CAPSTONE

BYU

University Rover Challenge

THE CHALLENGE

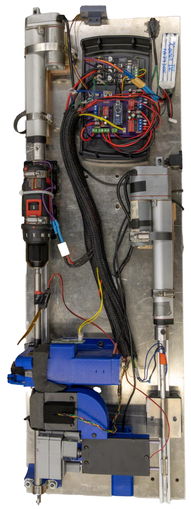
Our objective is to produce a rover that will score 95 points in the University Rover Challenge (URC) SAR, have no mechanical or electrical failures during the competition, and consistently score at least 80 points in each of the URC missions. These missions are as follows:

Autonomy
Navigate to multiple GPS waypoints, detect objects with AI, and avoid obstacles using machine vision — all without human input.

Delivery
Find, lift, carry and deliver objects up to 5kg in mass to predetermined GPS coordinates and maneuver precisely through difficult terrain.

Equipment Servicing
Accurately manipulate controls on a mock lander, simulating a human's dexterity and speed.

Science
Detect signs of life in a desert environment through soil and geological analysis at sample sites, and present findings to a judge.

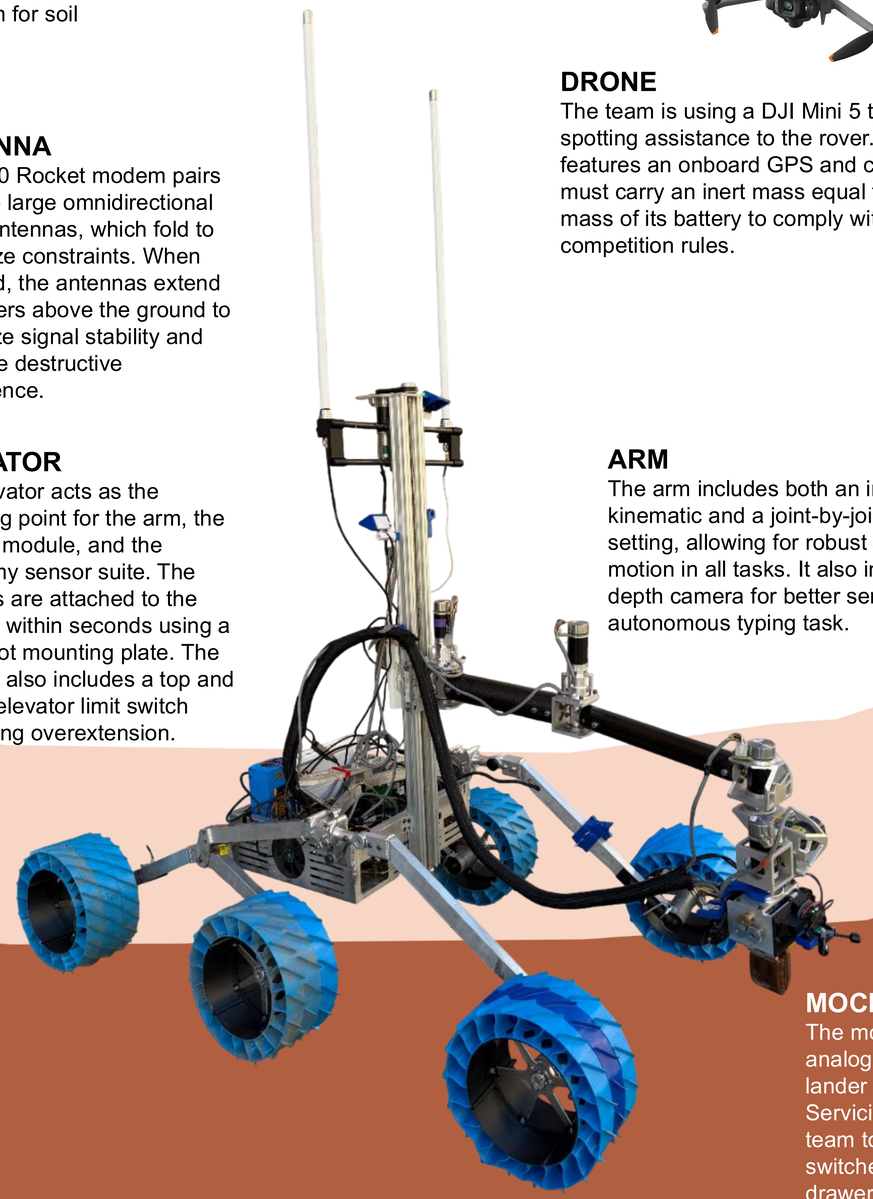


SCIENCE MODULE
The science module assesses soil habitability through spectroscopy and other sensors to detect moisture and elements necessary for life, and drills 10 cm for soil samples to test for life.

ANTENNA
An M900 Rocket modem pairs with two large omnidirectional dipole antennas, which fold to meet size constraints. When unfolded, the antennas extend 2.1 meters above the ground to maximize signal stability and minimize destructive interference.

ELEVATOR
The elevator acts as the mounting point for the arm, the science module, and the autonomy sensor suite. The modules are attached to the elevator within seconds using a new t-slot mounting plate. The elevator also includes a top and bottom elevator limit switch preventing overextension.

WHEELS
This year's rover features newly designed 3D-printed wheels, composed of TPU treads, ASA hubs, and aluminum mounting plates. These wheels provide improved traction in sand compared to their predecessors while weighing 0.5 kg less each— a total weight reduction of 3 kg.





DRONE
The team is using a DJI Mini 5 to provide spotting assistance to the rover. The drone features an onboard GPS and camera and must carry an inert mass equal to the mass of its battery to comply with competition rules.

ARM
The arm includes both an inverse kinematic and a joint-by-joint controller setting, allowing for robust and intuitive motion in all tasks. It also includes a new depth camera for better sensing during its autonomous typing task.

THE RESULTS

The Mars Rover team's objective this year is to score at least 80 points in all areas of the competition. This would ensure that we are able to place in the top three at the competition. The following are the best scores from our most recent competition simulations. We anticipate continued improvement over the next 4 weeks:

- **Autonomy**: 12/100
- **Delivery**: 60/100
- **Equipment Servicing**: 42/100
- **SAR**: 93.29/100
- **Science**: 60/100

New In 2025-2026

- NPK sensor to detect nitrogen, phosphorous, and potassium in soil
- Reduced backlash in the arm
- ASA+TPU 3-D printed wheels
- Mounting plate on the elevator
- Autonomous typing capabilities
- Autonomous hazard avoidance

See the rover in action!

VISION
The rover uses a network of 5 static cameras that provide visual feedback to the operators. A RGB-D camera provides depth information at the end of the robotic arm for high-precision manipulation. A ZED stereoscopic camera is used to detect target objects and identify hazards. Additionally, a FPV camera provides higher video quality and increases situational awareness during each task.

MOCK LANDER
The mock lander serves as a test analogue to the real competition lander for the Equipment Servicing mission. It allows the team to practice with the buttons, switches, keyboard, USB, and drawer.



BYU Mechanical, Electrical and Computer Engineering

2025-2026

BYU Mars Rover

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