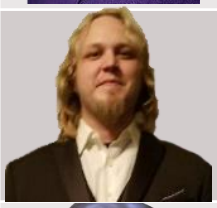
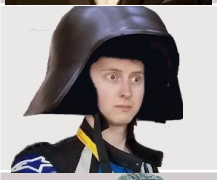
Automation & Controls Engineering Technology – Capstone Project
The 'Electric Coffin'

Dunwoody Dare Devils

E.J. Daigle

DUNWOODY
COLLEGE OF TECHNOLOGY

Team Composition

Name	First 2-year Program	Second 2-year Program	Current Employer	Current Position	Role on the Team	Picture
Matthew Snyder	ICON	AENT	Tesla Motors	Automation Controls Engineer	Project Manager, and Mechanical Design	
Blake Bodine	ICON	AENT	3M	Automation Technician III Lead	Visual Arts, Snacks, and Security	
Donald Posterick	ELTT	AENT	Viking Electronics	Embedded Systems Engineer	Team Captain, and Technical Development	
Ryan Lindgren	ELTT	AENT	Reyes Coca Cola Bottling	Controls Engineer	Driver	
Travis Granlund	ICON	AENT	Rockwell Automation	Field Service Engineer	Editor and Maintenance Supervisor	

AENT - Program Outcomes

(1) an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;

(2) an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;

(3) an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;

(4) an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and

(5) an ability to function effectively as a member as well as a leader on technical teams.

Abstract

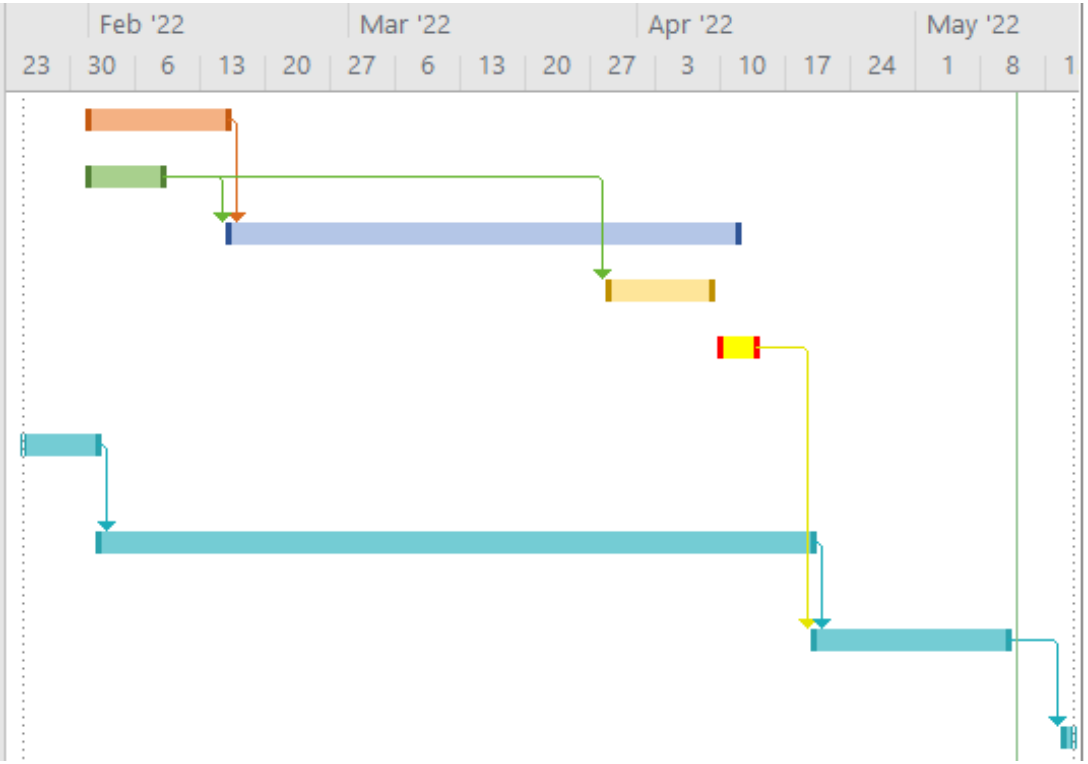
- The goal of this project was to make an electric vehicle that could compete at the Shell Eco Marathon. This would be done using the rules and requirements provided by the Shell Eco Marathon committee, as well as some internal requirements we decided on. The competition requires the speed controller to be custom and purpose built as well as the vehicle itself.
  The goal of the competition is to develop the most efficient, and innovative vehicle possible worldwide. This is accomplished through energy optimization and unique engineering amongst global academics and student ingenuity.
  We found that this competition would be an excellent opportunity to utilize our skills developed during our time at Dunwoody, and in AENT.

Top Level Requirements

Requirement	Assessment
Make an electric vehicle that could be entered into the Shell Eco Marathon	Pass 3 phases of registration.
Be able to drive vehicle around parking lot	Vehicle
Be able to enter the Track	Pass Tech Inspection (<50% of vehicles submitted will pass)
Be entered into leader board	Complete 4 laps in under 35 minutes to qualify successfully
Have adequate position in leader board	Be one of the most efficient vehicles at the competition (Top 3)

Gantt Chart Full Project

	Task Name	Duration	Start	Finish	P
1	Planning	11 days	Tue 2/1/22	Tue 2/15/22	
2	Purchasing	6 days	Tue 2/1/22	Tue 2/8/22	
3	Assembly	39 days	Wed 2/16/22	Mon 4/11/22	1,2
4	Practice / Test Runs	9 days	Tue 3/29/22	Fri 4/8/22	2
5	SHELL ECO-MARATHON UNITED STATES 2022	4 days	Sun 4/10/22	Wed 4/13/22	
6	Stage 1: Deliverable DUE	6 days	Tue 1/25/22	Tue 2/1/22	
7	Stage 2: Deliverable DUE	55 days	Wed 2/2/22	Tue 4/19/22	6
8	Stage 3: Deliverable DUE	15 days	Wed 4/20/22	Tue 5/10/22	7,5
9	Stage 4: Presentation	1 day	Tue 5/17/22	Tue 5/17/22	8



Technical Slides

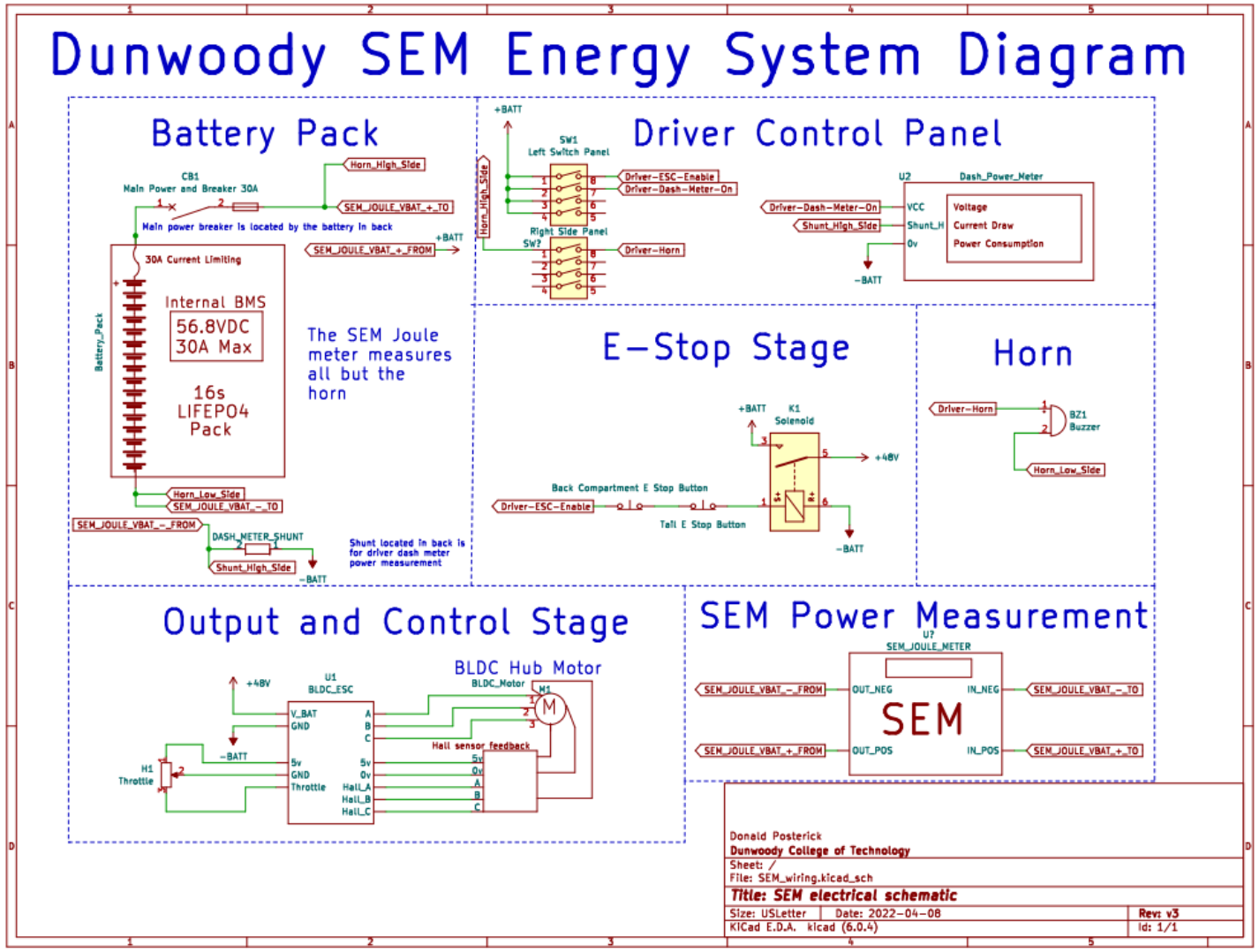
Mechanical

- BOF design (Body on Frame)
- Mild steel square tubing chassis
- Carbon fiber body
- Disk brakes on all wheels (foot activated, independent front/rear)
- 5 Point racing harness
- Roll cage surrounds driver's frame

Technical Slides

Electrical

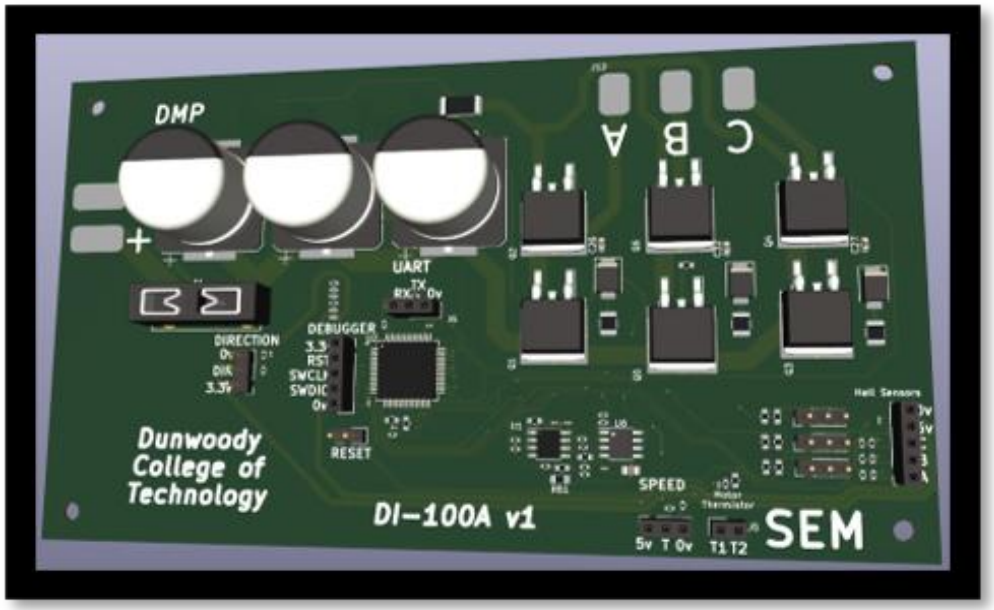
- 16s LIFEPO4 Battery Pack
- 2 E-Stops (1 Internal, 1 External)
- Multistage power monitoring for driver, and SEM officials
- Throttle contains dead man cutoff for safety

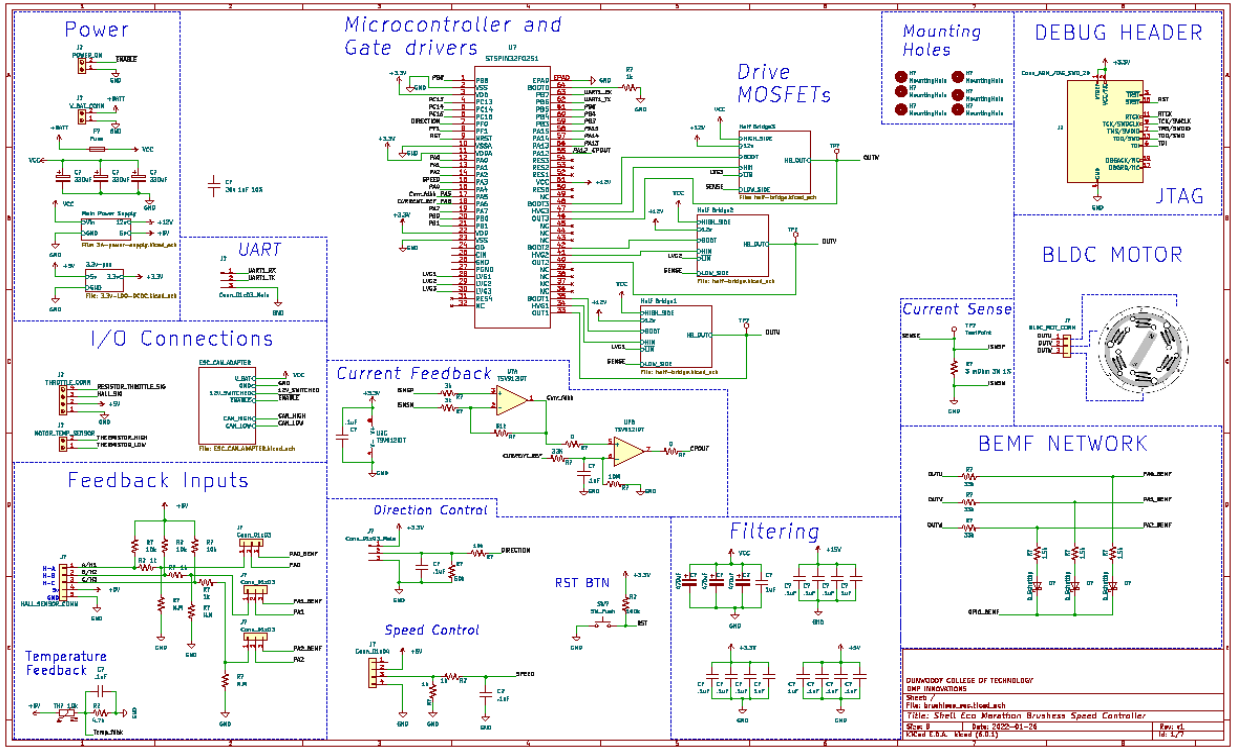


Technical Slides

Electronics

- 2-layer FR4 PCB
- BLDC ESC 100A @ 60v Max



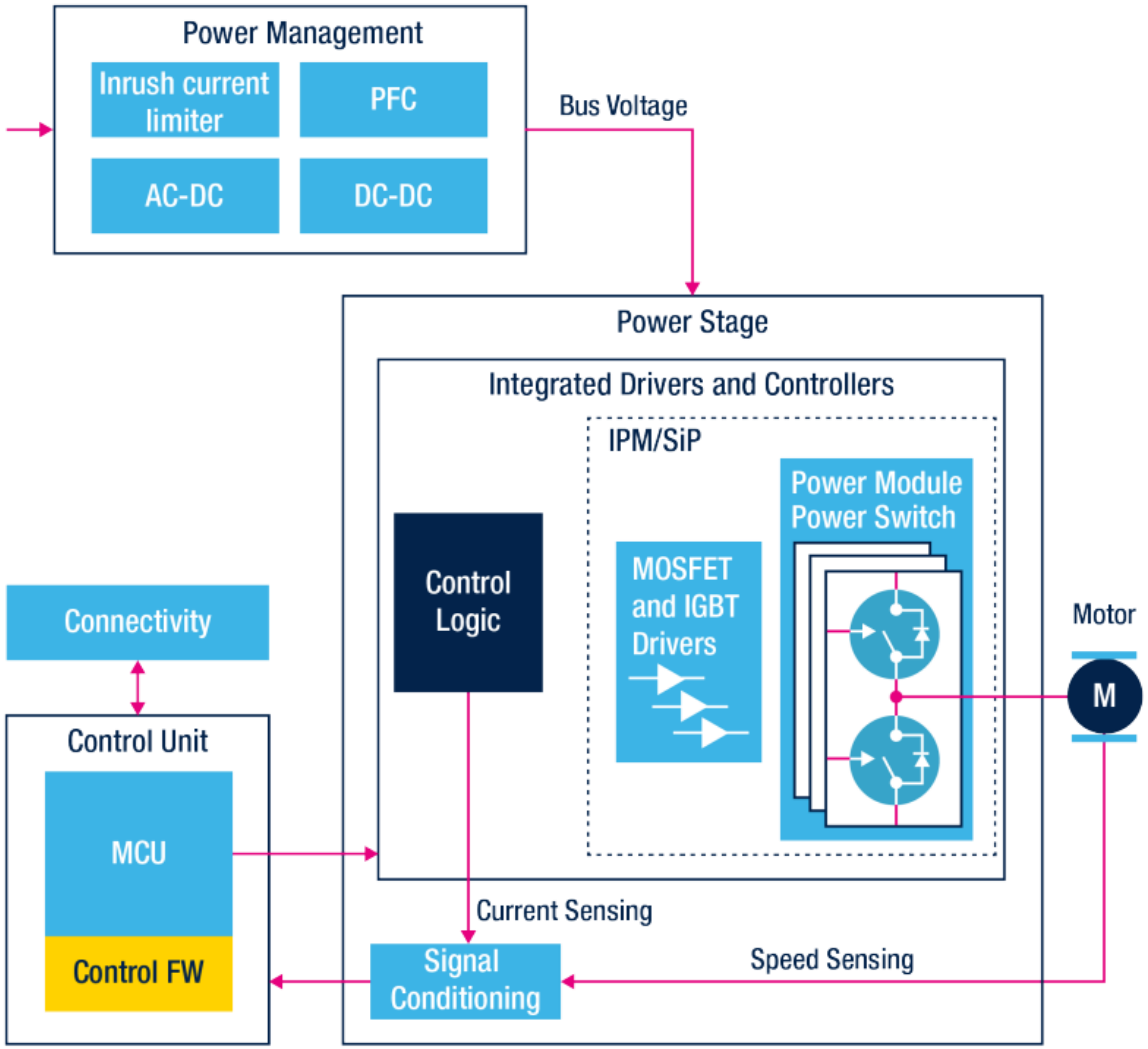


- High efficiency MOSFETS
- STSPIN32 microcontroller
- BEMF feedback network
- Advanced Hardware & Firmware level filtering

Technical Slides

Electronics cont.

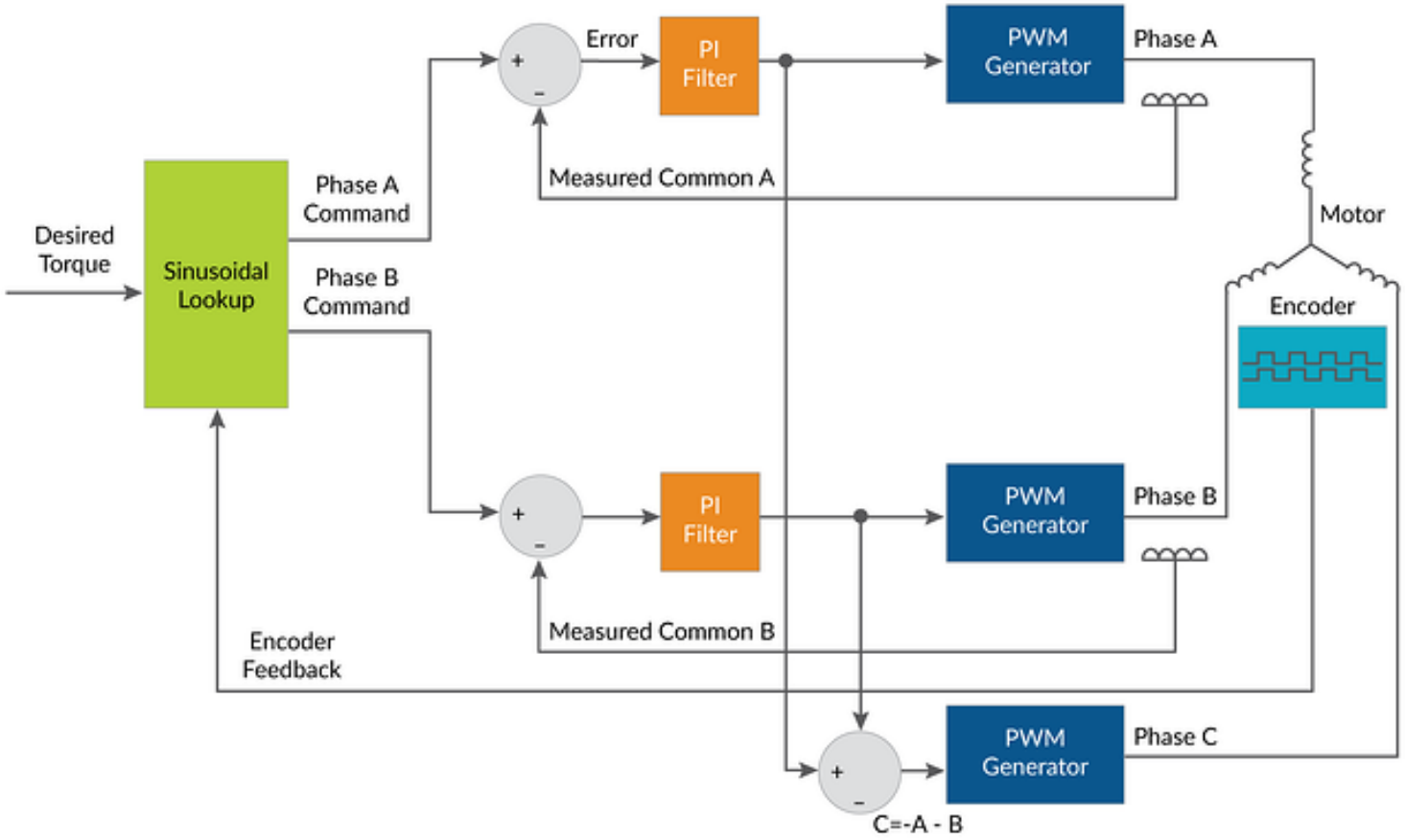
- Hybrid FOC
- High RPM Efficiency, Low RPM startup torque
- Switching Topology and gate driver firmware optimizations



Technical Slides

Firmware

1. Measure unenergized phase
2. Estimate rotor position
3. Lookup next position
4. Calculate phase commands
5. PI filter phase commands
6. Energize output stages
7. Repeat



Project Bill of Materials

- Table Format, quantity, part number, vendor, extended and total cost

Quantity	Part Number	Part Name	Vendor	Cost
5	DI-100A	BLDC ESC	Custom	$701.79
5	N/A	STSPIN32F103 & MOSFETS	Digikey	$100.08
50 ft	18/16 Gauge	Wires	Cognex	$79.01
1	CM366	Mirrors	O'Reillys	$24.60
1	IX48DB	105 dB 48v horn	Uxcel	$12.99
2	LFPB-51.2V6.6A	LiFePO4 51.2V 337Wh	BatterySpace	$640.00
2	CB10A-ND	10A Circuit Breakers	Digikey	$48.80
			Total Parts	$1,607.27

Conclusion

- We successfully ran our prototype and got 2nd place overall
- Our problem-solving skills and planning helped our project succeed.
- In retrospect, we should have had paid more attention to the technical inspection requirements
- Being our first time competing in this competition, we were pleasantly surprised by getting 2nd

Recommendations for the Future

- Reducing the body length to ensure we pass the requirement (current body is at max length).
- Peripherals to allow for the driver to have a better understanding of where he is in the process.
- Having better communication and a greater understanding of requirements is key to getting a better overall result.

Music Video


V-257 478
SMP
SCRAP METAL
V-128 502
DUNWOODY CAPSTONE PROJECT
ELECTRIC COFFIN

Questions

Name	Email
Blake Bodine	blakebodine88@gmail.com
Donald Posterick	donny.p@live.com
Matt Snyder	snydermatthew27@gmail.com
Ryan Lindgren	ryan.lindgren96@gmail.com
Travis Granlund	granlundtr@gmail.com