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R.E.D. Rover

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COMPETITION OVERVIEW

The purpose of this project is to build a next generation vehicle for space exploration. We plan to participate in the 2016 University Rover Challenge. The rover will be tele-operated by astronauts to assist with surface exploration. This competition is held annually at the Mars Desert Research Station (MDRS) located in Hanksville, Utah.

COMPETITION TASKS

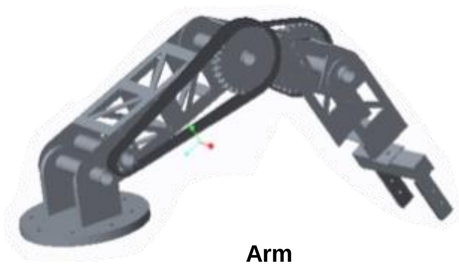
- *Astronaut Assistance*: seek, find, and collect multiple objects that are scattered throughout the 1.0 km radius competition field and deliver them to "astronauts" that are spread about in the area.
- *Terrain Traversal*: travel across various types of terrain; sand, soil, stone, and rocks. The rover will also need to be fully functional after suffering a vertical drop from up to 0.5 m, and will travel up to 1km through marked gates as part of an obstacle course.
- *Science Cache*: travel to specific GPS coordinates and collect a soil sample to remotely analyze its pH, temperature, and humidity levels.
- *Equipment Servicing*: perform multiple types of operations on equipment systems; turn knobs, push buttons, flip switches, and read gauges.

Rover Assembly

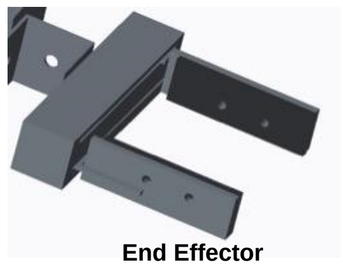
ARM

- Pick up objects from the ground
- Take soil sample
- Manipulate valves and switches

The belt-driven arm has two joints at the shoulder, one joint at the elbow, and two joints at the wrist. Movement about these joints, in addition to the rover's movement, provide the arm with six degrees of freedom (DOF). An end effector is attached at the wrist, allowing for the arm to grasp and move objects. Both the arm and end effector are machined from Aluminum 6061 alloy.



Arm



End Effector

DRIVETRAIN

- Provide locomotion
- Withstand a 0.5 m drop
- Provide capability to move through rough terrain and over large rocks

The rover is equipped with a rocker bogie suspension system made of carbon fiber. This allows for the rover to easily traverse uneven terrain while still being extremely light and maintaining its structural integrity. The rocker bogie pair is connected through a counter-rotating differential that consists of four bevel gears and two steel rods.

Rocker Bogie Suspension

COMMUNICATIONS

- Provide a range of at least 1 km
- Support enough throughput for two HD video streams, command, and data
- Minimize latency for real-time operation

An Ethernet network will be set up, with a 5GHz wireless link connecting the rover sub-network with the base station sub-network. The rover will use an omnidirectional antenna and the base station will use a sector antenna with a 120° arc. Throughput at 1 Km was 40.5 Mbps with a latency of ~500ms. With two HD cameras, command, and data, we require a throughput of 30 Mbps.

CONTROLS

- Display video
- Provide user controls
- Convert user commands into Ethernet packets

A base station will contain a computer, communication equipment, and user controls to command the rover. A screen will display a GUI with the video stream, GPS coordinates, battery life, and other relevant information for the user. An Xbox controller will be used to drive the rover and manipulate the arm.

ELECTRONICS

- Provide power for: motors, controllers, communications
- Control power to motors
- Establish communications

Power will be delivered via a 12vDC/22AH lead acid battery. Our expected drive time is 60 minutes. A microprocessor will interpret commands into actions and provide non-video data back to the base station. PWM controlled motor controllers will be used to drive the motors. Video will automatically live-stream to the base station through the Ethernet network.