BOLT Electric Motorcycle Design Team

Faculty Advisor: Dr. R.L. Clark Jr. and Dr. Arthur Ball

Key Sponsors: Altium Designer, Collision Plus Inc., CSM, General Motors, Lockheed Martin, Trova Commercial Vehicles, Yamaha Motor Ventures

Senior Design Members:

Erin Cox, Caleb Esatto, Josh Dalton, Dalton Reck, Erin Freck, Mason Gautschi, Colton Gehr, Collin Gray, Matt Mayger, Mason McCray, Ben Ryan, Marissa Sluss, Weesam Semaan, and Kensey Wishon

Introduction

BOLT designs, builds, and races electric motorcycles. The goal of this year's project is to develop the next iteration BOLT bike that will compete in the AHRMA Formula Lightning Division. This project builds on the previous year's senior design projects with a new powertrain, updated cooling system, and new modular battery packs.

Customer Needs

The team held discussions with our faculty advisor and potential customers to develop customer needs and target specification values.

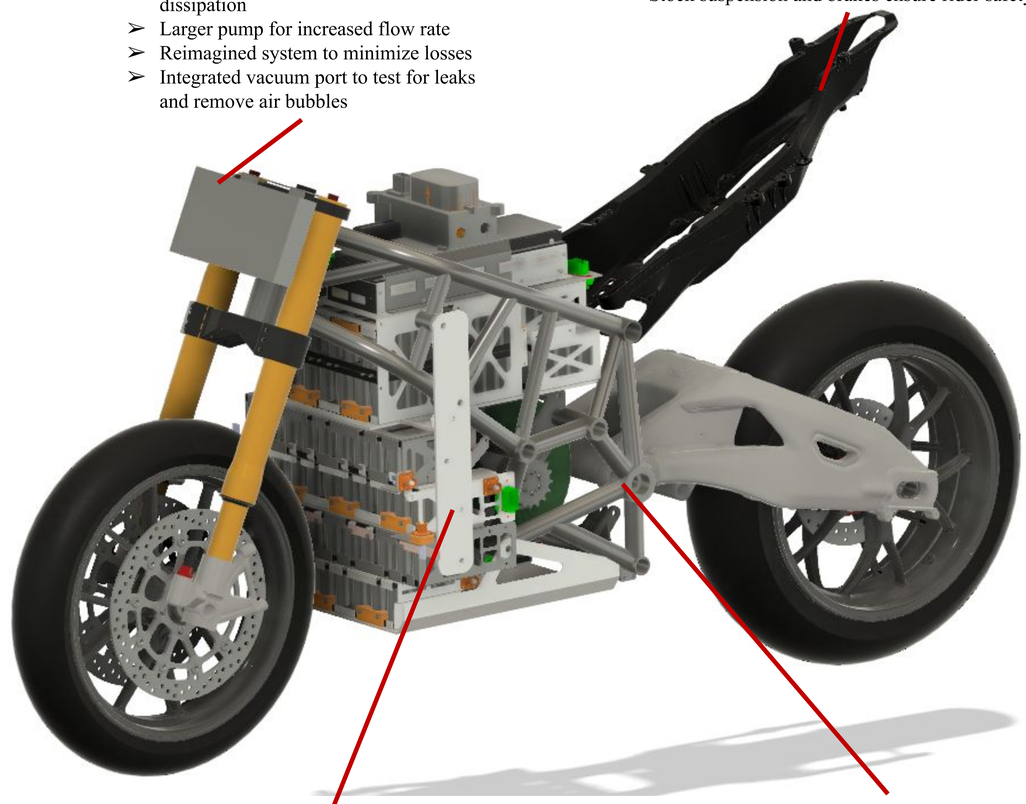
High voltage systems are safe
Capacity is sufficient to complete a race
Maintain safe battery temperature
Maintain safe motor and motor controller temperature
Maintain reasonable weight (~460lbs)
Appropriate center of gravity
Durability on the track
High lean angle
Ensure ease of assembly
Minimize cost
Power comparable to similarly sized superbikes

Upgraded Cooling System

- Increased radiator size for more heat dissipation
- Larger pump for increased flow rate
- Reimagined system to minimize losses
- Integrated vacuum port to test for leaks and remove air bubbles

Stock Components

- Utilized stock frame components made of magnesium alloys to decrease bike weight
- Stock suspension and brakes ensure rider safety



Powertrain Components

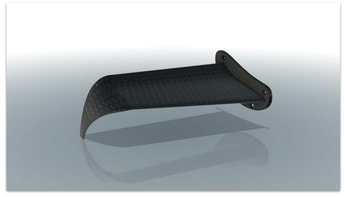
Motor - Emrax 268 MV
- 210kW at 4500RPM
- 500nm peak torque
- 22.3kg

Motor Controller - PM150DZR
- 225Arms continuous current
- 170kW peak output
- 10kg

BMS - Orion BMS 2
- 144 cell capacity
- 2.2kg

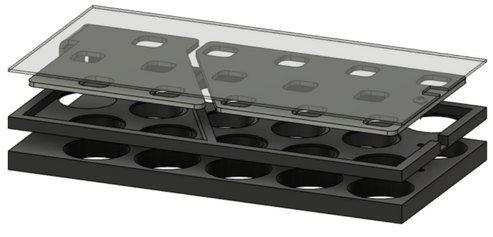
Battery Cells - Molicel P45B
- Delivers rated power for up to 5 minutes
- Tested at up to 60A per cell continuous
- Total pack: 600V at 300A
- Peak power: 180kW

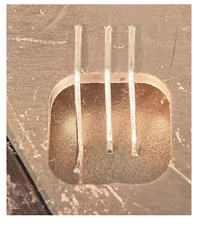
Winglets



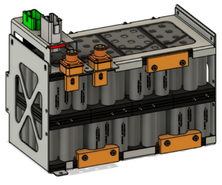
- First step in the team's creation of a full aero package
- Designed for 20lbs of downforce at race speeds
- Manufacured out of carbon fiber reinforced nylon

Modular Pack Design





- Includes milled and 3D printed ABS alongside laser cut aircraft grade 1100 aluminum
- Multi-layered design ensures easy manufacturability
- State-of-the-art wire bonding decreases contact resistance
- Modular and easily serviceable in the event of a cell failure



Battery Pack Structure

- Lightweight sheet sheet metal construction
- Modular design increases serviceability
- Structure decreases load on individual cells
- Easily removed from the bike with plugged connections and quick disconnect fittings

Bike Structure

- Welded 4130 steel
- Tube trellis design maximises weight and strength
- Custom designed, built, and manufactured by students.
- Welds tested under 3 ton loads
- Aluminum internal structure for efficient mounting
- Optimized for internal volume and quick assembly

Increased Sensor Data Collection

Thermistors

- Monitors temperatures of individual battery modules
- Increased from 8 thermistors (BOLT IV) to 47 thermistors (BOLT V)

Strain Gauges

- Monitors the forces on the custom frame
- Logs data to CAN for future analysis

Telemetry

- Real time CAN data transmission from the bike when it is on the track
- Data displayed using a custom GUI

Improvements Over Previous Generation

- 88% decrease in assembly and disassembly times
- Safer and more efficient high voltage work
- Increased power ceiling from 110kw to 200kw
- New cutting-edge motor and batteries for maximum power with minimal heat losses
- Sufficient cooling to ensure maximum performance over the course of a race
- Robust sensor data collection and wireless telemetry

Future Considerations

- Design and validation of aeronomic fairings
- Race data collection and dataset creation
- Testing to determine optimal gear ratio; race preparation
- System power delivery tuning and optimization