NASA Robotic Mining Competition

Competition Overview

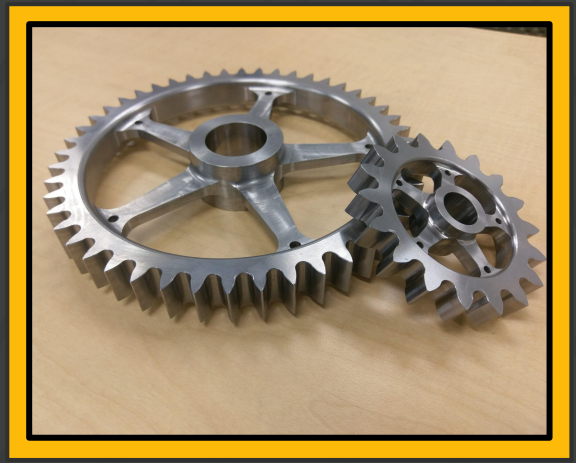
- Orchestrated by NASA
- Mars-like Environment
- Extremely Competitive

Competition Overview

- Autonomous Mining
  - Harvest Martian ice
- Mechanical Limitations
- Electrical Challenges

Mechanical Goals

- Cut overall weight by 40%
- 3x faster mining cycle
- Maximize Mining Depth

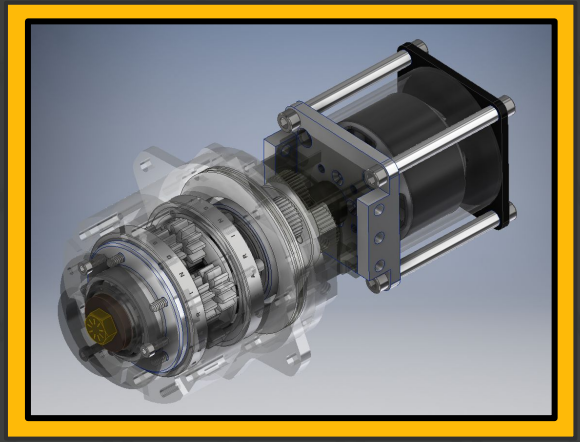


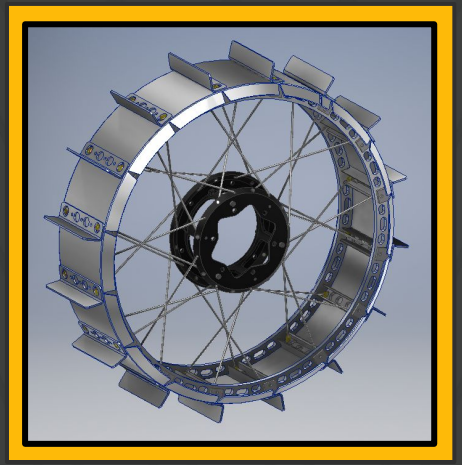
Gravel Collection

- Bucket Hopper
  - Integrated sifter
  - 2 conveyors
- Mono-boom Backhoe
  - Custom linear actuator
  - Optimized geometry

Drivetrain

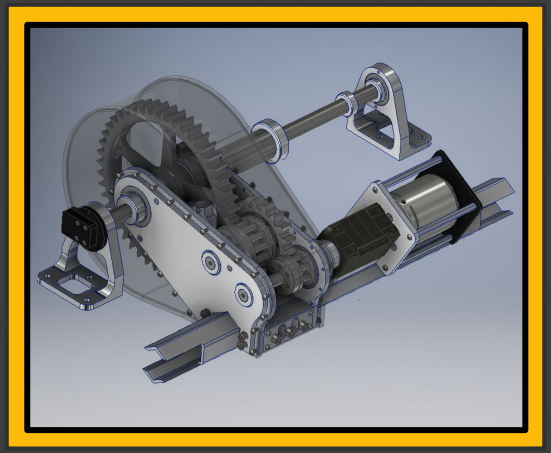
- Spoked Wheels
  - Inspired by NASA robot
  - Large Side-loads
- Planetary Gear Train
  - Adequately robust
  - Compact & lightweight

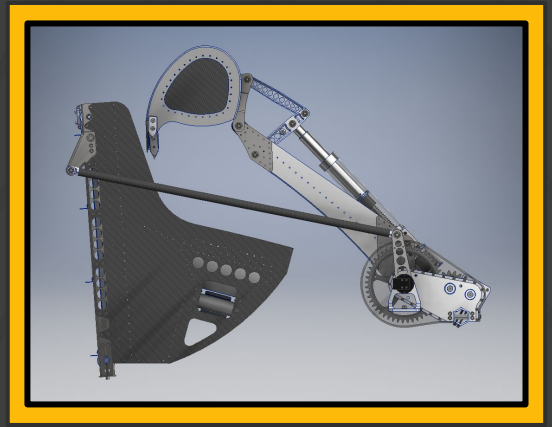




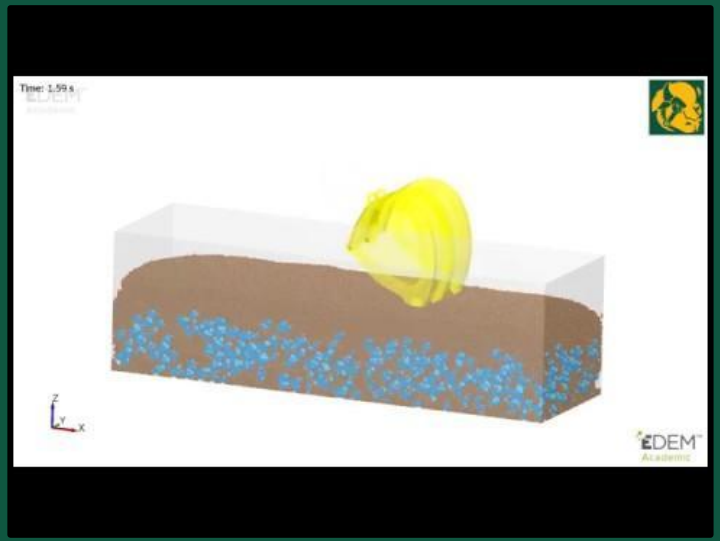
Central Drive

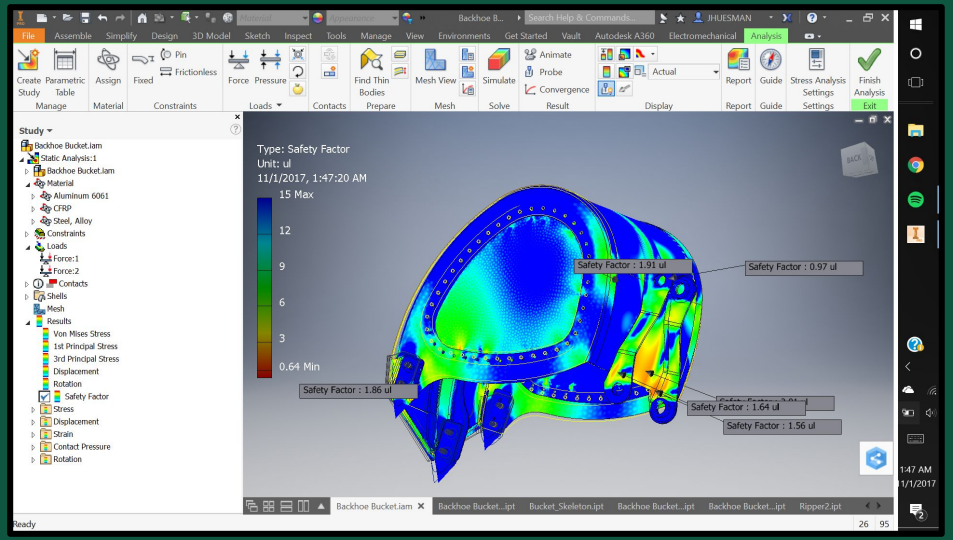
- Custom Gearing
  - 4340 unhardened steel
  - 3HP DC brushless motor
- Mechanical Coupling
  - Maximum digging speed
  - Large torque requirement





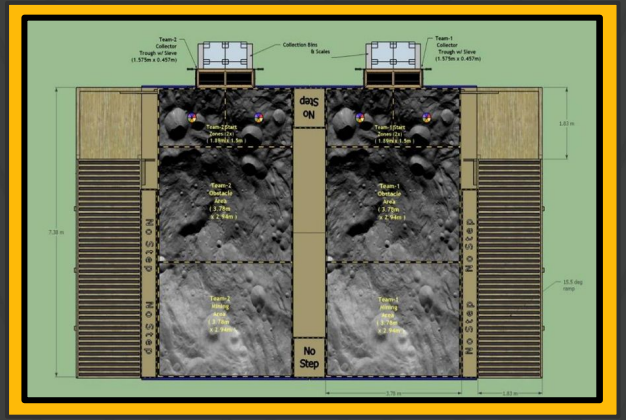
Mechanical Simulation





Software Overview

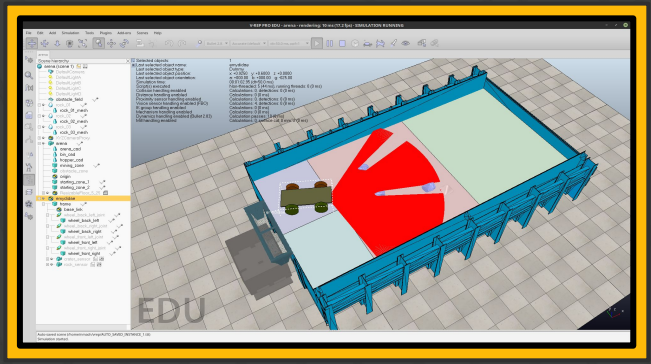
- Autonomy
- Local Planner/
  Drive Controller
- Localization



System Diagram

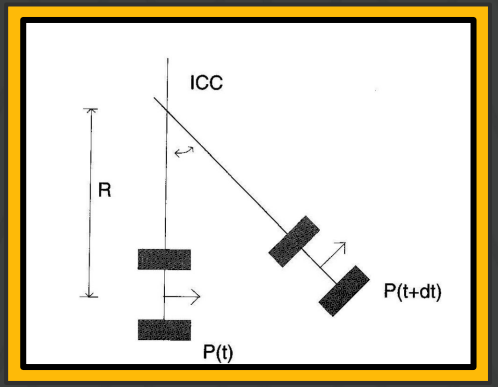
Autonomy

- Finite State Machine
- Mapping
- Global Planner



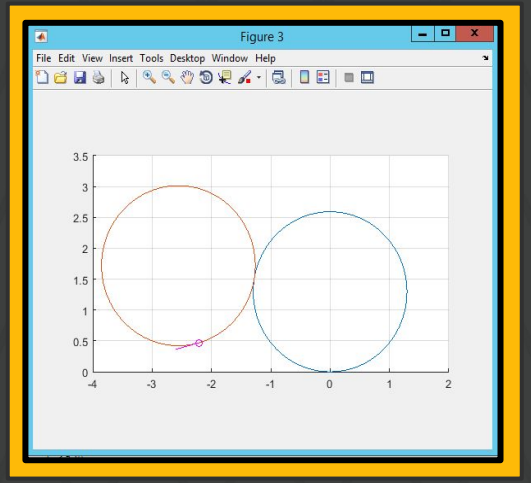
Drive Control

- Keeps Robot on Path
- Rejects Sensor Noise
- Rejects Disturbances
- Implements Traction Control



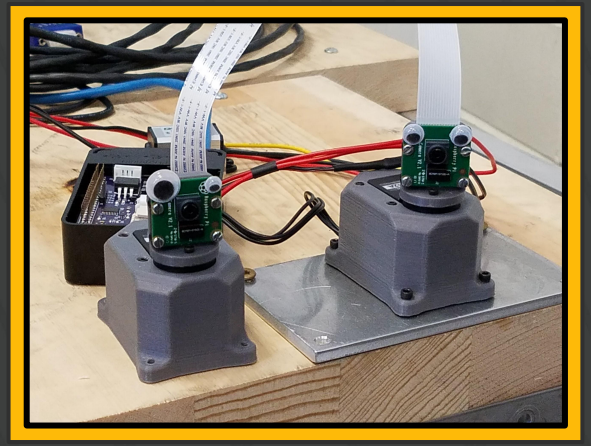
Local Planner

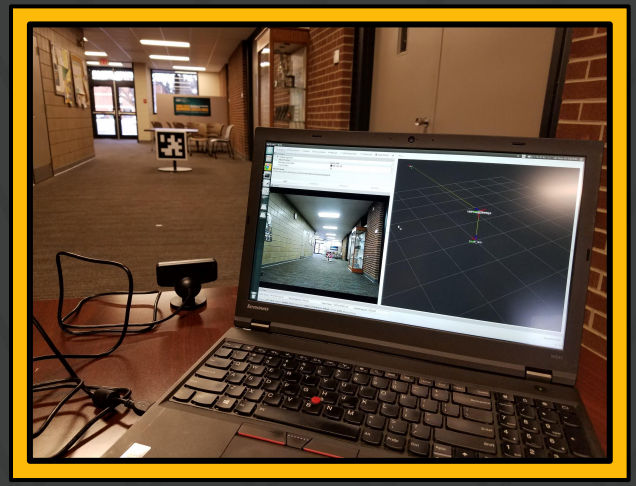
- Parses a waypoint into a path for the drive controller
- Works by drawing circles between two poses



Localization

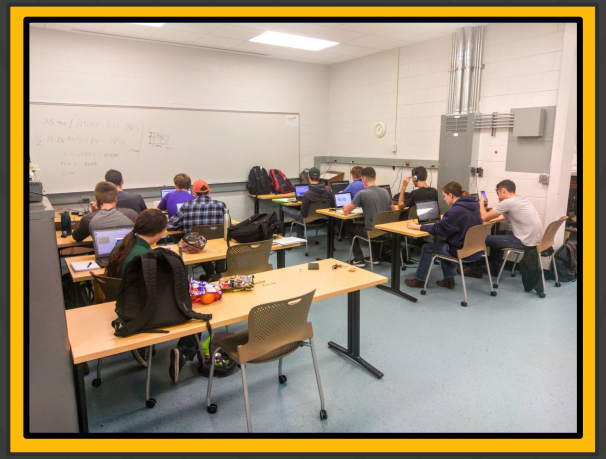
- Calculate position at 30Hz
- 2 Cameras
- Linux Based

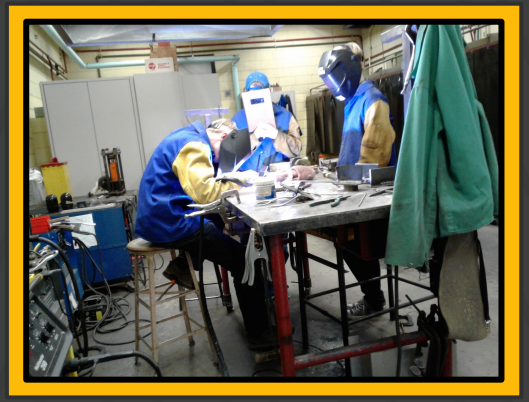




Mechanical Schedule

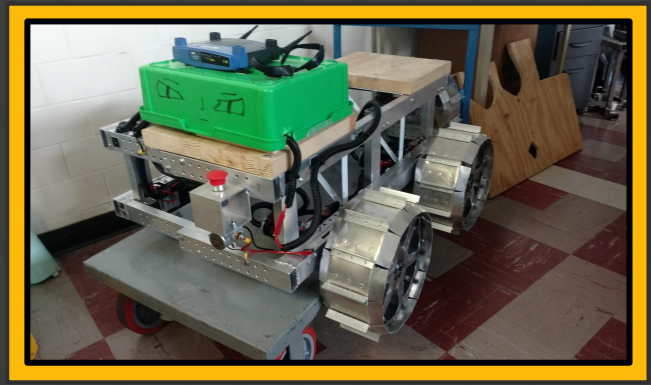
- Design & Prototyping
- Manufacturing Planning
- Manufacturing
- Testing





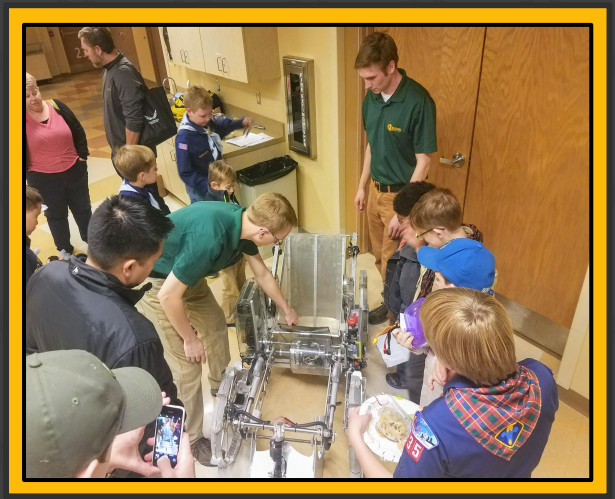
Electrical Goals

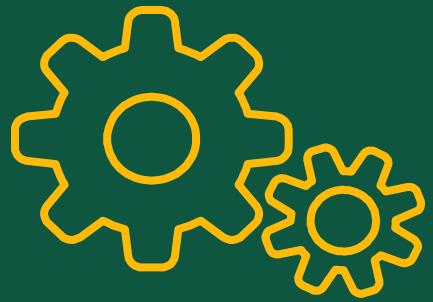
- Scrum
- Incremental, Measurable Progress
- Decoupling electrical & mechanical progress



Outreach

- Engage with K-12 Audience
- Focus on STEM education
- Underrepresented groups





Questions?