week

Future Improvements

Autonomy:

- Additional encoders for wheels
- Multicamera lidar system

Conveyor Belt:

- Improve rock prevention

Power Distribution:

- Redesign PCB with separated ground terminals
- Integrated Controller for PCB for outputs

LUNA_COMP3: NASA LUNABOTICS COMPEITION 2022

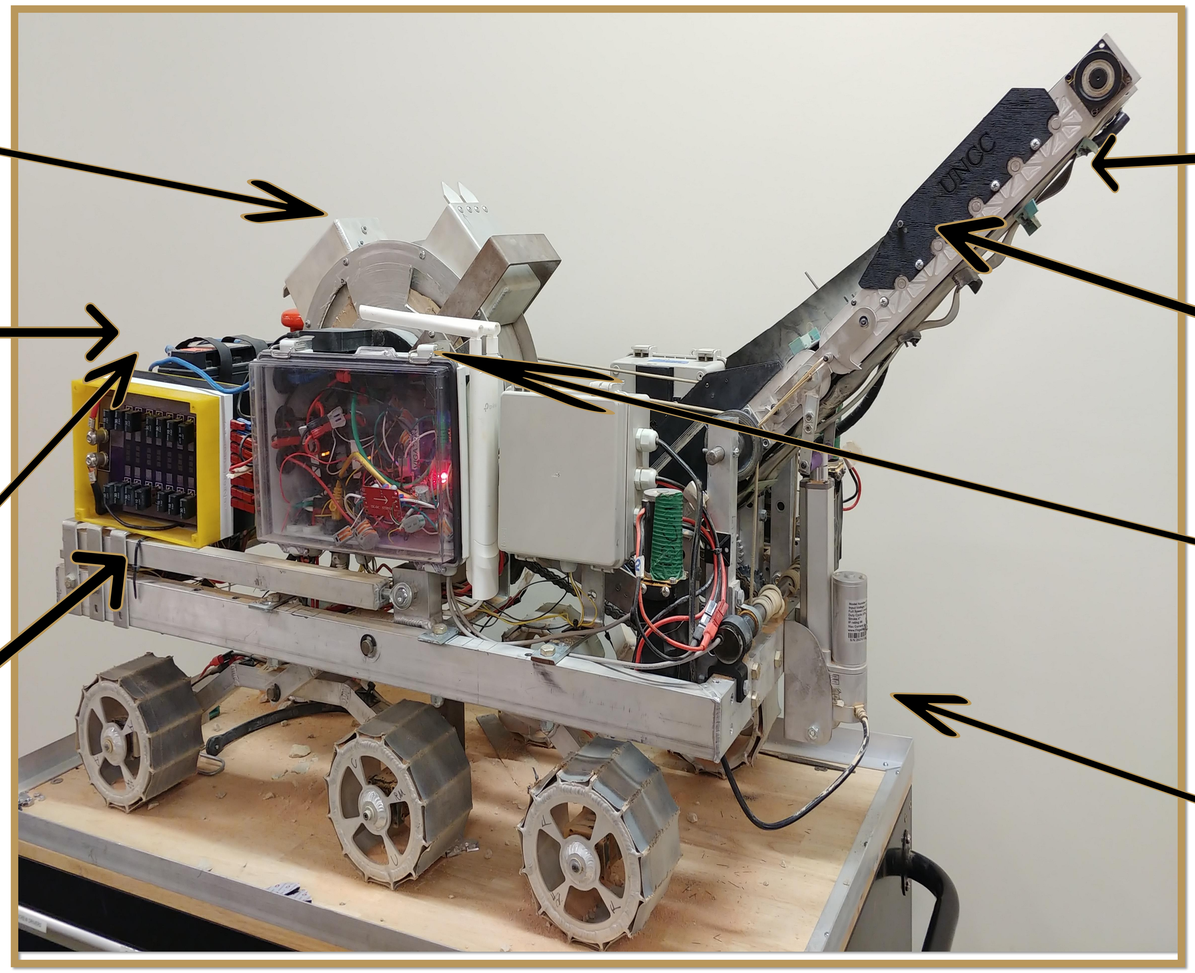
The Rover Overview

Drum Nozzle

RealSense Camera

Energy Meter

Power Panel



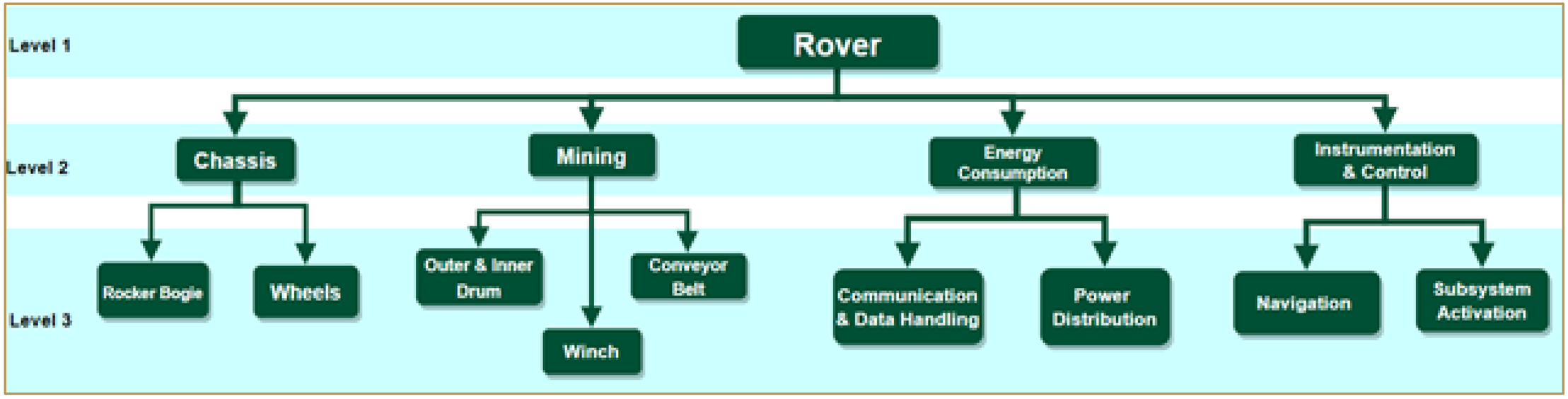
Conveyor Belt

Conveyor Walls

Pozyx Tag

Linear Actuator

System Hierarchy



NASA Robotic Mining Competition Overview

NASA Robotic Competition Overview

Lunabotics is a NASA Artemis Competition where students are tasked to design and build a prototype rover that operates in a lunar-like environment. The rover must navigate, mine, and deposit autonomously. The Competition consists of 3 phases:

Design It: Plan and provide new design implementations using the previous rover (inherited design)

Build It: Manufacture and implement on the new design changes to create an efficient operational rover

Dig It: Compete in the Lunabotics Competition at Kennedy Space Center in May 2022

Concept of Operations

- Rover is placed randomly in the arena and begins to navigate towards a specific location
- Rover transverses through the obstacle zone
- Rover begins to mine in the excavation zone and collect regolith in the drum
- When the drum is full, rover begins navigating to the collector sieve using the same path
- The drum fully deploys/extends and deposits on the conveyor belt
- After deposition into the collector sieve this process is repeated with a 15 min time period

LUNA_COMP3: NASA LUNABOTICS COMPEITION 2022

Design Specifications and process

Design Specifications

Current Rover Specifications:

1. Payload undeployed volume:

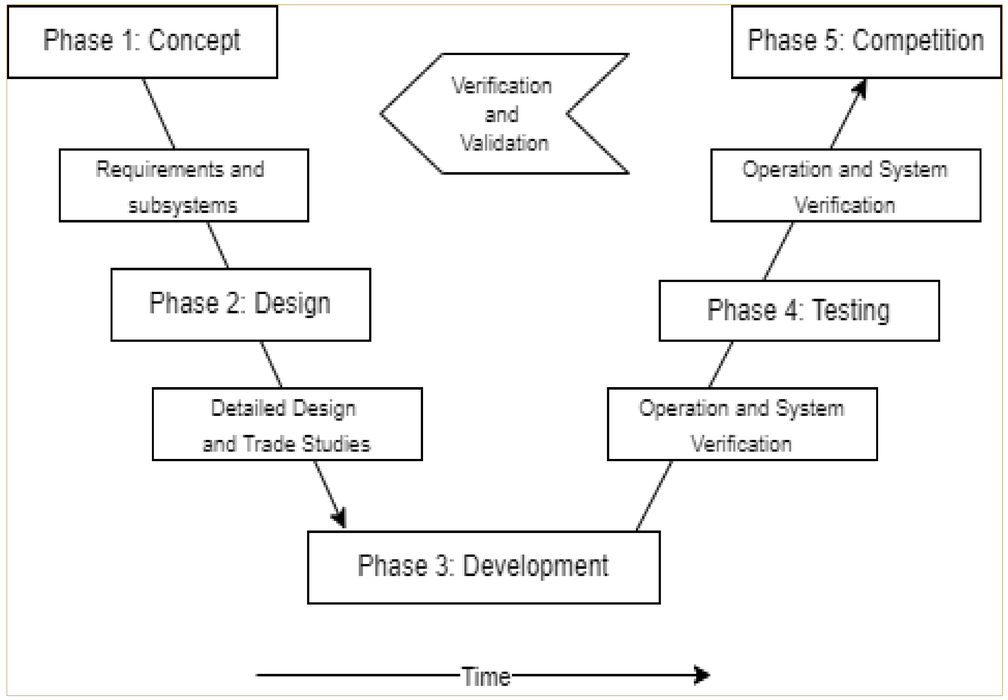
   1.04 m length x 0.516 m width x 0.572 m height

2. Payload deployed volume:

   1.32 m length x 0.516 m width x 0.728 m height

3. Mass: 56.73 kg

Design Process

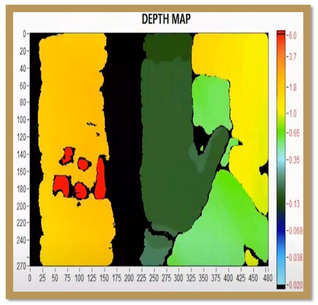


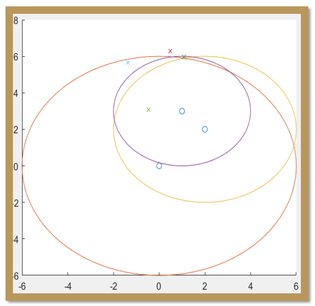
LUNA_COMP3: NASA LUNABOTICS COMPEITION 2022

Implementations and Results

Autonomy

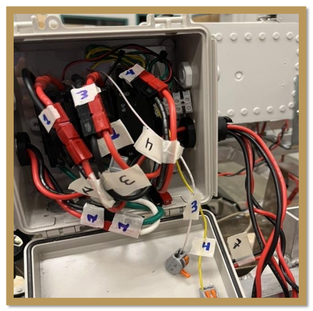
- Navigation, mining, digging, and deposition
- Intel RealSense camera detects obstacles

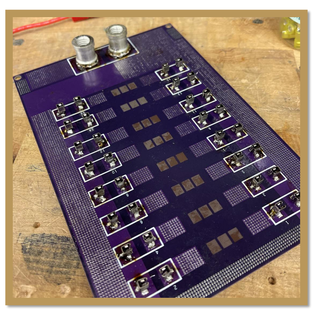




Power Distribution

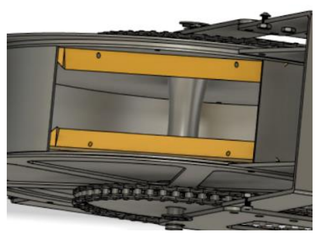
- 12 Volt paired outputs rated for 40 Amps
- Complete rewiring of rover





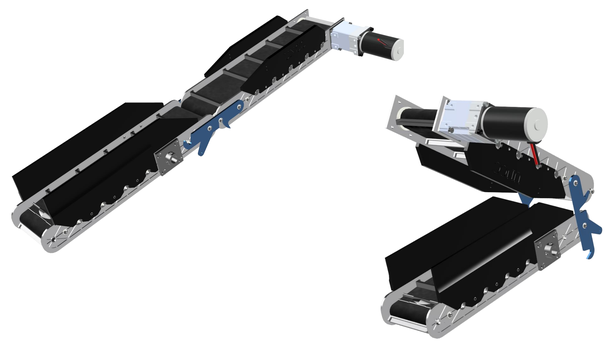
Drum Nozzle

- Optimized flow direction
- Ability to flow icy regolith without jamming



Conveyor Belt

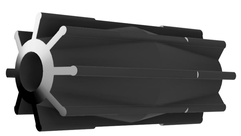
- Transport regolith into collector
- Folds to meet size constraints



Testing Problems and resolutions

Rock Binding Prevention

- Rock reliefs
- Belt Brush
- Winged conveyor pulley
- Rubber back on mining buckets



Power Distribution

Problem: Power and signal dropping out

Solution: Buck converters incorporated

Autonomy

Problem: Operational Jams

Solution: encoder redundancies