Cranfield Formula Electric Series

MSc Advanced Motorsport Engineering
2015 Group Design Project

CFES©

Cranfield Formula Electric Series

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LiON GP

Introduction

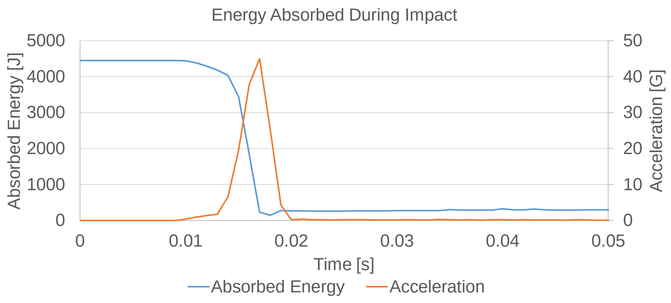
With the increasing awareness of the need for alternative fuels and the growing prevalence of electric cars it makes sense that motorsport would branch out in that direction. With only a handful of series permitting the use of electric only vehicles, LiON GP set out with the goal to build a powertrain and cooling system for a new, club level electric racing vehicle the LGP-01.

Objectives

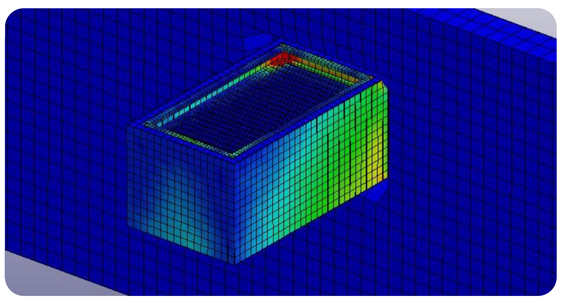
- To design a structure capable of protecting the battery packs in a side impact collision
- To design and model a cooling system capable of keeping the batteries and motors within safe operating conditions throughout a 20 minute race
- To complete a performance statement of the system via Donington GP lap simulation

Battery Design and Safety

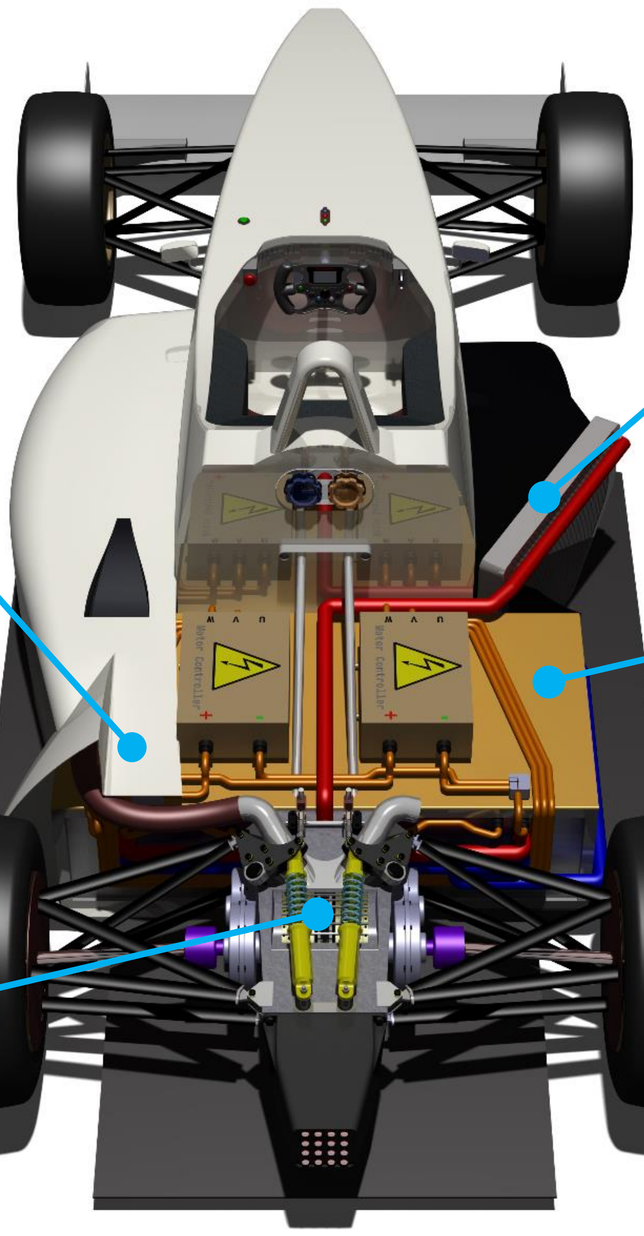
- Simulate a crash at 50kph in to a Euro NCAP deformable barrier
- Battery pack was capable of absorbing 4500J without structural failure



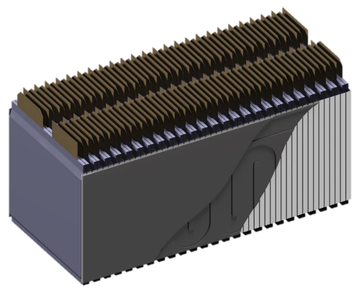
- 6061 aluminium sheet + Rohacell 110 IG structural foam crash structure
- 200 cells for a total of 740V, 29.6 kWh battery pack.

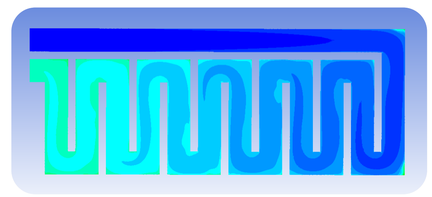


Vehicle Mass	735kg
Peak Power	200kW (270bhp)
Qualifying Pace	1:30.15
Race Pace	1:35.16



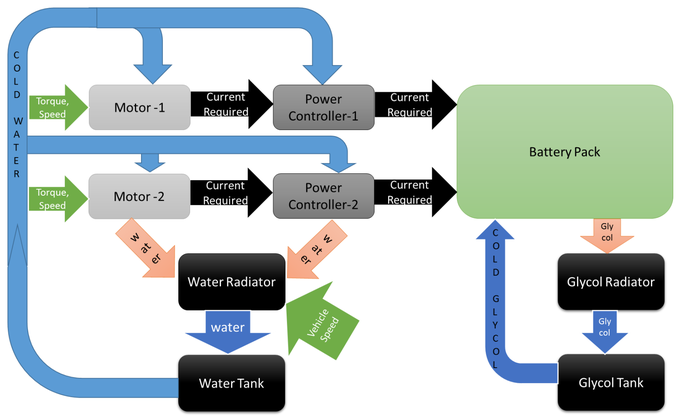
Battery Cooling



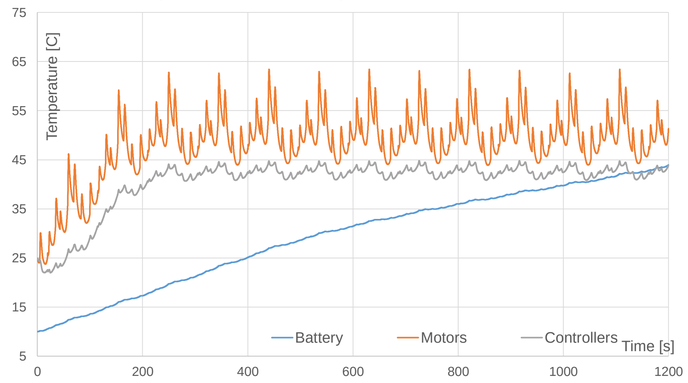


- 100% ethylene-glycol
- Chiller plates alongside the battery packs within the structure
- Battery cells separated with flanged aluminium plates within battery box
- External cooler during charging and between sessions

Thermal simulation

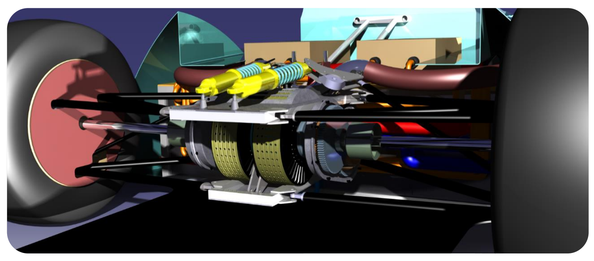


Component Temperature Evolution



Motors & ReGen

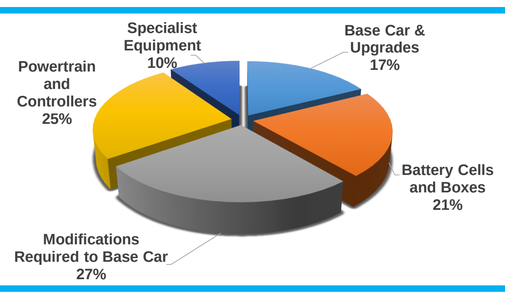
- Two EMRAX 228 water-cooled electric motors
- Single speed gearbox 2.4:1 ratio



- 35% of braking energy harvested
- Up to 480Nm of braking torque
- Both high grip and low grip setups
- Braking force electronically controlled for good brake distribution.

Costing

- Second-hand FB02 retrofitted for use in CFES
- Materials sourced locally when possible
- All components last for a minimum of 1 season
- Total cost of £57000



Conclusion

- Using two Emrax 228 electric motors it has been shown that it is possible to achieve a similar performance level to BRDC Formula 4 with a fully electric powertrain.
- An aluminium battery crash structure can meet necessary safety requirements while still being relatively inexpensive and simple to build.
- It is possible to effectively manage the thermal characteristics of the systems with a traditional cooling system

Supported By: Williams Advanced Engineering, Virgin Racing Formula-E Team, National College for Motorsport, Cranfield Motorsport Simulation, Altair, ChassisSim The Winner's Edge, AVL Boost, Racecar engineering, MSA Motor Sports Association United Kingdom

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