# ECE Group 14 Executive Summary

The Oregon State University Robotics Club (OSURC) Mars Rover team competes in both national and international competitions. These competitions have strict requirements regarding weight, safety, and longevity. This motivated the team to design a new battery and battery monitoring system (BMS) for the rover. This new 24V 6S3P 9 Ah battery system fulfills the team's capacity requirements while being lighter, safer, and less expensive than the team's original lithium-ion battery. The design of this project required characterizing battery cells, testing individual blocks of the BMS, and performing final assembly and testing.

Numerous lithium-ion battery cells were tested to determine which one was best for the battery. Each different model of cell was tested on a custom battery characterization board that would place the cell under load and measure how it responded. The LG 18650-LGHG2 was chosen because of its 3 Ah capacity, 20A continuous discharge capability, and competitive price.

Individual blocks of the BMS were designed by different members of the team and tested in isolation. This includes the microcontroller circuit, analog front end, power distribution, and battery control. These blocks were checked off during fall and winter term to ensure steady progress.

Final assembly of the battery and BMS happened during the end of winter term and beginning of spring term. The battery cells were welded together using nickel strips into the required 6S3P configuration, placed into the 3D printed enclosure, and topped with the BMS. The system was tested to meet basic requirements such as cost, size, Modbus communication via RS-485, output voltage between 19.8V and 25.2V, and low power consumption in backup mode. The system was also tested to meet mission critical requirements such as continuously supplying over 35A for 30 seconds and cutting off power from the battery if the BMS detected hazardous conditions.

The final battery and BMS developed in the project succeeded in making the rover lighter, safer, and less expensive to operate. The battery is able to supply the power necessary for the rover to operate while the BMS monitors temperature, cell voltages, and current to ensure the battery is safe. Future revisions of the BMS will likely replace the complicated differential amplifier used for current sensing for an all-in-one IC solution such as the INA series from Texas Instruments. This will make the system less complex while still providing accurate current sensing.

The team learned two valuable lessons during this project, the first of which is the importance of understanding parts availability. Just because a part is available at the beginning of a design doesn't mean that it will be available next month, next week, or even the next day. The final lesson the team learned is how critical it is to properly document a project. While the battery and BMS designed in this project aren't very complicated, the rigorous testing and research that went into their development was. Fortunately, these details have been recorded in the Project Document for the current and future OSURC members who will be responsible for maintaining and updating the battery system.

# General Timeline

Read-only view, generated on 13 May 2022