



# Andrew Randell

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B.E.Sc. Mechatronics Engineering  
University of Western Ontario

16-Months at Intel Corporation

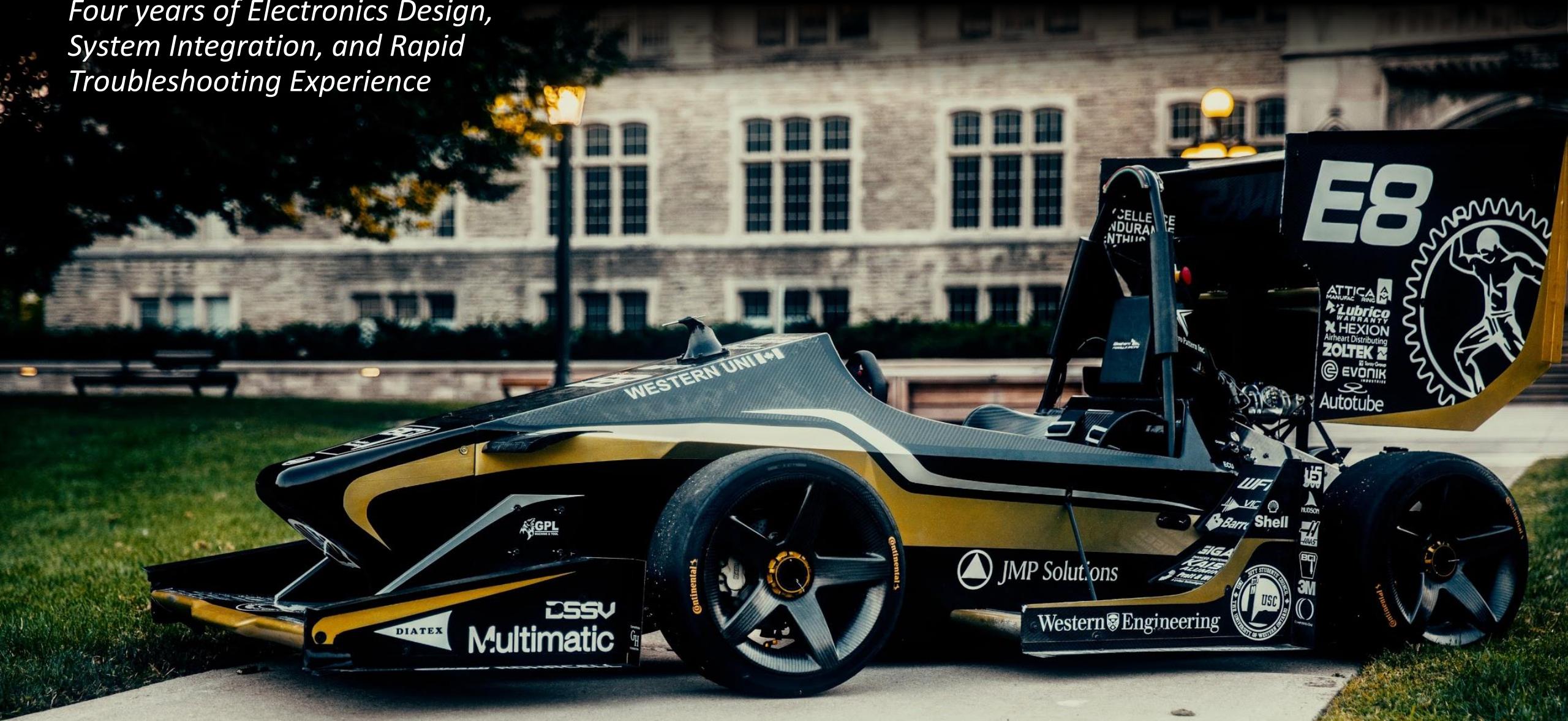
48-Months of Formula-SAE experience



# Western Formula Racing: Formula-SAE



*Four years of Electronics Design,  
System Integration, and Rapid  
Troubleshooting Experience*



## 2021 WFR Electrical Director

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- One of three team leaders responsible for 50+ team members and 10 subsection leads who design, build, and race a 504-volt, \$160,000 electric vehicle at international SAE competitions
- Administered vehicle propulsion system design from the ground up for the 2021 vehicle. Increased the system efficiency by 30% with accumulator cell arrangement optimizations, and integrating an all-new motor controller
- Designed a Bespoke Battery Management System with hardware and control algorithms to manage 720 Lithium-ion battery cells arranged in a 6P120S configuration
- Managed cross-functional meetings and workgroups for team members. Mentored junior team members

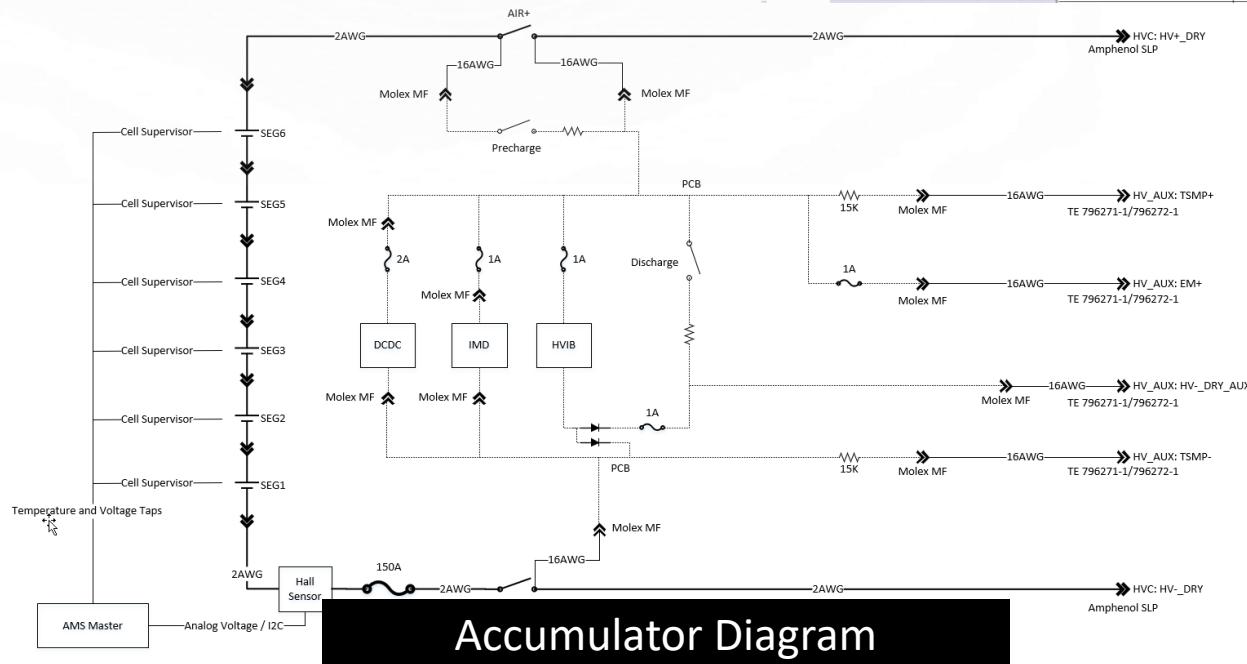


## 2021 Preliminary Accumulator

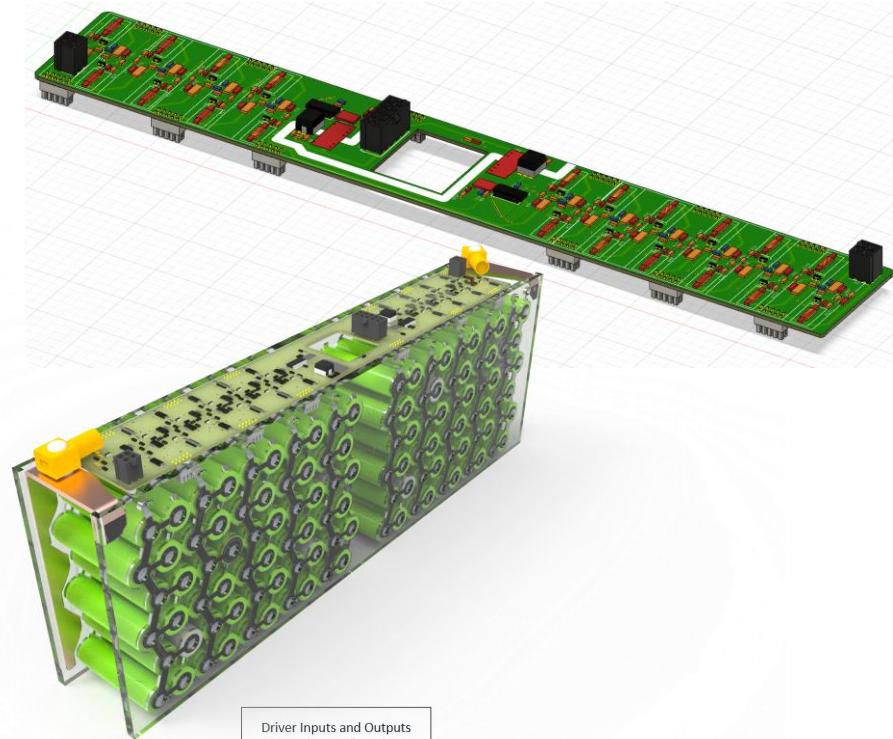


## Preliminary System Specifications

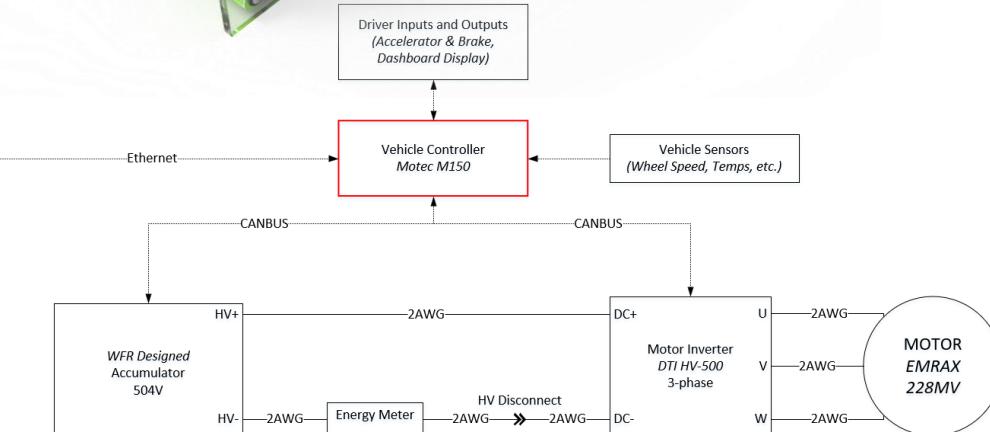
Not LTS Input	Nickname	2019/2020	6 Module Wide 6P 500V DTI	7 Module Wide 7P 450V SciMo
ACCUMULATOR P Count		7	6	7
Module S Count		19	20	18
Module Count		5	6	6
Cell Count		665	720	750
Cell Selection			Sony VTC5 +	Sony VTC6 +
Cell Nominal Capacity (mAh)		3.000	3.120	3.120
Cell Rated Current A		20	30	30
Cell Peak Voltage		4.20	4.20	4.20
Cell DCR mOhm		30.00	21.88	21.88
Module Peak Voltage		79.0	84.0	75.0
Module Peak Current (A)		6.0328	5.6683	5.6683
Peak Pack Discharge		299.0	594.0	453.6
Pack Peak Discharge Current A		140.00	180.00	210.00
Pack Energy (kWh)		6.43	7.49	7.88
Fractional Acc Case Mass Delta		1.00	1.20	
InVERTER				
Inverter		RMS PM100DXR +	DTI HV-500 +	SciMo ISCI (2x) +
Inverter Position Sensor Interface			Resolver Native	Encoder
Inverter DC Voltage Vdc		400.00	350.00	800.00
Inverter Current Limit Arms		450.00	350.00	550.00
Inverter Mass Kg		7.50	6.70	5.00
Inverter Cost \$		\$7,500.00	\$4,000.00	\$15,000.00
MOTOR			Emrax 228 MV +	2x SciMo SY31 +
Motor		340.00	340.00	100.00
Motor Current Arms		500.00	500.00	450.00
Motor Voltage @ MaxRPM		400.00	350.00	400.00
Motor Max Speed Load RPM/dc		14.00	14.00	15.51
Motor Specific (idle Speed RPM/dc)		12.00	12.00	11.00
Motor Mass Kg		240.00	240.00	100.00
Motor Peak Torque Nm		6.500.00	6.500.00	20,000.00
Motor Max Speed RPM		400.00	500.00	30,000.00
Motor Cost \$		4,389.00	5,544.00	450.00
MOTOR SPEED		5.50	6,560.00	20,000.00
Idle Cell Voltage (4.2V + 100% SoC)		4.00	4.00	4.00
Accumulator Load Current A (Steady State)		60.00	48.00	52.00
Loaded Accumulator Voltage (DCIR Drop)		355.57	458.87	414.43
DC Bus Power kW		21.33	21.15	21.55
Motor Max Speed Loaded RPM (DCIR Drop)		3,911.29	5,058.57	15,276.56
Motor Max Speed Idle RPM (DCIR Drop)		4,978.00	6,438.19	15,276.56
ESTIMATION				
Maximum Accumulator Voltage Profiled				
Motor Max Speed Idle RPM (100% SoC, 4.2V/cell)				
Motor Max Speed Idle RPM (100% SoC, 4.2V/cell)				
DRIVETRAIN				
Final Drive Type		Double Reduction	Double Reduction	
Final Drive				Optimized
Final Drive Ratio		3.05	4.30	13.00
Wheel Diameter in		18.40	18.40	18.40
Max Wheel Torque Nm		924.00	1,032.00	1,300.00
Max Vehicle Speed km/h (8% Loss from Specific Idle Speed)		104.79	121.35	120.18



## Bespoke BMS



Vehicle Diagram

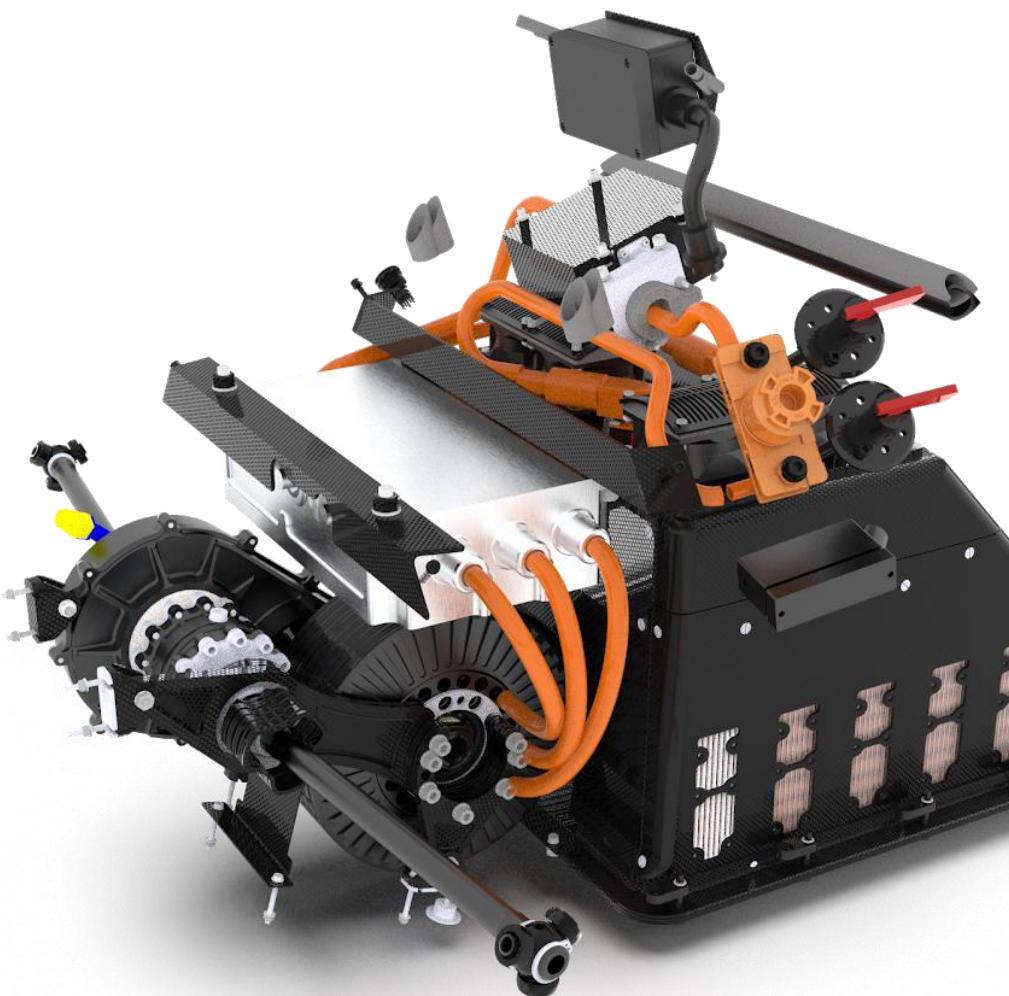




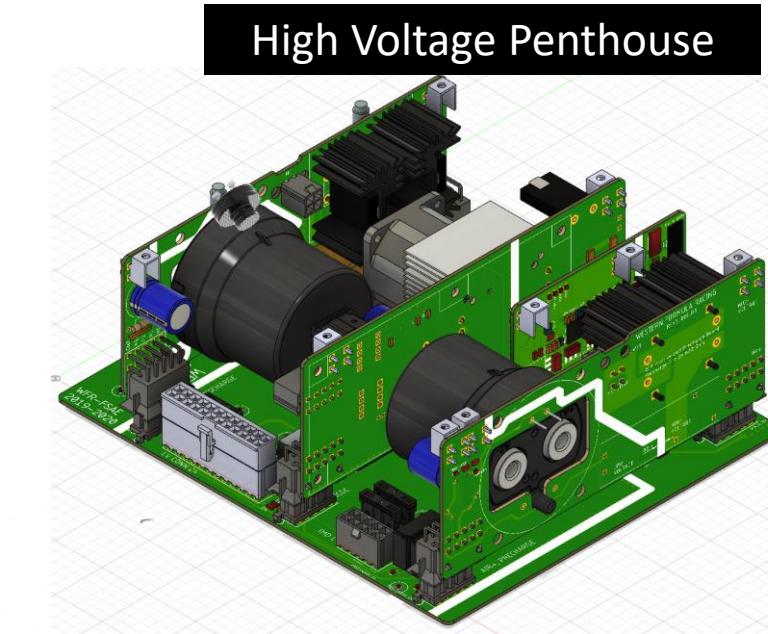
## 2020 WFR Energy Accumulator Lead

- Lead electrical system design and assembly for a 400-volt energy Accumulator. Incorporated all discrete control components to a modular PCB assembly, resulting with stellar accumulator reliability and serviceability allowing the vehicle to complete the season with no serious faults
- Assembled and tuned a Cascadia PM100DXR inverter and Emrax 228MV motor used in the propulsion system
- Designed a 400V to 12V DCDC converter based on Vicor DCM modules to power the vehicle's low-voltage systems

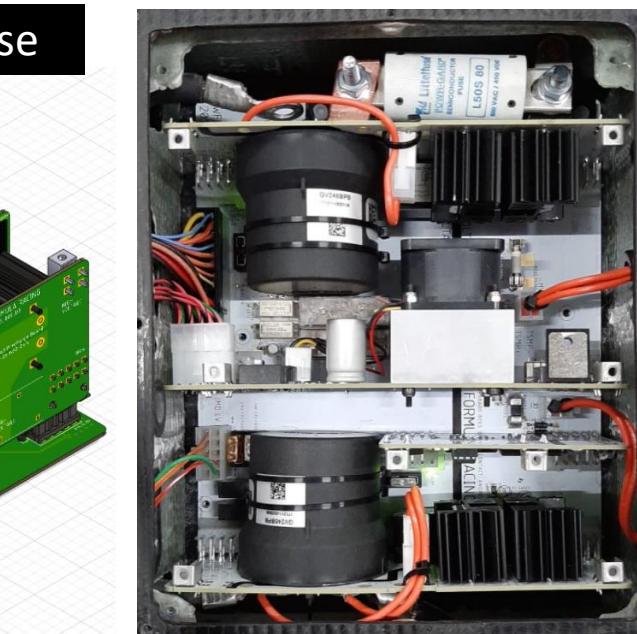




Propulsion System Rendering

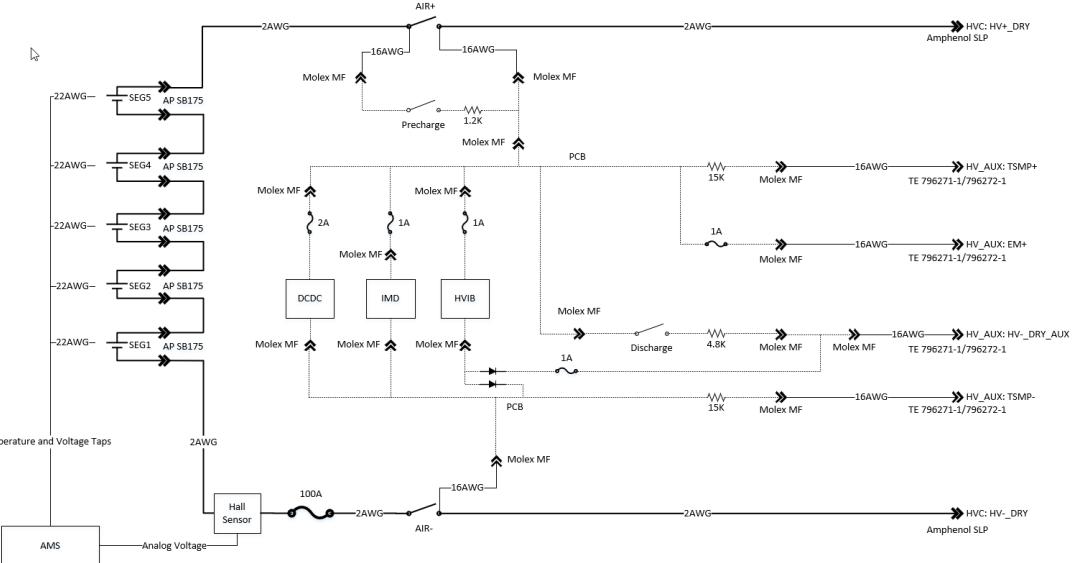
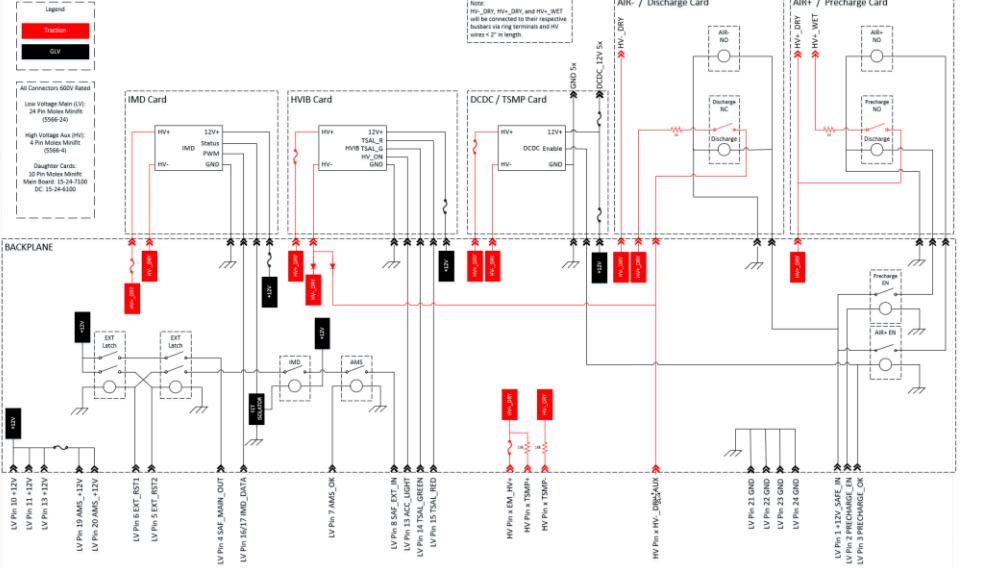


High Voltage Penthouse

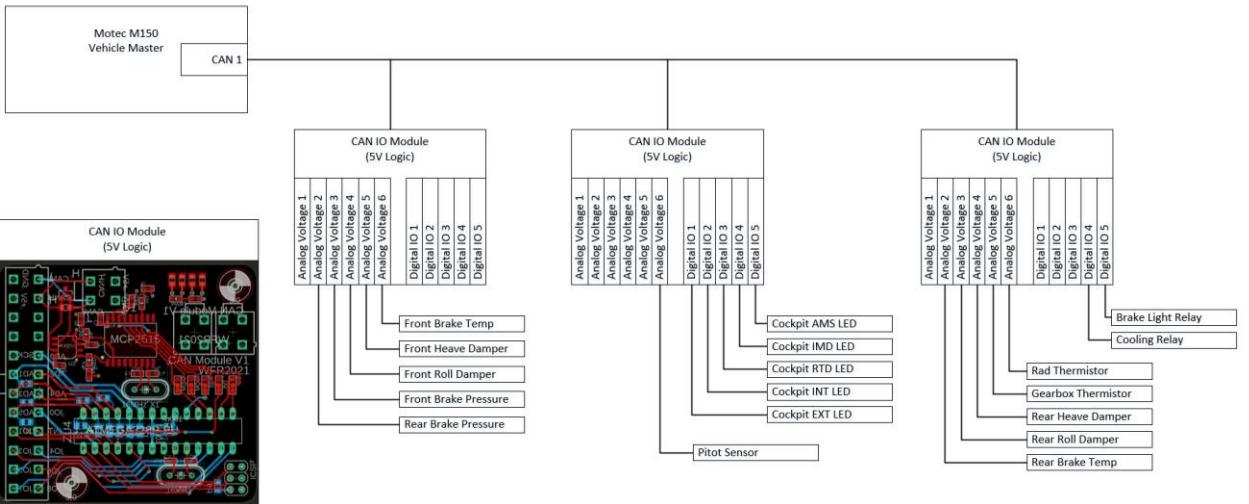


Printed Circuit Boards

[See my WFR20-E Marketing Content](#)



# Design Synthesis, Documentation, & Knowledge Transfe





## WFR20-E Glamour Shots





## 2019 WFR Low-Voltage & Data Acquisition Lead

- Acted as the Certified High Voltage Electrical Safety Officer for the \$150,000 vehicle and 55+ member team
- Lead low-voltage harness design and assembly utilizing a bespoke Power Distribution Module with telemetry, an Android-based dashboard display with OBDII, and a Motec M150 engine controller and DAQ





Electrical  
Safety  
Authority

For Your Safety

THIS IS TO CERTIFY THAT

ANDREW RANDELL  
Attendee # 103841

ATTENDED A

Workshop on

Safety in a High Voltage Environment  
Half Day

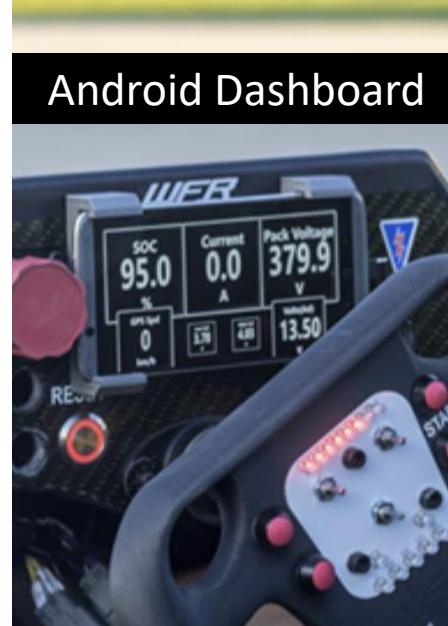
October 25, 2018

Scott D. Saint, P.Eng., MBA, C. Dir.  
Vice President and Chief Public Safety Officer

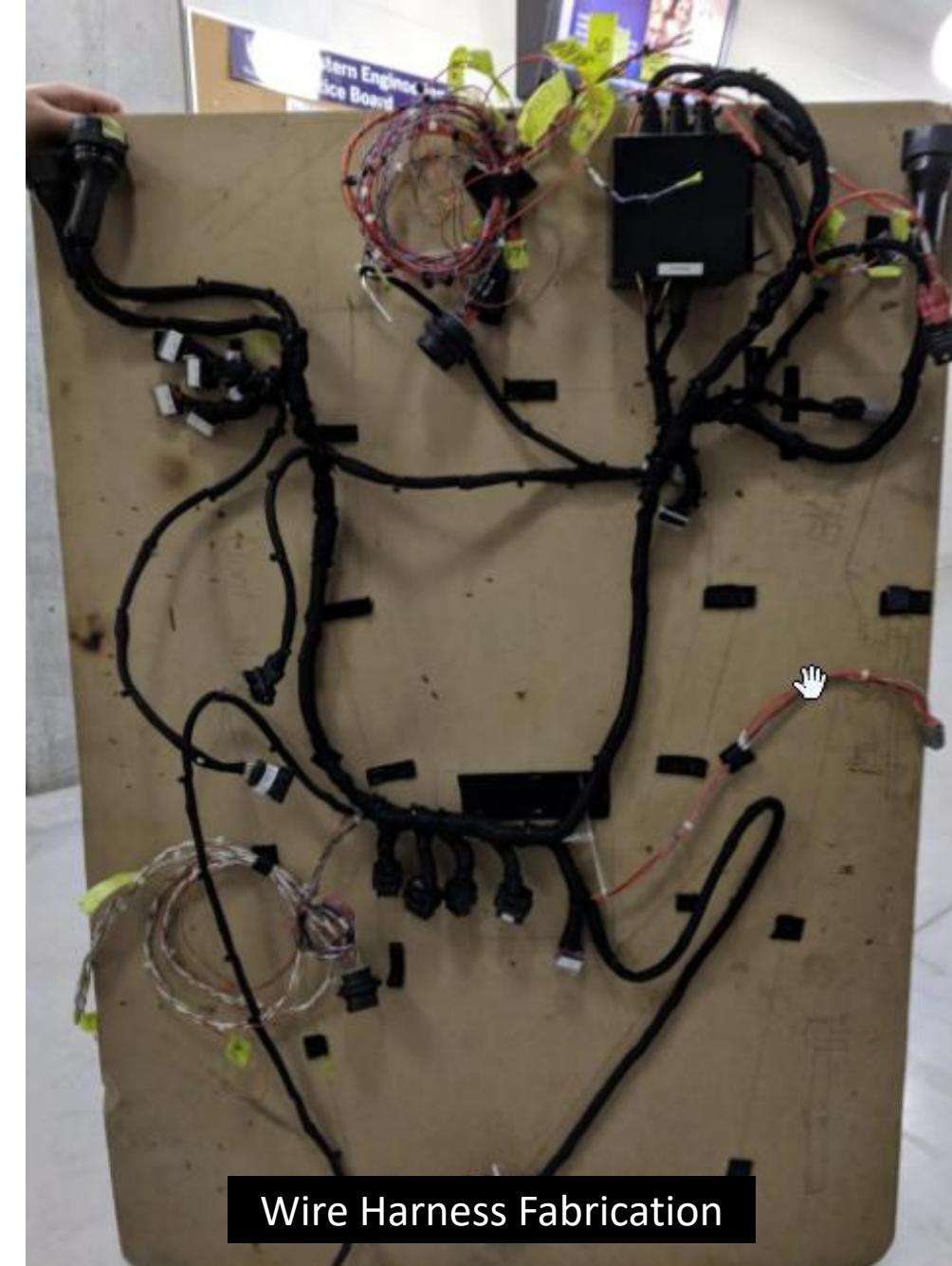
FORM ESD-101/10



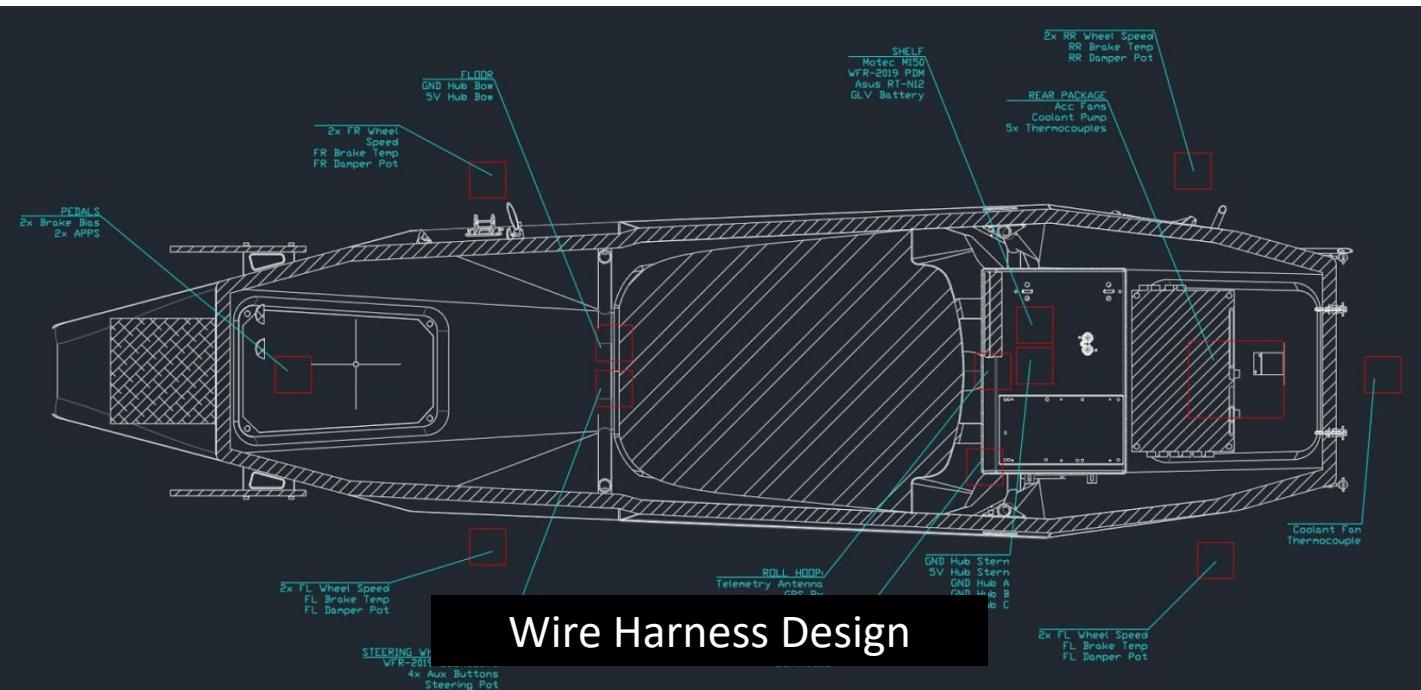
4<sup>th</sup> Place FSAE North



Android Dashboard



Wire Harness Fabrication



Wire Harness Design



## WFR19-E Glamour Shots

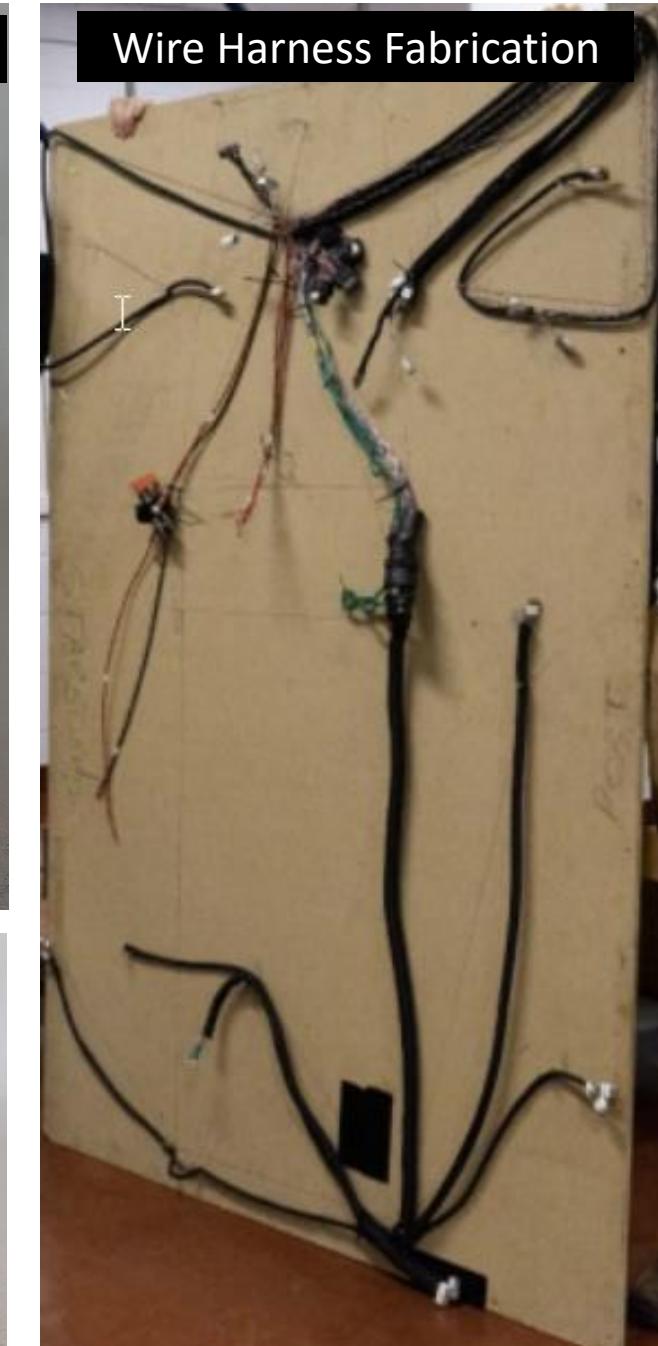
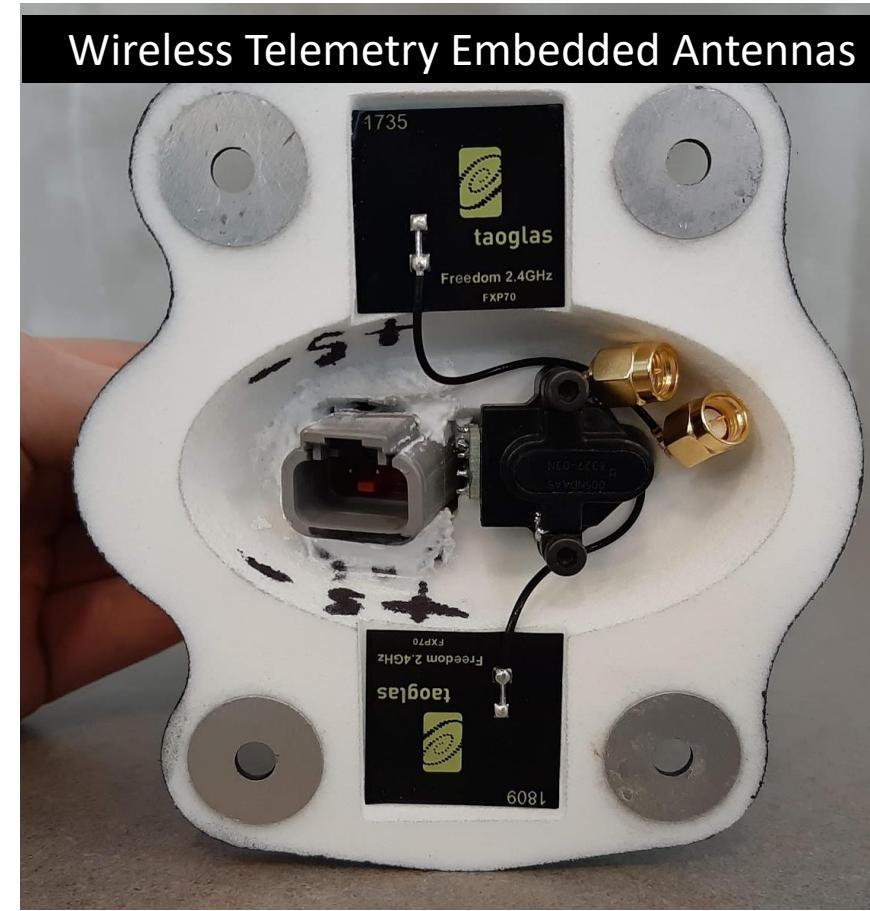
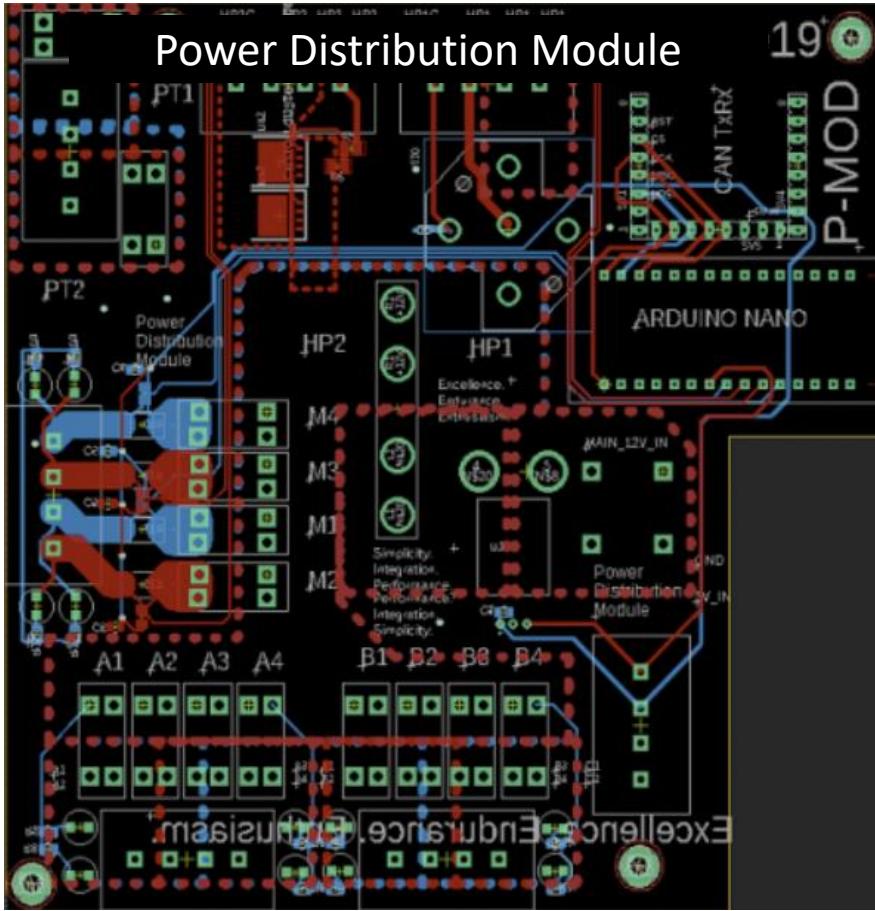




## 2018 WFR Electrical Member

- Incorporated wireless telemetry based on a generic 802.11n local area network with a router running OpenWRT
- Supported the electrical team with duties including: system design, wire harness assembly, and troubleshooting







## Product Marketing, Drone Photography, and Creative Content

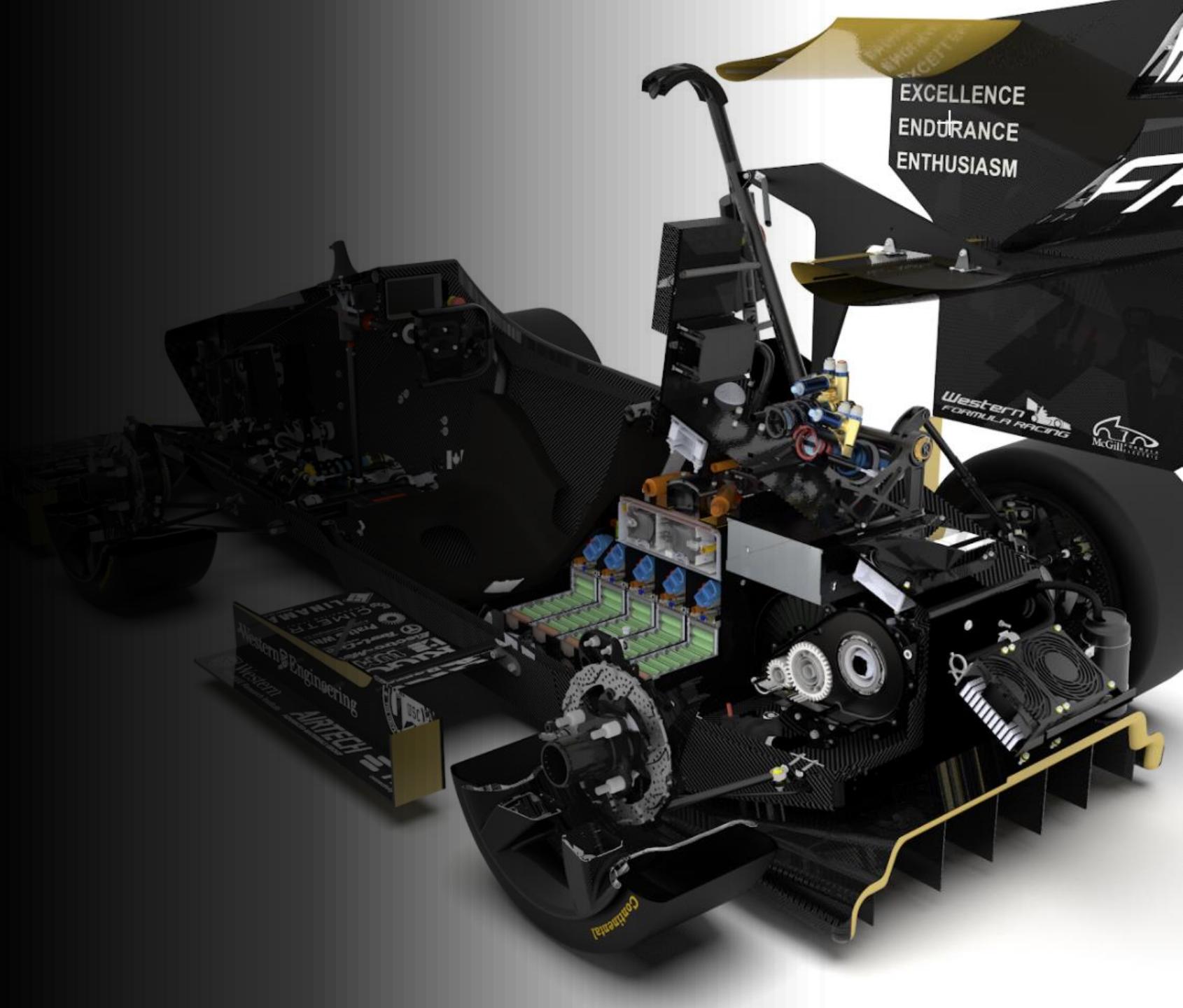
Photorealistic renderings of  
Solidworks models via Keyshot

Tunable and spherical product renders

- [Spherical Interactive Render](#)
- [Section View Interactive Render](#)

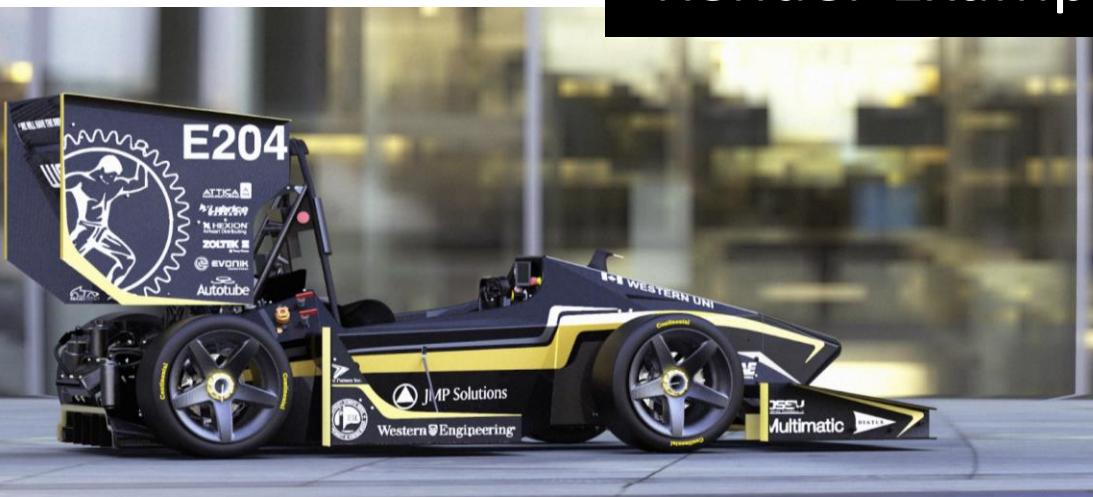
Video editing and production

- [WFR20-E Year in Review Video](#)
- [WFR20-E Testing Montage Video](#)





Render Examples (*WFR20-E*)



# Professional Experience

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24-months of Professional Internship  
and Co-op Experience





# Intel Corporation 16-month Internship

## Platform Architect and PCB Designer

- Lead architecture and design for a high-speed silicon validation platform to be scaled across Intel validation teams
- Designed prototype PCBs to improve platform bring-up and validation efficiency in a laboratory setting
- Incorporated CPLD devices for system housekeeping tasks resulting in PCB layout area and cost reduction
- Implemented ECAD processes and tools to increase design workflow efficiency
- Managed Intel's relationship with third-party vendors for specific platform subsystems and exploratory projects
- Submitted two patent applications for system behaviour during power state transitions





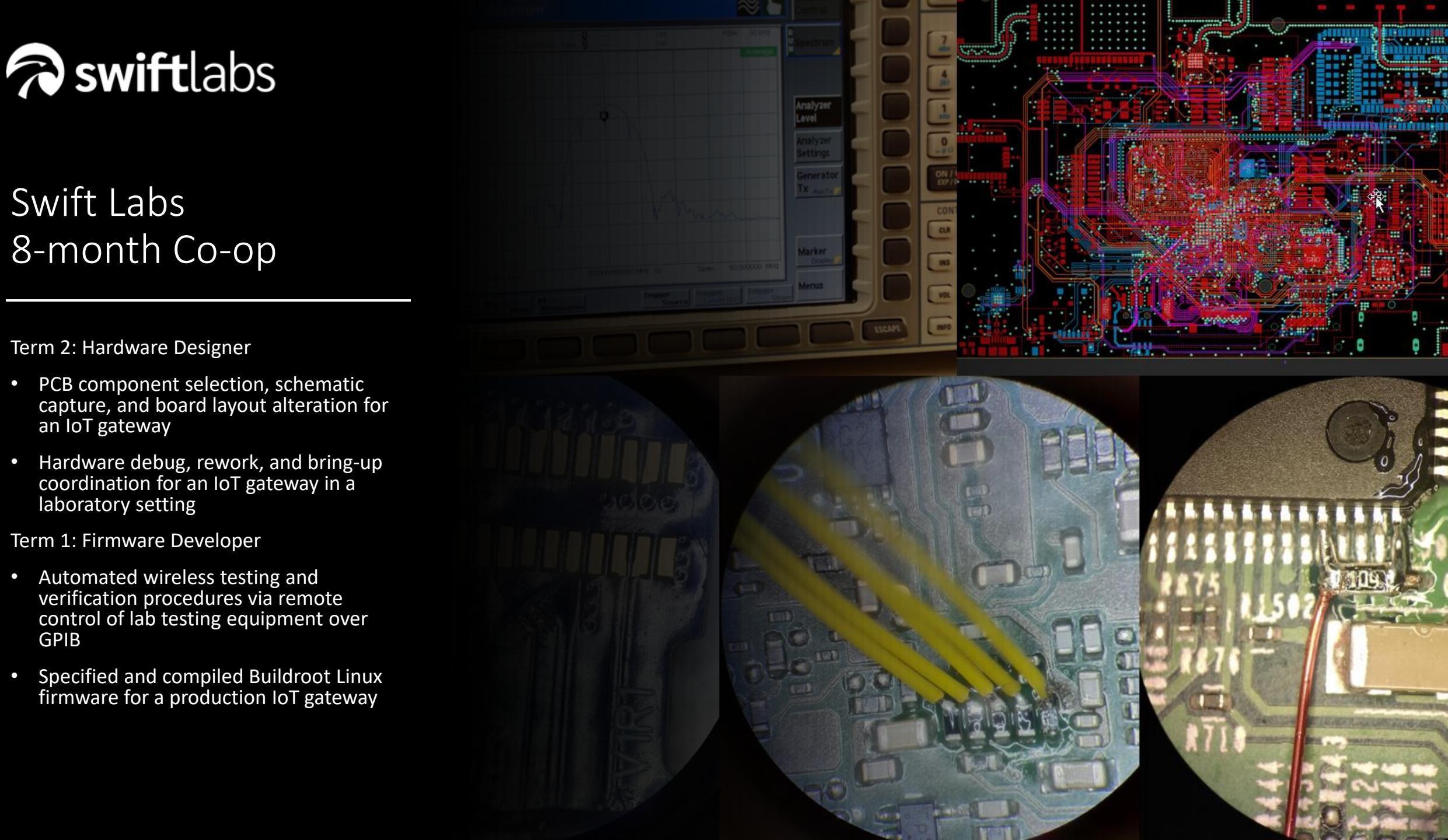
## Swift Labs 8-month Co-op

### Term 2: Hardware Designer

- PCB component selection, schematic capture, and board layout alteration for an IoT gateway
- Hardware debug, rework, and bring-up coordination for an IoT gateway in a laboratory setting

### Term 1: Firmware Developer

- Automated wireless testing and verification procedures via remote control of lab testing equipment over GPIB
- Specified and compiled Buildroot Linux firmware for a production IoT gateway





cādence

OrCAD™  
CADENCE PCB SOLUTIONS

 AUTODESK® EAGLE

 SOLIDWORKS

 KeyShot

 Ps     Pr

 Excel

## Technical Skills

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### Design Tools

- OrCAD
- Allegro PCB Layout
- DE HDL Schematic Capture
- Eagle PCB
- MATLAB and Simulink
- Excel
- LTSpice
- PowerDC
- Solidworks (CSWA)
- Git & Github
- Python
- C++

### Prototyping

- Oscilloscope
- Logic Analyzer
- SMD Soldering
- Arduino
- I2C, SPI
- CANBUS
- High-voltage wiring
- 3D Printing

### Creative & Office

- Adobe Creative Suite
- Keyshot Rendering
- MS Office
- LaTeX



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Bachelor of Engineering Science  
Mechatronics Engineering 2021  
Dean's Honour List



# MSE4401 Path Planning

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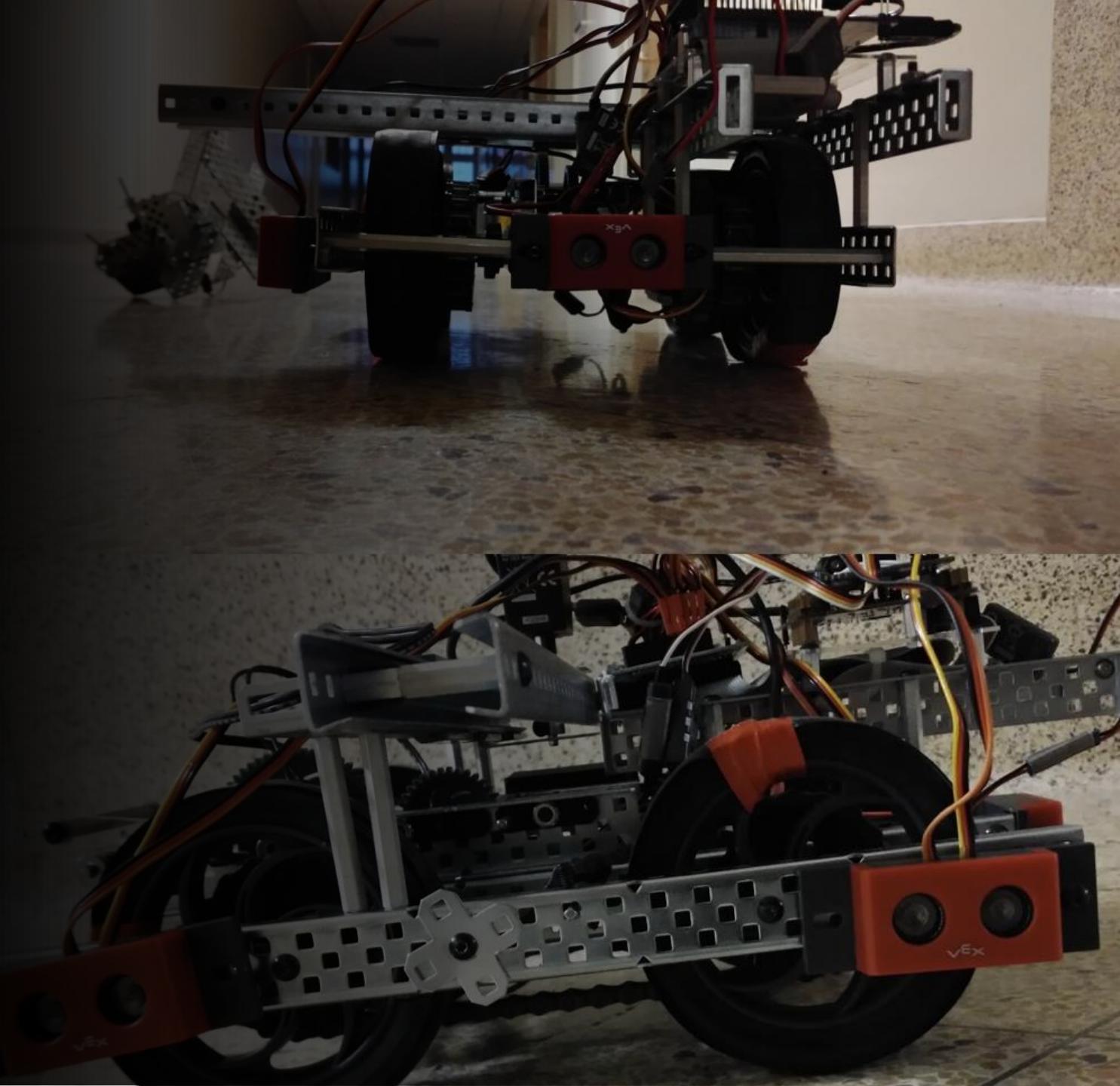
- Develop Code to control a robotic arm
- Move objects between positions
- Quintic Interpolations
- Gradient decent
- MATLAB based



# MSE2201 Autonomous Robot

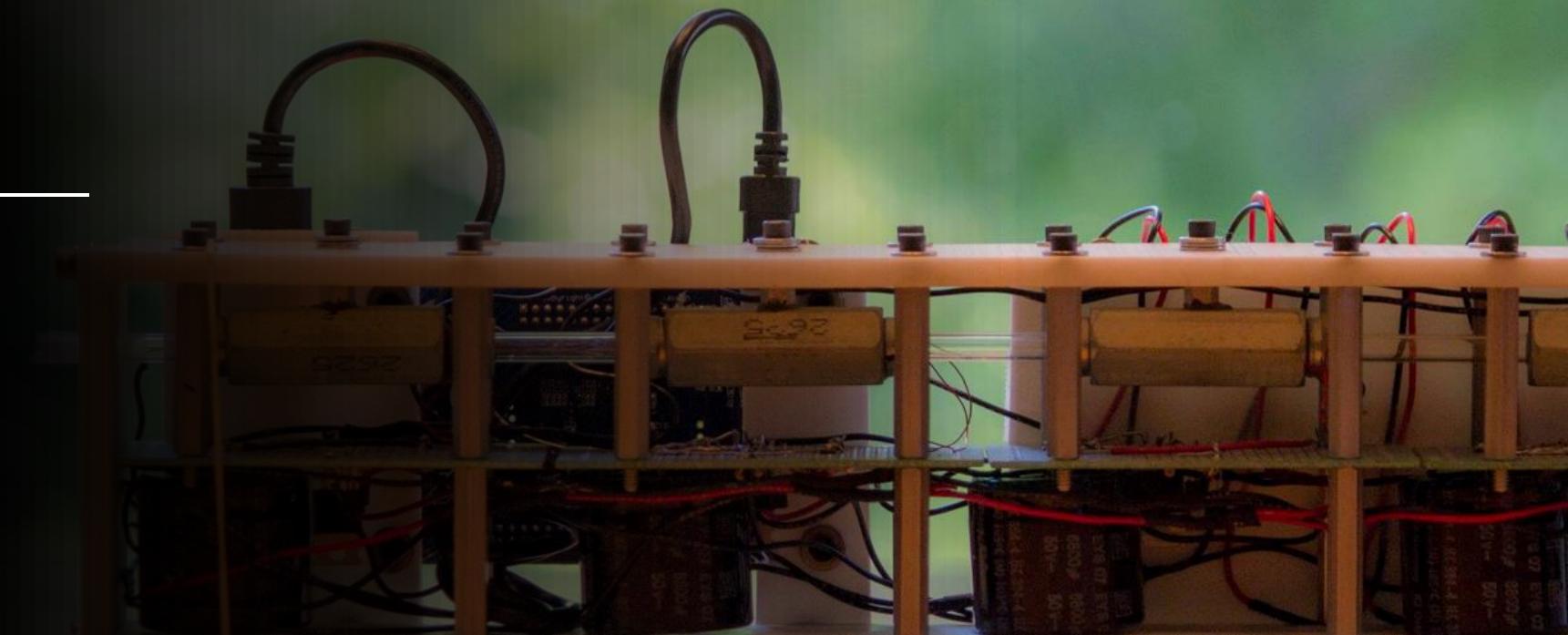
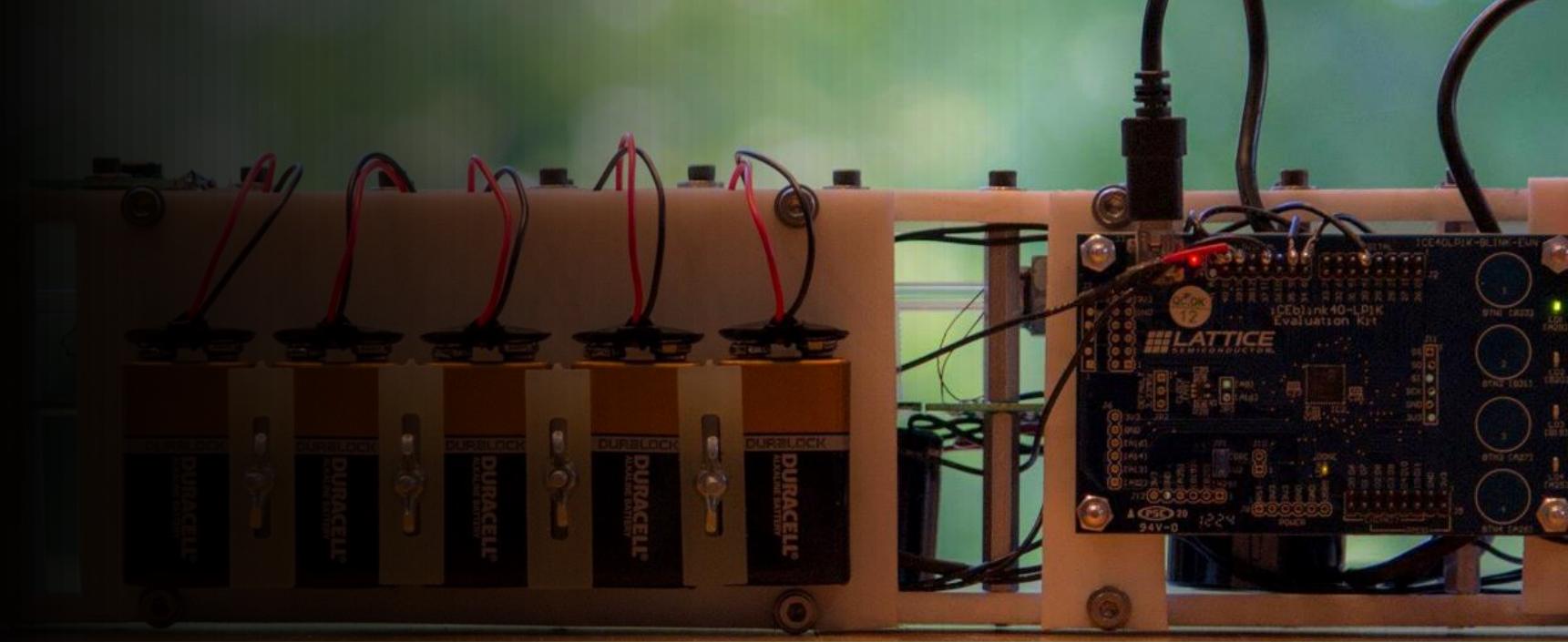
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- Develop an autonomous robot to navigate a course
- Detect and pick up objects
- Deposit objects in the proper location



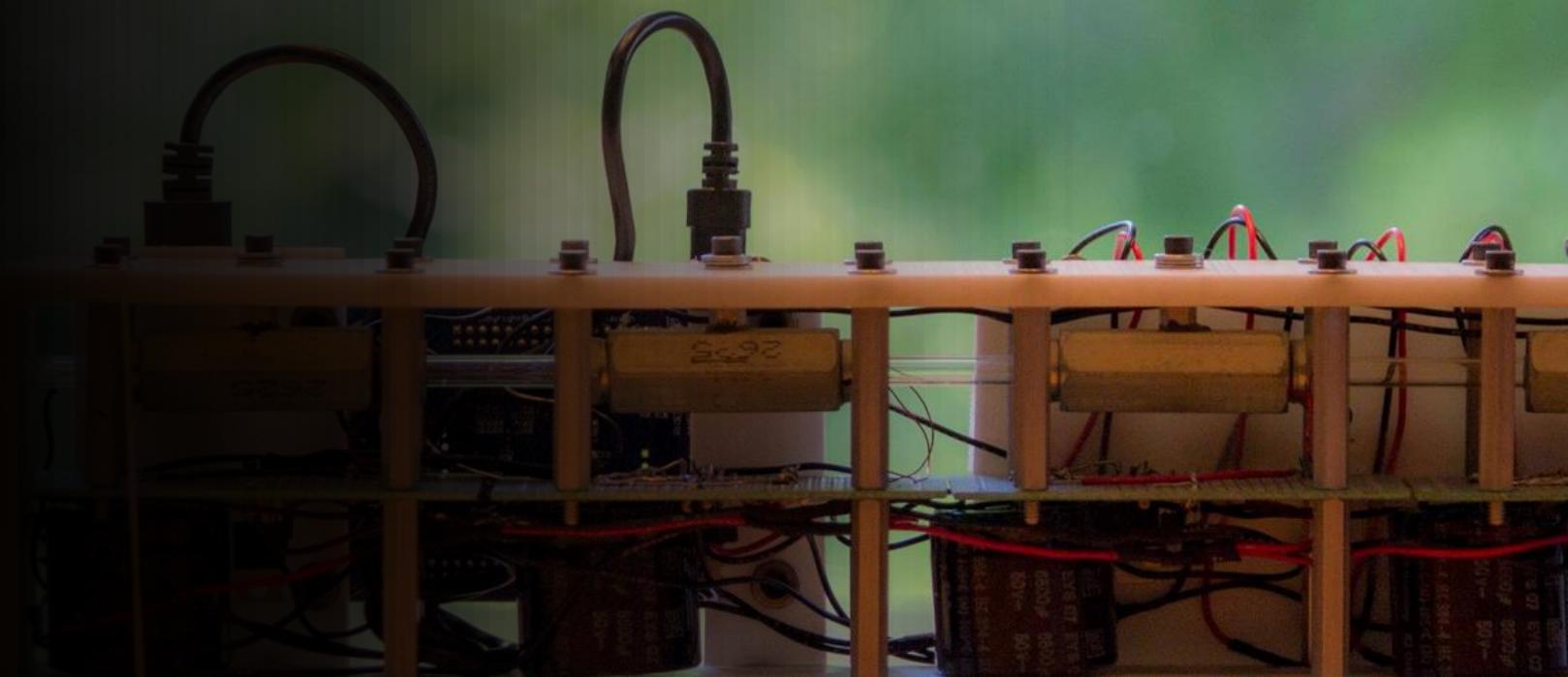
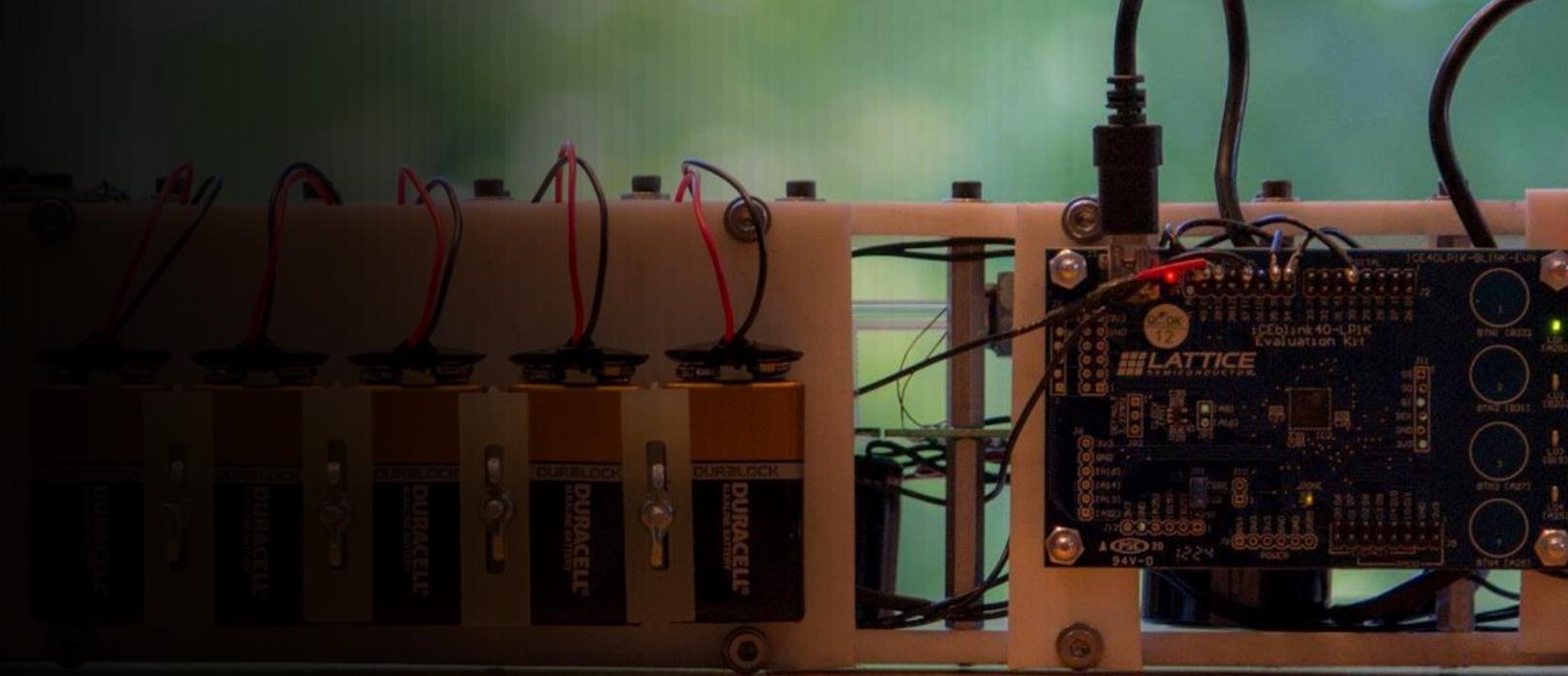
# Personal Projects

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# Home-built Linear Accelerator

- Four-stages
  - 6800uF Caps
  - 48V
  - MOSFET Switches
  - FPGA Controlled
  - [YouTube Video](#)

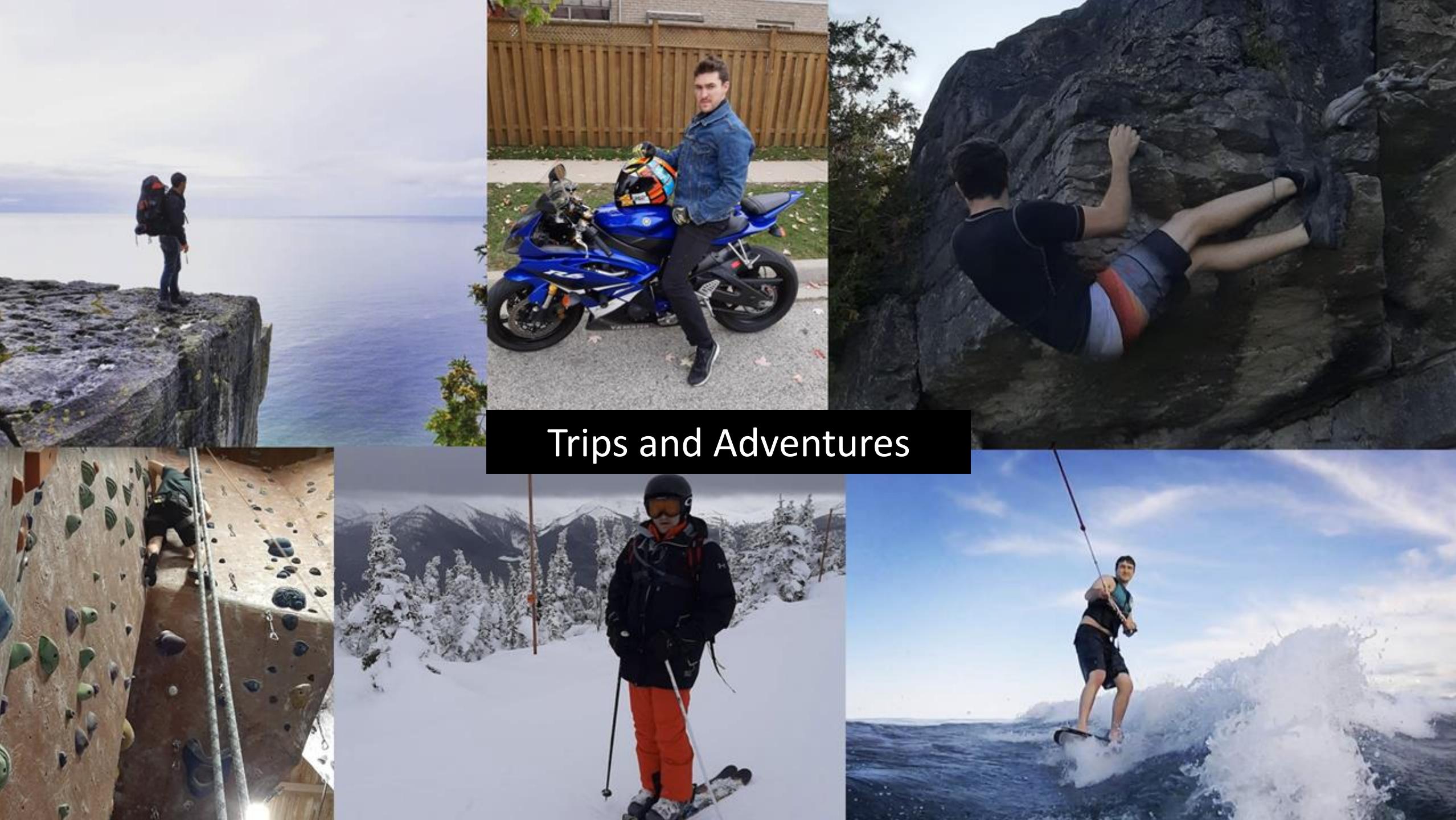


# Computers and Networking

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- Built several desktop PCs for personal and business use
- Manage a FreeNAS media server and NAS for personal use
- Set up several local area networks with multiple access points
- Portfolio site: [andrewrandell.ca](http://andrewrandell.ca)
  - Hosted on Github Pages
  - Modified HTML5 template





## Trips and Adventures