Northrop Grumman Space Rover

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Background

The field of planetary robotics is expanding rapidly as we continue to explore. Accordingly, the rover industry needs to make strides toward mass-production. The traditional space rover infrastructure of highly-specialized, single-use devises that cost billions is not sustainable. We need inexpensive, modular, and reconfigurable rovers that can be adapted to perform in a wide range of environments. To achieve such modularity, we created an autonomous electronics box called the "Red Rover" designed for a general planetary destination with a standard interface.

Overview

The Red Rover is a modular space rover capable of receiving and executing commands from a base station up to 200m away. Once it has reached its destination, The Rover can travel to predefined waypoints and transmit critical atmospheric information and photographs. The electronics box, the "brain" of The Rover, is customizable with peripherals. Peripherals are removable systems and off-the shelf products that interface with the box enabling high-performing planetary missions in various environments. The peripherals for our sample mission include: a four-wheel propulsion system, a camera mast, an atmospheric breakout board, a multichannel gas sensor, and an ultrasonic sensor.

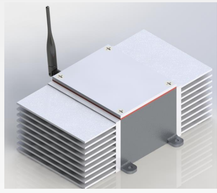
Design Specifications

Engineering Characteristics	Target Specifications	Test Result
Maximum Mass of Rover	20 [kg]	9.58 [kg]
Maximum Volume of Rover	1 [m^3]	~0.055 [m^3]
Rover is Modular	Yes	Yes
Minimum Rover Battery Lifetime	3 [hr]	2 [hr]
Minimum Rover Communication Range	100 [m]	200 [m]
Operating Temperature Range	-40°C to 70°C	-40°C to 70°C
Flight Load Factor Range	-1.5 to +3.5	Untested

Red Rover

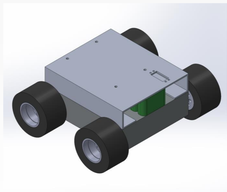
Red Rover Final Prototype

Key Components



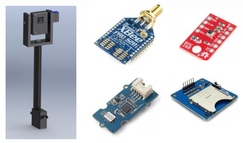
Electronics Box

Enclosed aluminum box that houses all design-critical components including: single board computer, batteries, and communication hardware.



Propulsion System

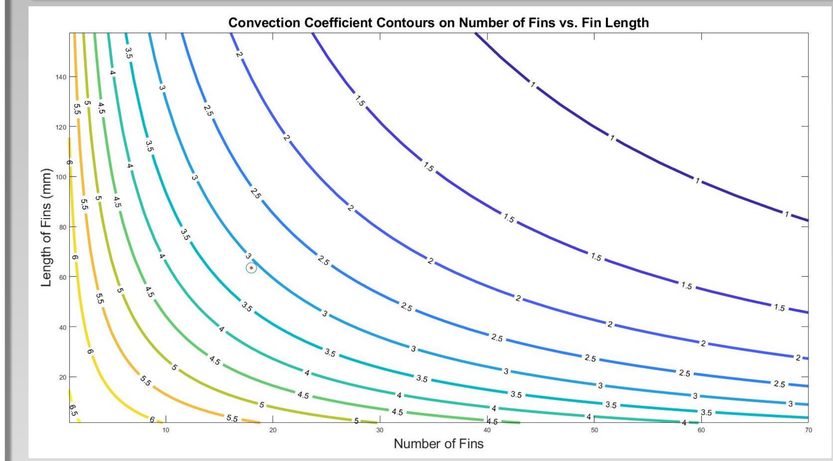
Consists of motors, gearbox, motor driver, chassis, and power source for motors.



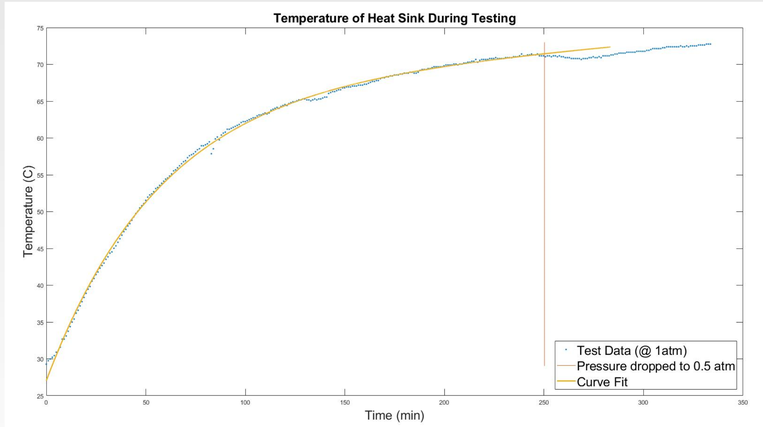
Peripherals

Removable systems that interface with the box including: camera mast, atmospheric sensor suite, SD card, Xbee Radio, and 9 DOF IMU.

Testing Results



The thermal characteristics of our design were tested using an Isotemp Vacuum Oven at 70 °C. The data obtained indicates that the maximum temperature the electronics box can endure in Earth's atmosphere is 75 °C. This testing procedure also confirmed that the electronics box is airtight, therefore, can survive in the vacuum of space.



Conclusion

The Red Rover design met or exceeded almost all of the target specifications provided by Northrop Grumman. It is a modular electronics box capable of integrating countless different peripherals and propulsion systems. This unique configurability enables The Rover to conquer a multitude of foreign environments.

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