LUNA_COMP2: NASA Robotic Mining Competition

Senior Design II – Spring 2021

Dr. Aidan Browne & Dr. Michael Smith (Faculty Mentors)

UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE of ENGINEERING

Joseph Satterwhite (PL), Ryan Barbour, Jacob Daniel, Chaitanya Gokule, Jacob Herbert, Armel Luabeya Tshitala, Peter Mancini, Sydney McCain, Ricardo Martinez, Holden Stanley

jsatter9@uncc.edu, rbarbou6@uncc.edu, jdanie42@uncc.edu, cgokule@uncc.edu, jherber9@uncc.edu, aluabeya@uncc.edu, pmancini@uncc.edu, smccain2@uncc.edu, rmarti89@uncc.edu, hstanle4@uncc.edu

Project Specifications

Maximum NASA Rover specifications:

1. Payload position: 1m x 0.5m x 0.5m
2. Operation Position: 1m x 0.5m x 1.5m
3. Deposition Position: 1m x 0.5m x 2.5m
4. Weight: 60kg

Current Rover specifications:

1. Payload position: 0.993m x 0.492m x 0.477m
2. Operation Position: 0.993m x 0.492m x 0.477m
3. Deposition Position: 0.933m x 0.492m x .892m
4. Weight: 51.2kg

Concept of Operation:

- Rover begins traversing simulant lunar terrain
- Geolocalization system confirms rover is at mining zone
- Rover begins to mine and collect regolith/gravel until certain weight is met
- With full mining drum, rover begins to move toward deposition bin
- During deposition, rover extends support arms to deposit regolith/gravel
- After depositing all minerals, rover will repeat this process up to 15 minutes

Design Philosophy and Approach

Use of systems engineering approach to identify requirements and risks, re-engineer subsystems, and validate performance.

Five Stages of Systems Engineering:

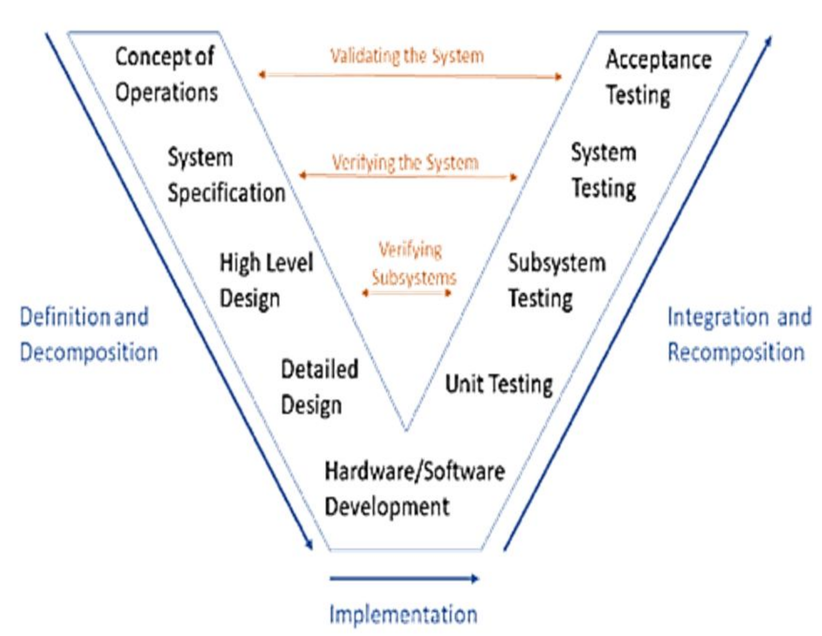
Conceptualization:
- Identify need and goals
- Split into three sub-systems
  - Mining, Chassis, and Navigation & Control
- Identify risks
- Identify design alternatives
- Create project management plan

Design
- CAD models
- Analysis and calculation

Development:
- Order parts
- Fabricate rover

Testing:
- Code implementation
- Testing and data gathering
- Rover troubleshooting

Delivery:
- Virtual presentation to NASA judges



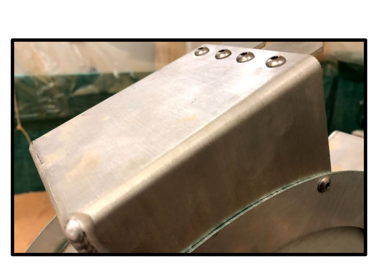
V System Engineering Approach

Design Implementation

Manufacturing Processes

Machining

Water-jetting



Welding and Bending

3D Printing

Assembly Process

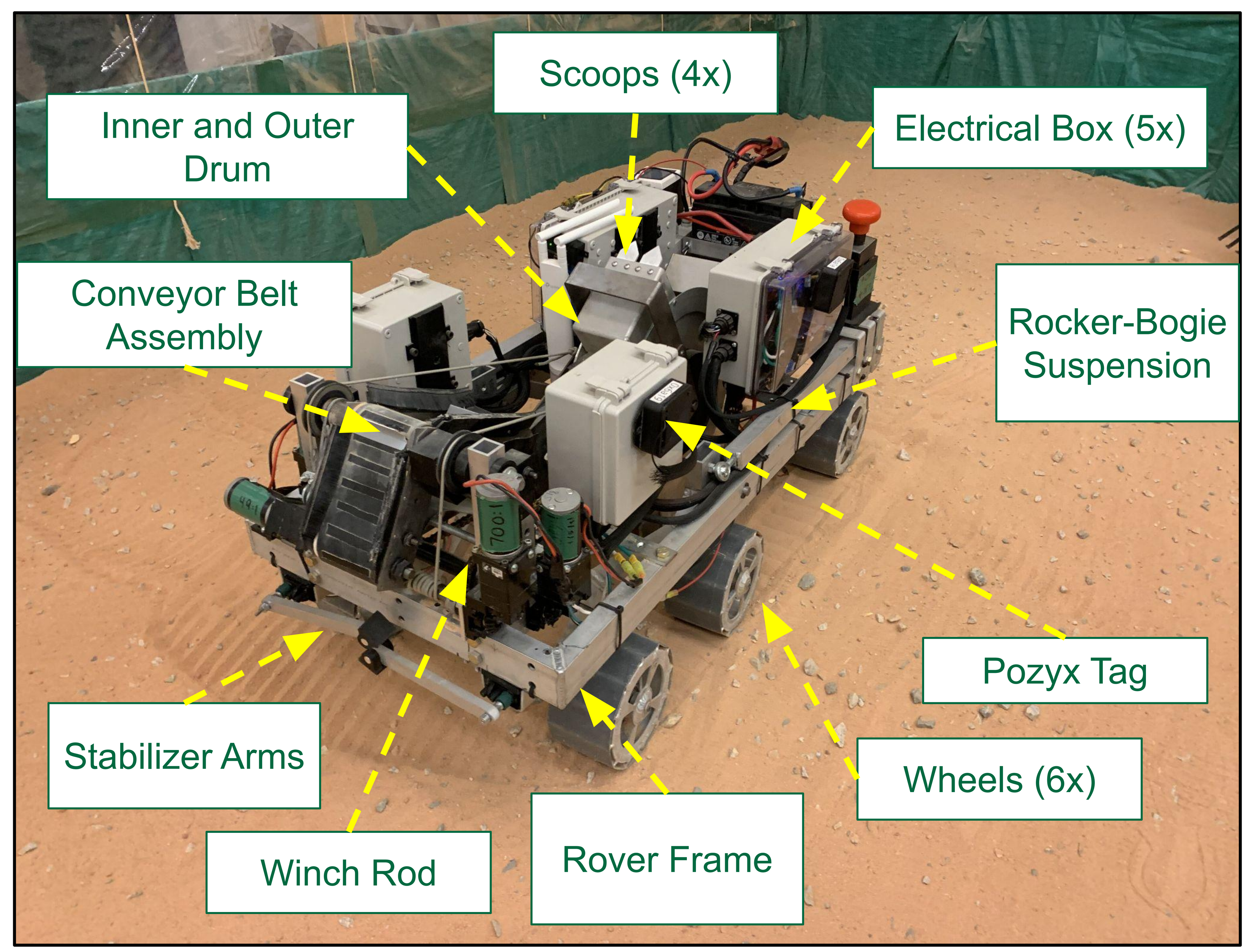
1. Manufacturing
2. Assemble Chassis
3. Assemble Mining
4. Wire Navigation & Control
5. Implement Navigation & Control software

NASA Robotic Mining Competition (RMC): Lunabotics 2021

As a part of NASA's Artemis Student Challenge, the NASA RMC is meant to stimulate creative ideas towards NASA's goal of exploring the Moon's Lunar surface by 2024. Project objective is to use system engineering approach:

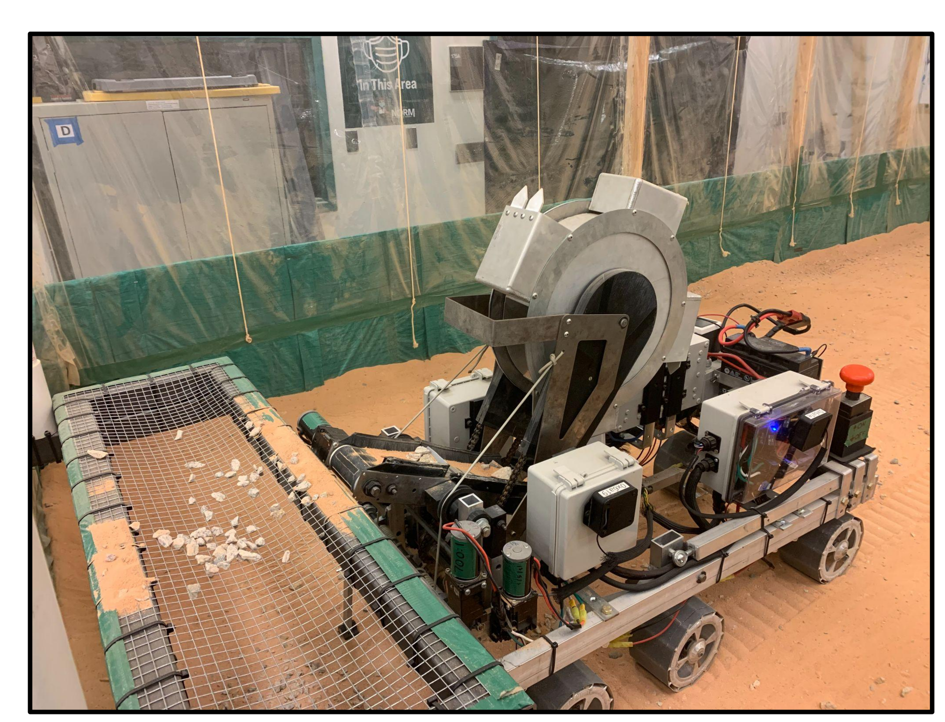
- **Design:** Provide a completed CAD model and calculations of the rover
- **Development**: Manufacture an autonomous rover prototype capable of mining, collecting, and depositing lunar regolith
- **Delivery:** Compete in and win the RMC with the most efficient lunar rover prototype

2021 Lunar Prototype



Rover Orientations

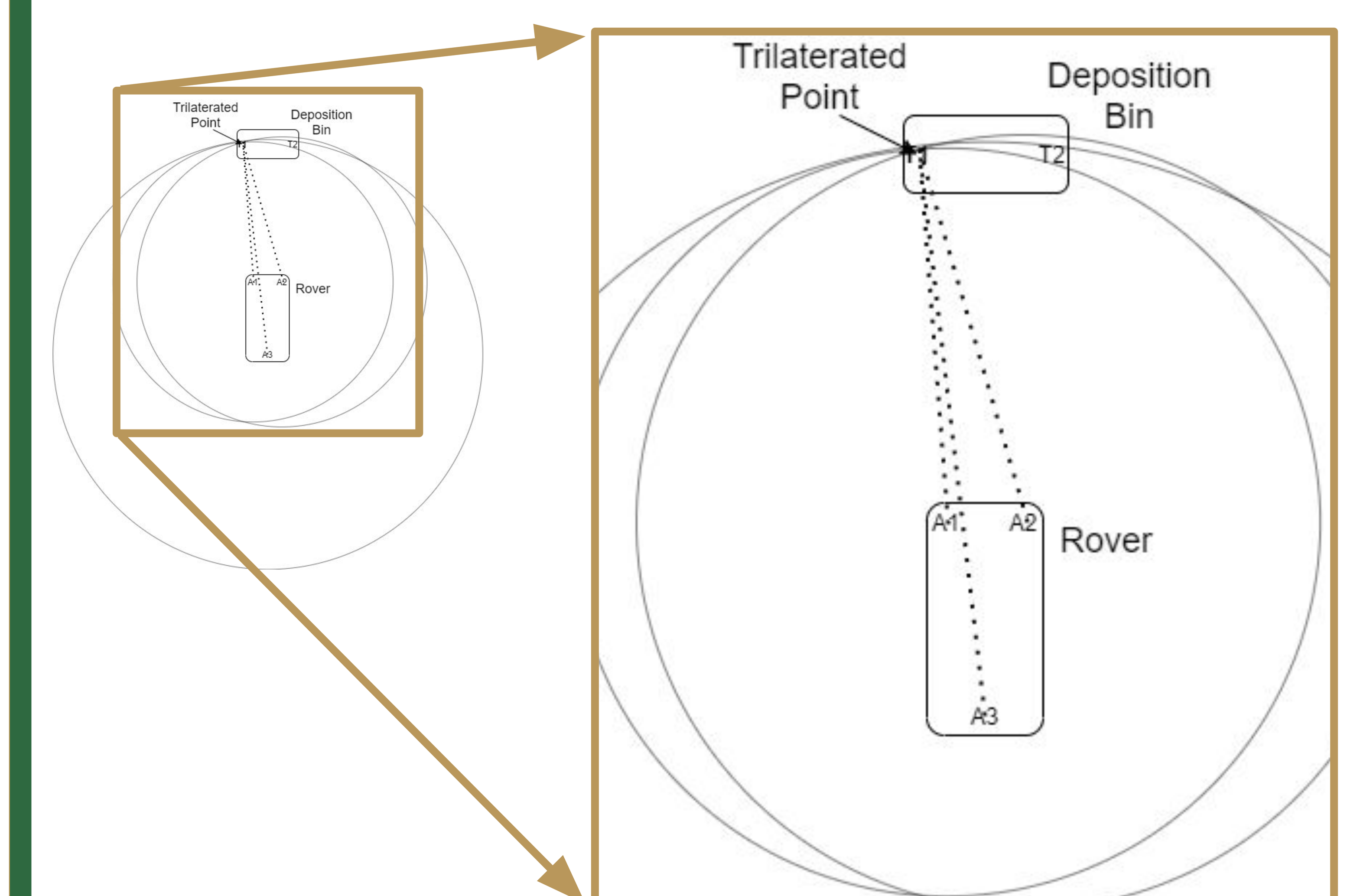
Mining Orientation



Deposition Orientation

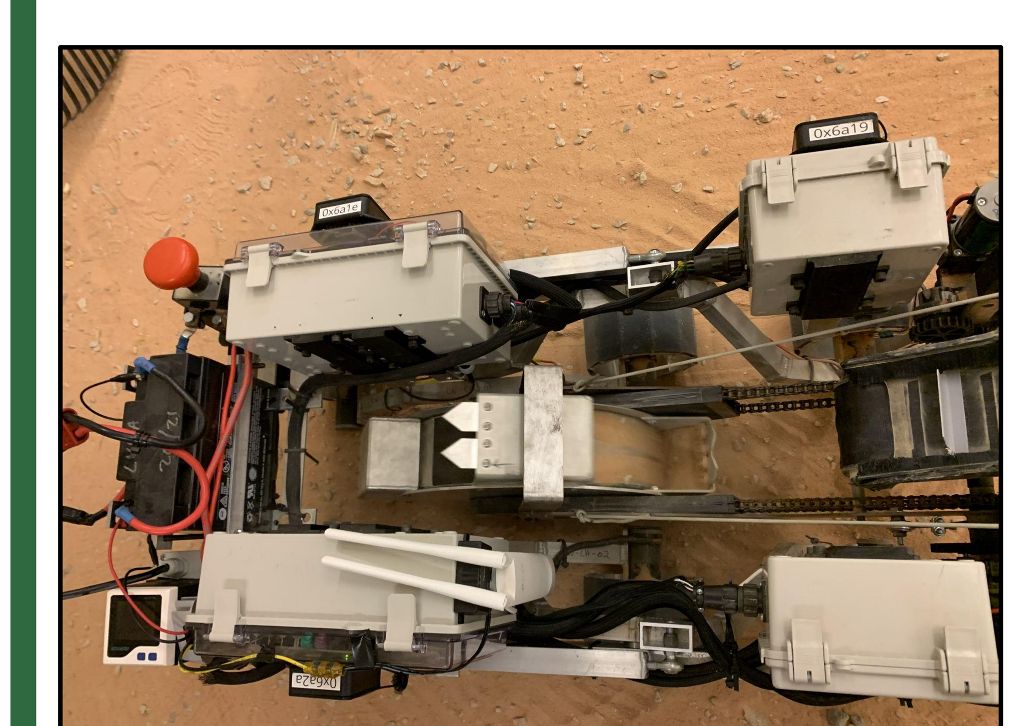
Wireless Localization

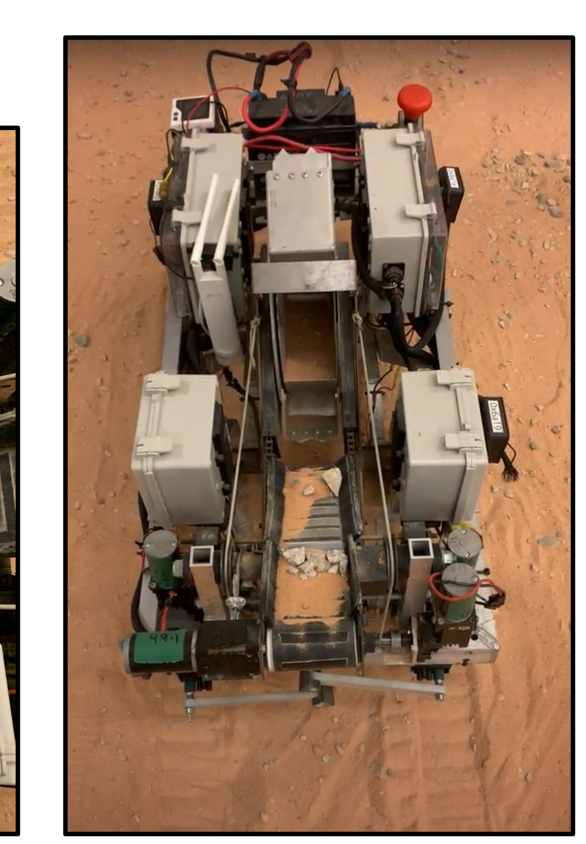
- Localization system consists of two Pozyx tags mounted on deposition bin and three Pozyx anchors mounted on rover
- Each anchor emits ultra-wide band radio waves until tag is detected, with radius of emission being distance to tag
- The point at which all three radii intersect is the location of the tag
- Once each tag is located, the position of the bin relative to rover is known
- To the computer, it appears the bin is moving as the rover moves
- Movement will be translated to instructions for the rover



Performance Goals Accomplished

- Completed a full mining run in approximately 20 minutes
- Collected 68.51 grams of icy regolith simulant during a full run
- Can operate for at least 15 minutes, continuously
- Can deposit mined material without tipping
- Can operate with minimal dust emissions





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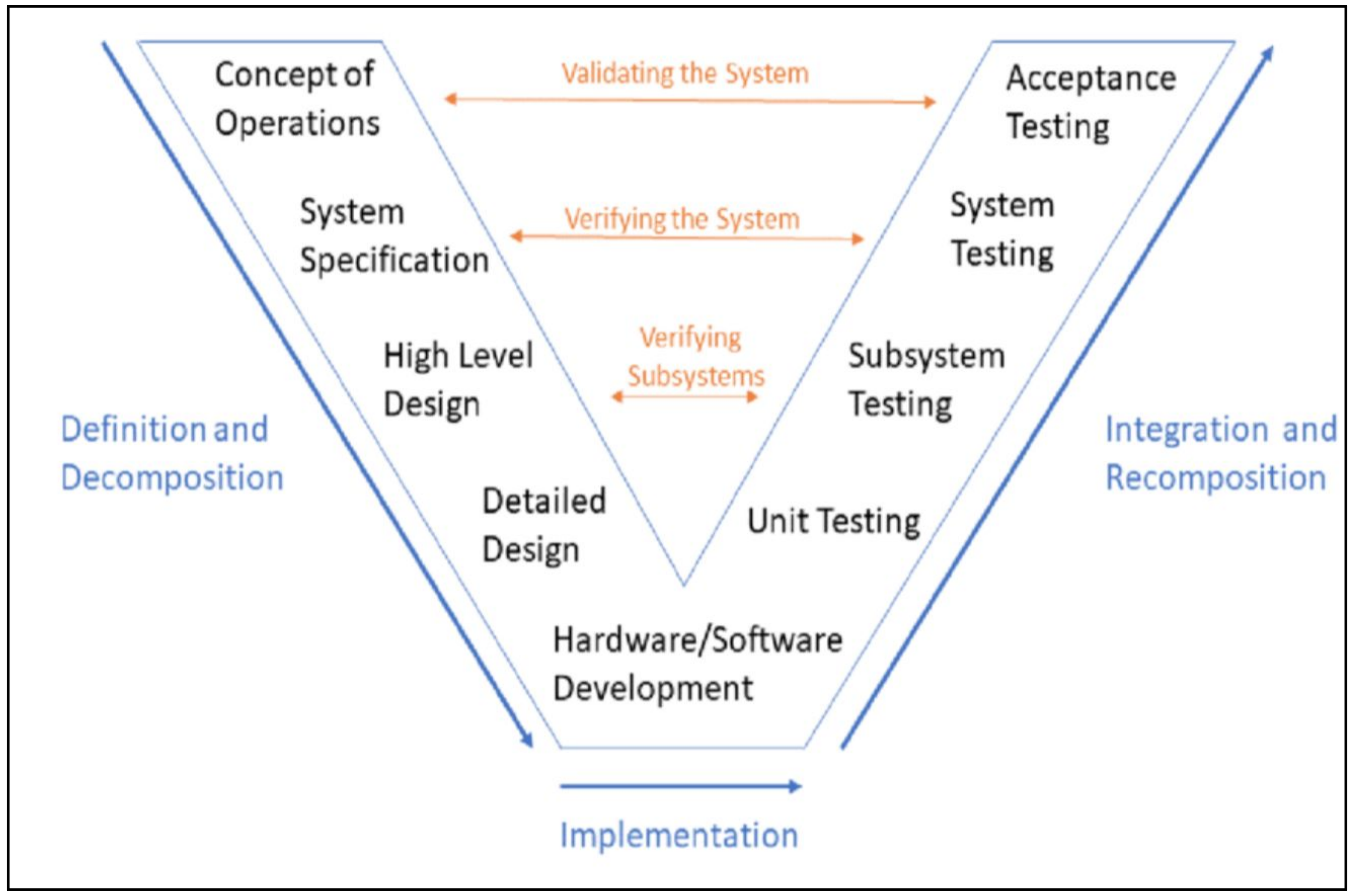

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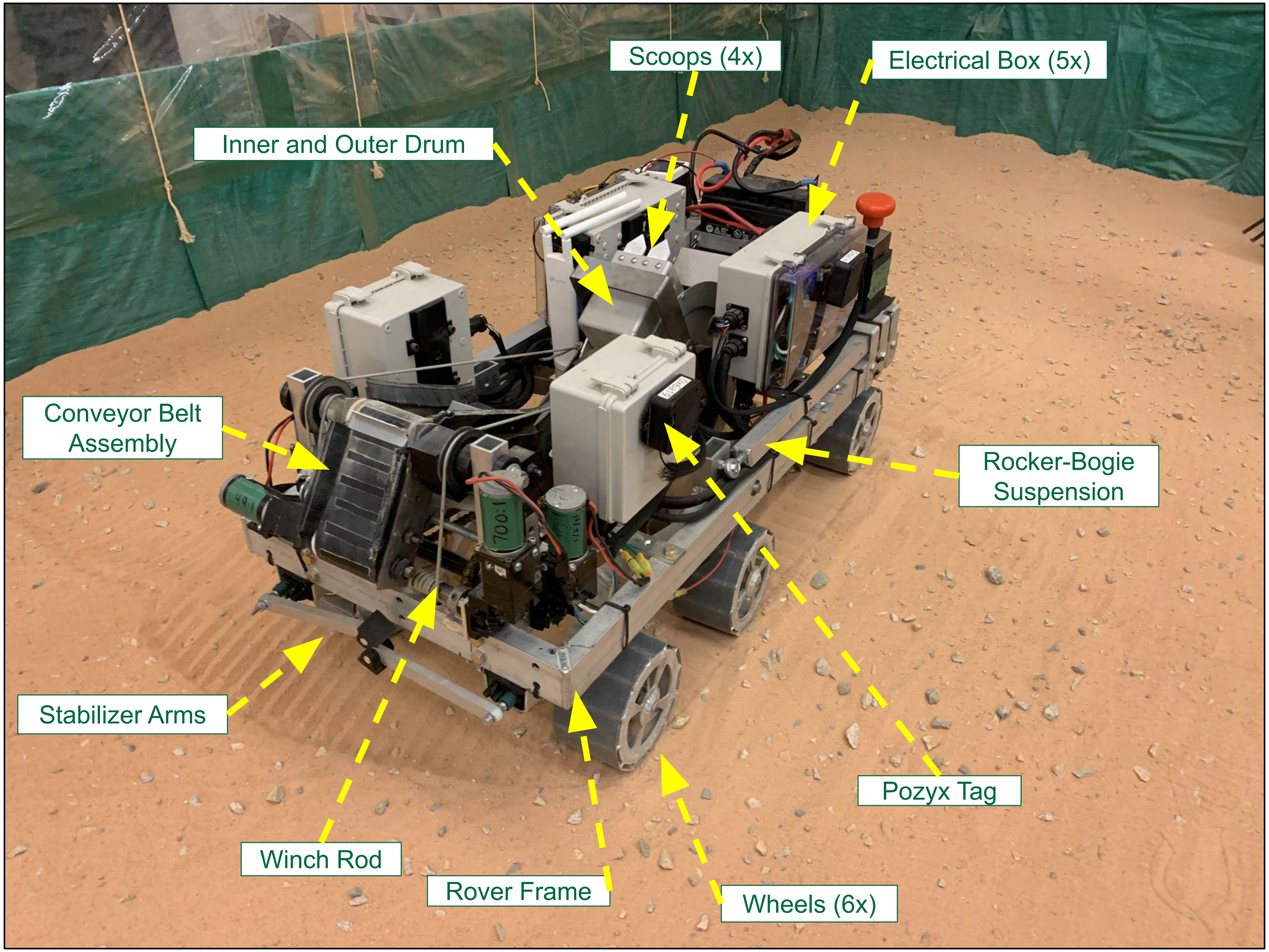

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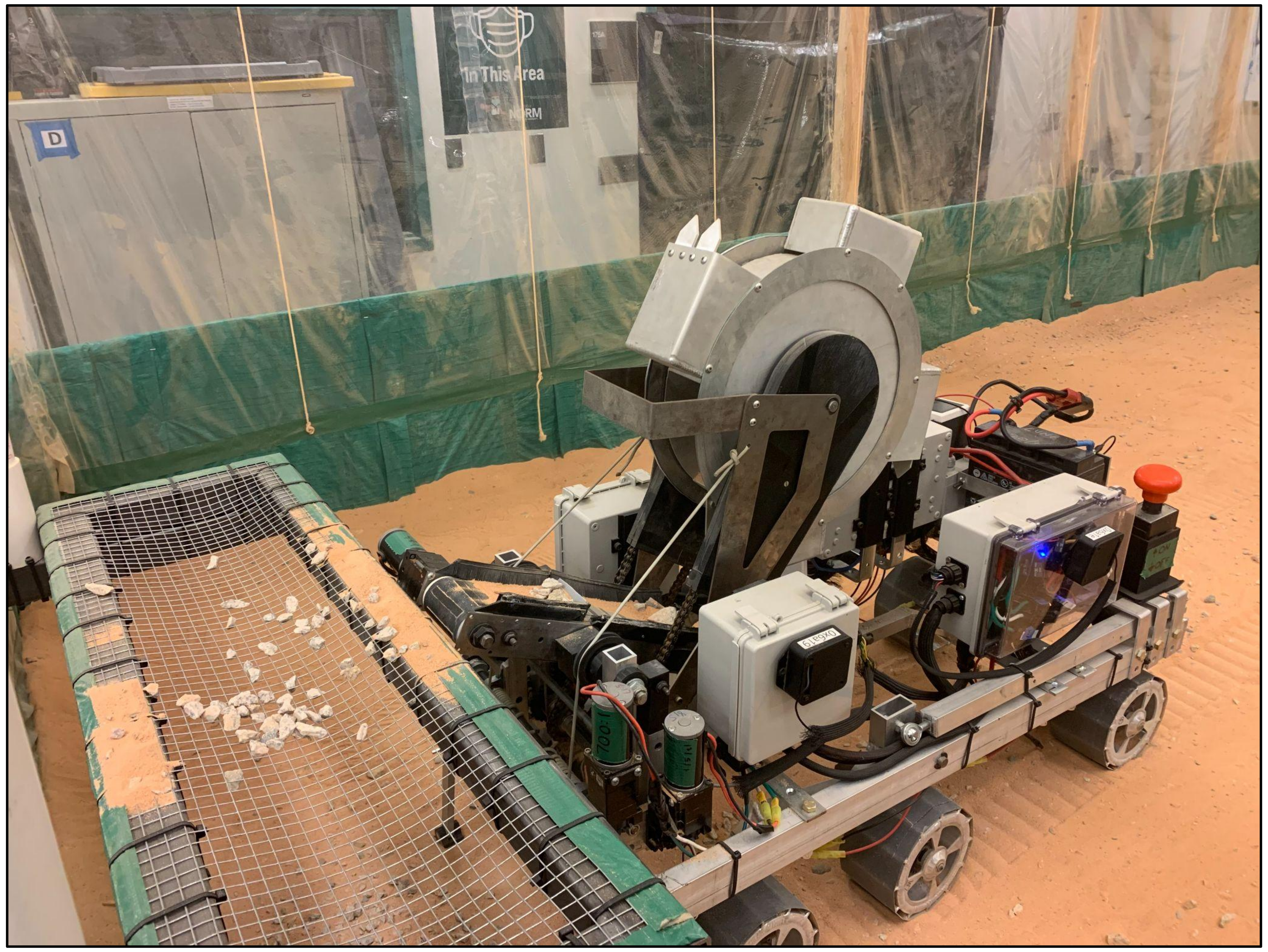

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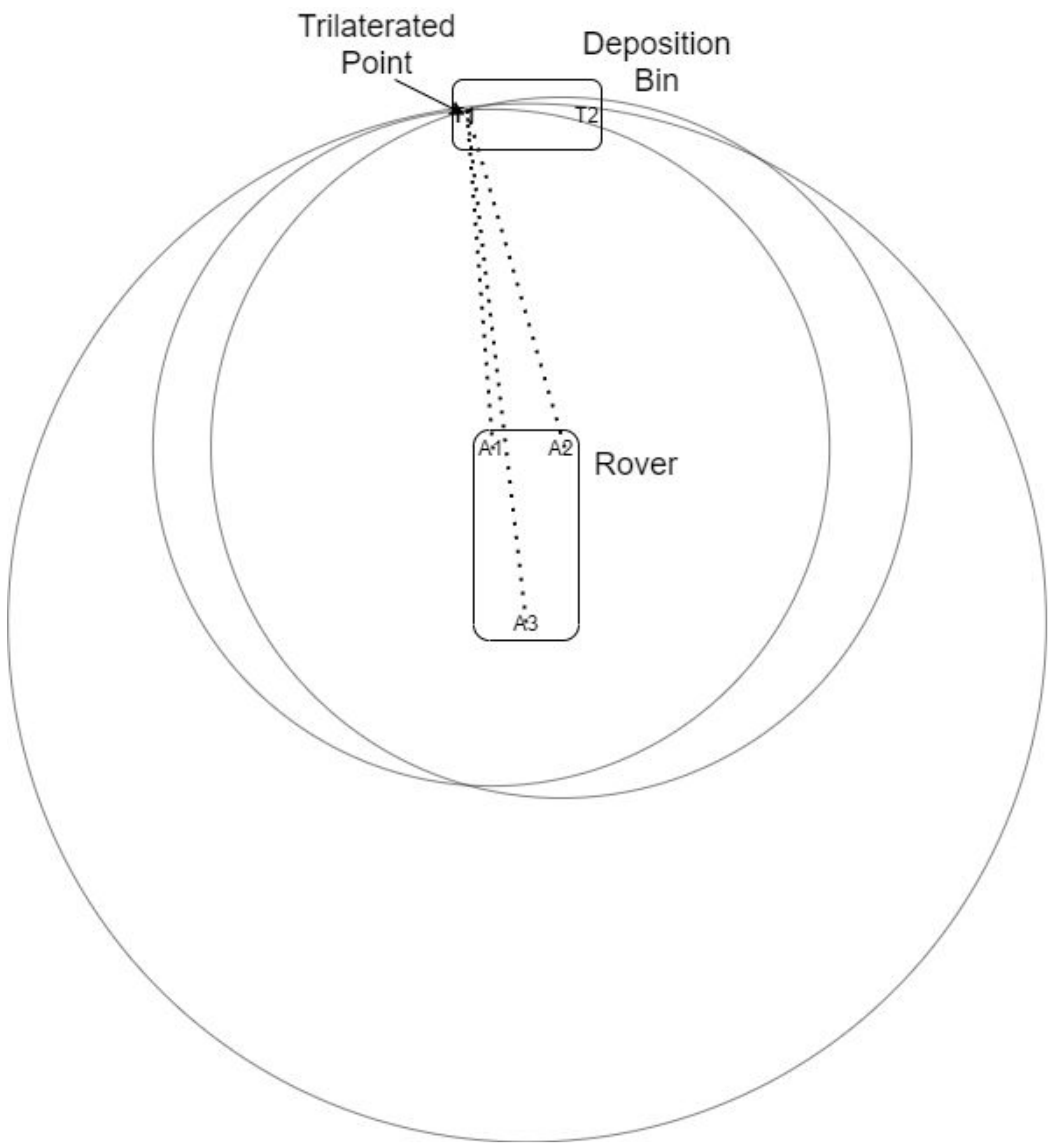

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