



Andrew Randell

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*

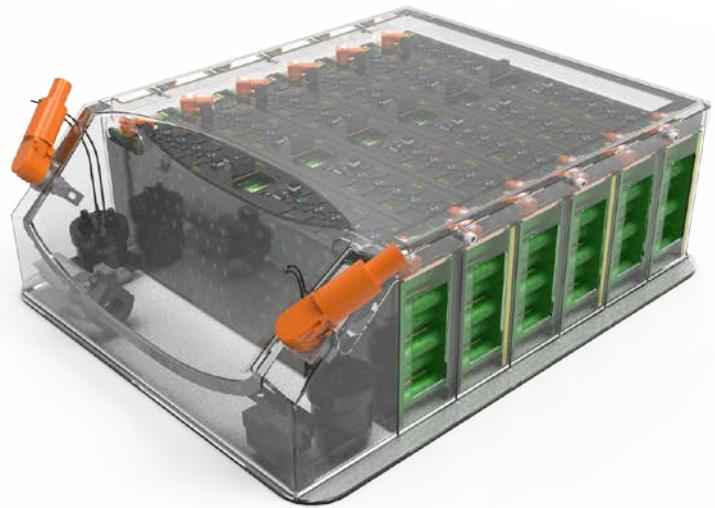


2021 WFR Electrical Director

- 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

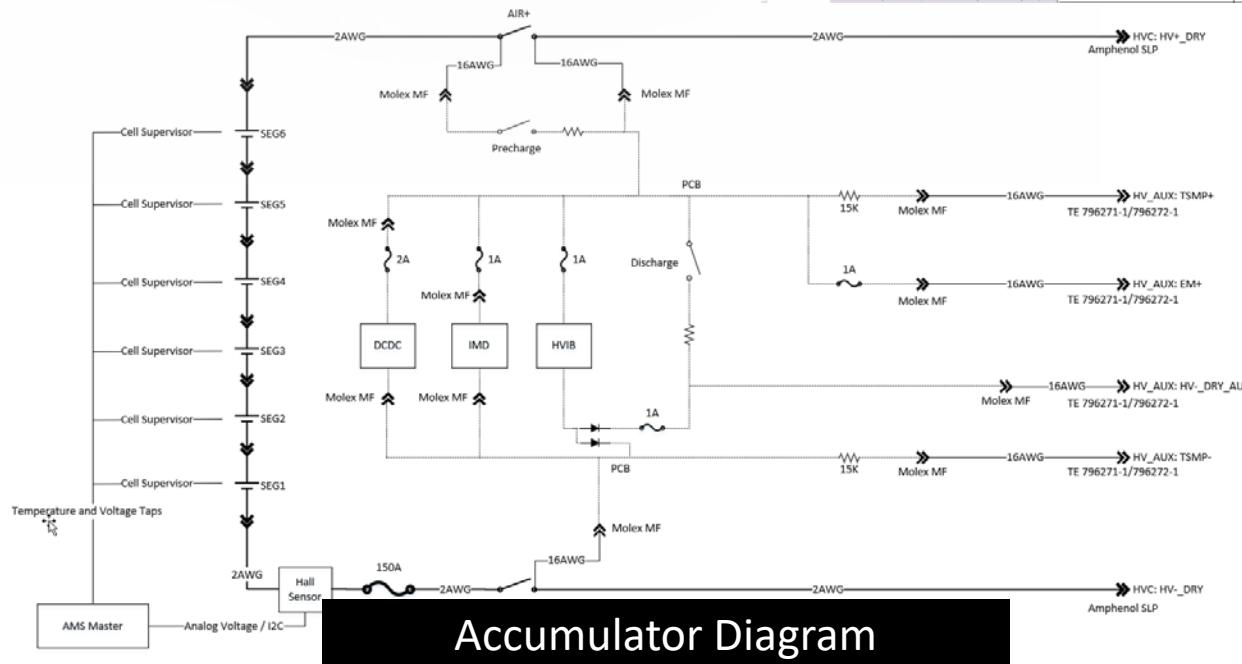


2021 Preliminary Accumulator

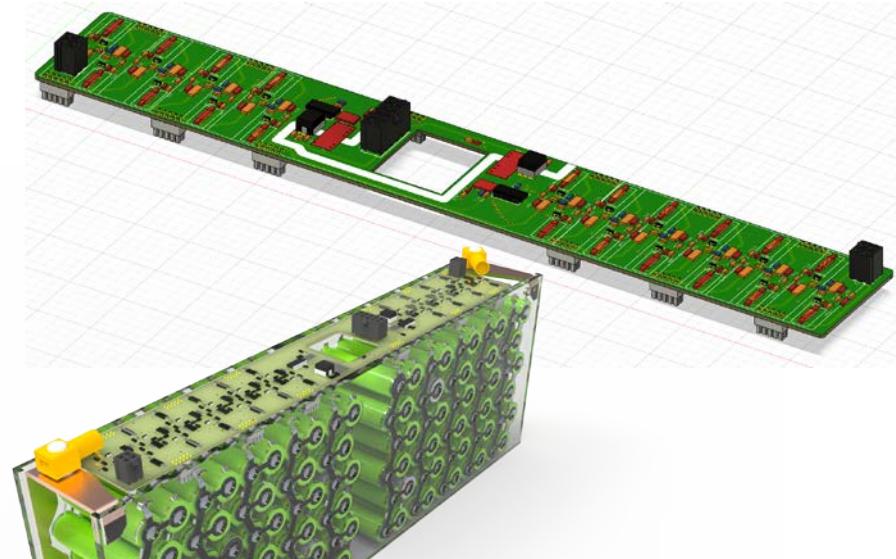


Preliminary System Specifications

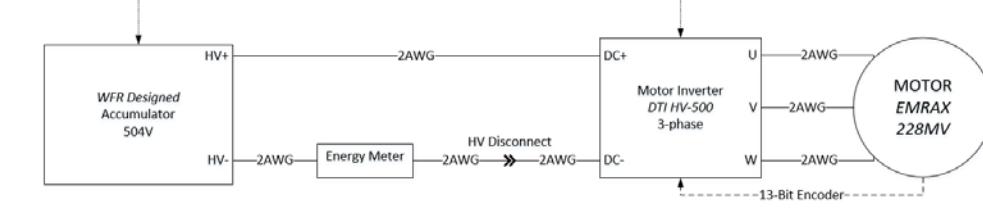
Nbr LTS Input	Nickname	2019/2020	6 Module Wide 6P 500V DTI	7 Module Wide 7P 450V ScMo
ACCUMULATOR_P_Count	Module S Count	7	6	7
Module Count	Cell Count	19	20	18
Cell Count	Cell Selection	5	6	6
Cell Nominal Capacity (mAh)	LG HG2	695	729	750
Cell Rated Current A	Sony VTC6	3.008	3.120	3.120
Cell Peak Voltage		29	30	30
Cell ESR @0m		4.29	4.20	4.20
Module Peak Voltage		30.09	21.88	21.80
Module Peak Current A		79.8	84.0	75.6
Module Energy (J)		6,632.80	5,840.93	5,943.93
Pack Peak Charge Current A		14.40	16.00	15.24
Pack Peak Discharge Current A		14.00	18.00	21.80
Pack Energy (kWh)		5.43	7.49	7.66
Fractional Acc Case Mass Delta		1.09	1.20	
INVERTER	Inverter	RMS PM100DXR	GTI HV-500	SiMo (SC1 (2x) + Encoder)
	Inverter Position Sensor Interface	Resolver Native	Resolver + Adapter	602.00
	Inverter Output Voltage Volc	400.00	360.00	356.00
	Inverter Current Limit Arms	400.00	360.00	356.00
	Inverter Mass Kg	7.50	6.70	5.00
	Inverter Cost \$	\$7,500.00	\$4,360.00	\$16,024.00
MOTOR	Motor	Emrax 228 MV	Emrax 228 MV	2x SiMo SY31 +
	Motor Current Arms	340.00	340.00	126.00
	Motor Voltage @ MaxRPM	500.00	500.00	456.00
	Motor Specific Load Speed RPM/Vdc	11.50	11.00	46.51
	Motor Specific Idle Speed RPM/Vdc	14.00	14.00	14.00
	Motor Mass Kg	12.00	12.00	11.00
	Motor Peak Torque Nm	240.00	240.00	136.00
	Motor Max Torque RPM	6,500.00	5,560.00	20,002.00
	Motor Cost \$	400.00	500.00	456.00
	Maximum Accumulator Voltage Permitted	500.00	500.00	20,002.00
	Motor Max Speed RPM (DCIR Dreq)	4,389.00	5,544.00	20,002.00
	Motor Max Speed RPM (DCIR Dreq)	5,560.00	6,560.00	20,002.00
	Motor Max Speed RPM (DCIR Dreq)	4.00	4.00	4.00
	ESTIMATION	Idle Cell Voltage (4.2V - 10% FeC)	60.00	60.00
	Accumulator Load Current A (Study State)	60.00	60.00	52.00
	Loaded Accumulator Voltage (DCIR Dreq)	355.57	459.87	414.45
	DC Bus Power kW	21.33	21.15	21.55
	Motor Max Speed RPM (DCIR Dreq)	3,911.29	5,358.57	10,276.56
	Motor Max Speed RPM (DCIR Dreq)	4,978.00	6,138.19	10,276.56
DRIVETRAIN	Drive Type	Double Reduction	Double Reduction	
	Final Drive	Optimized	Optimized	
	Final Drive Ratio	3.85	4.30	13.00
	Wheel Diameter in	18.00	18.40	18.40
	Max Wheel Torque Nm	924.00	1,312.00	1,322.00
	Max Vehicle Speed km/h (8% Loss from Spastic Idle Speed)	504.79	121.35	126.10



Bespoke BMS



Vehicle Diagram

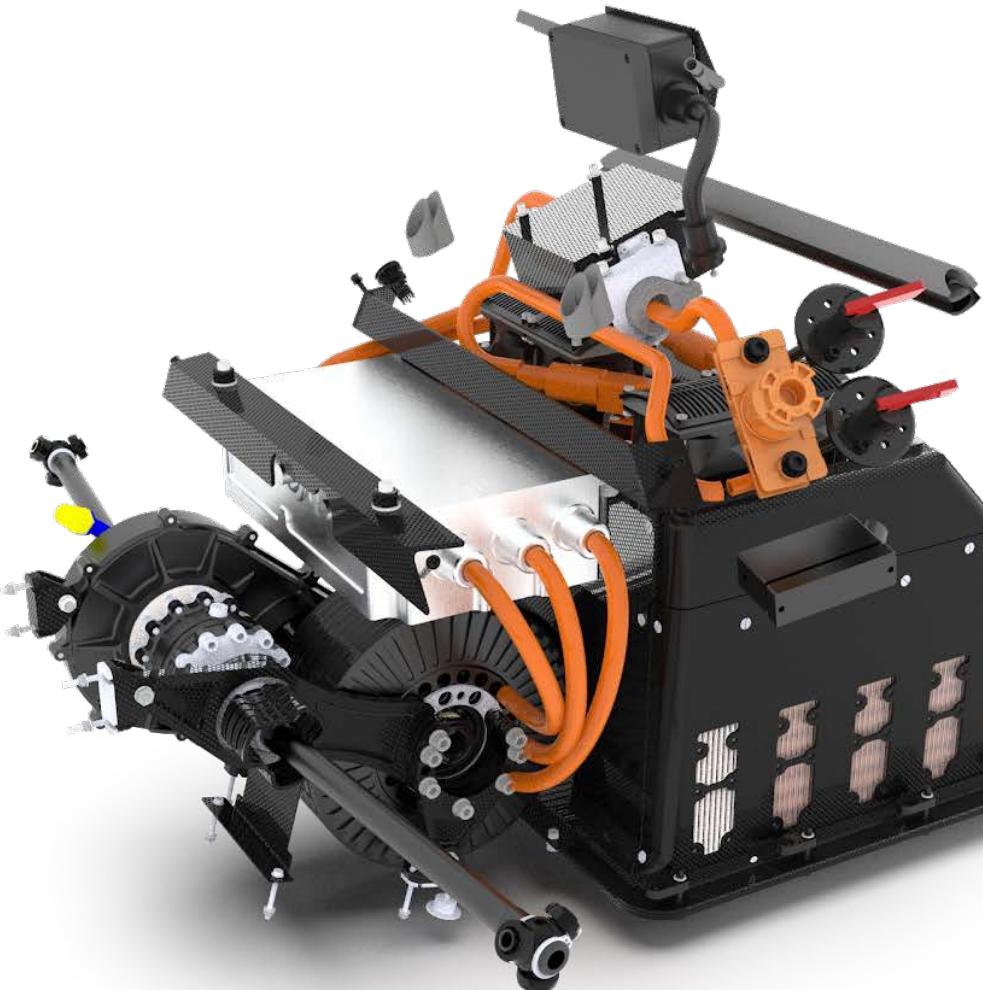




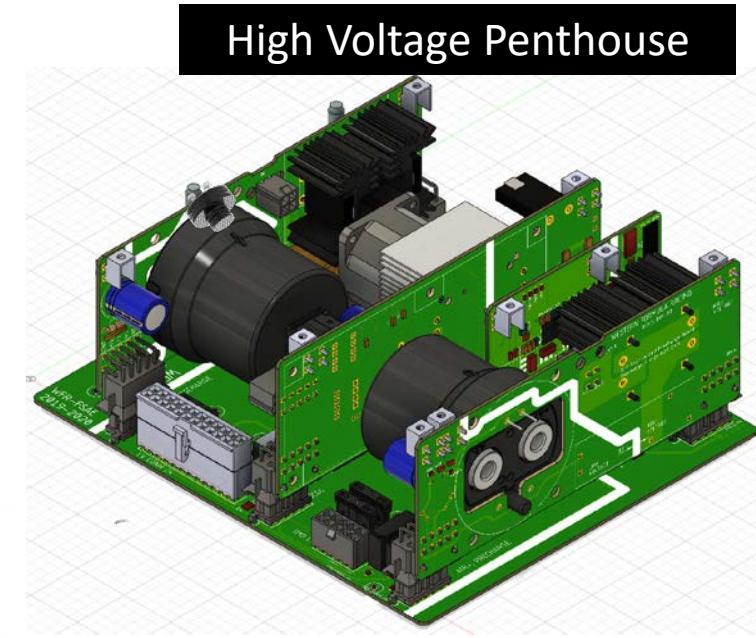
2020 WFR Energy Accumulator Lead

- 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





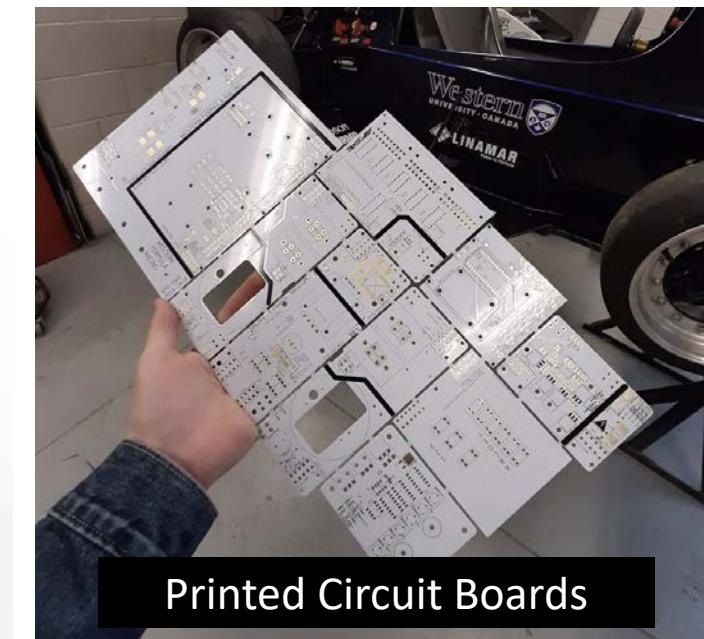
Propulsion System Rendering



High Voltage Penthouse

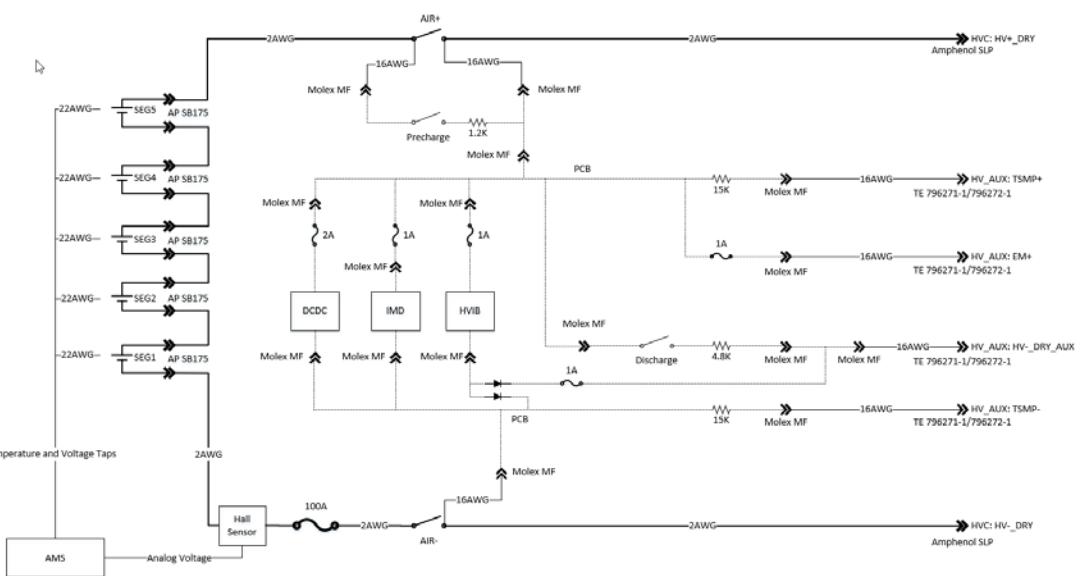
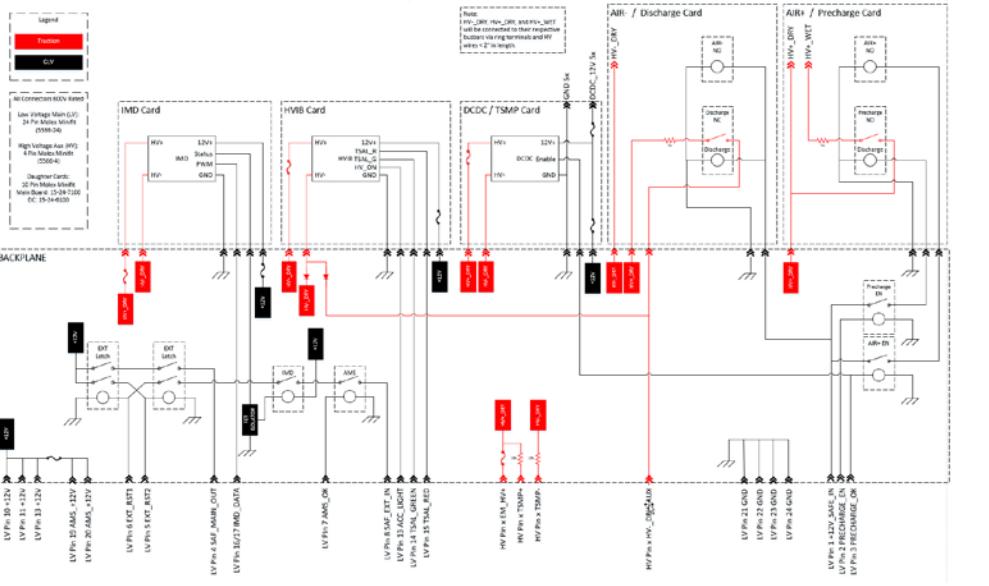


High Voltage Penthouse

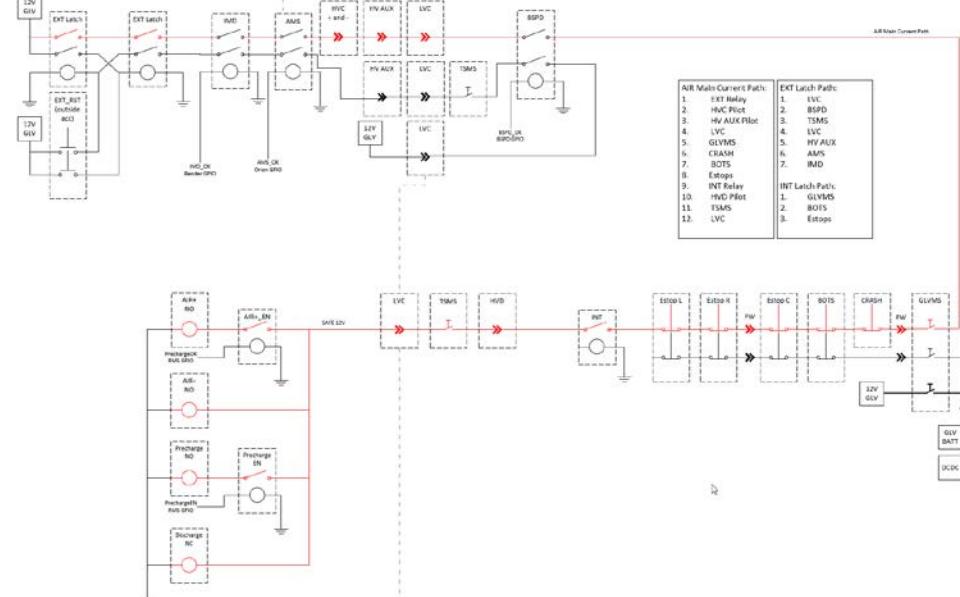
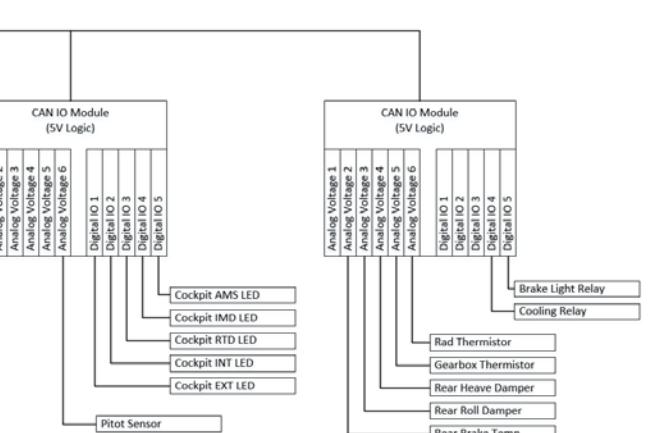
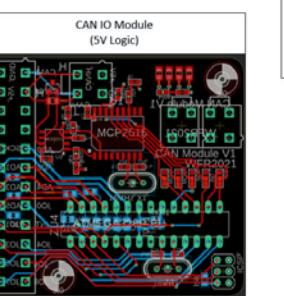


Printed Circuit Boards

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



Design Synthesis, Documentation, & Knowledge Transfer





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

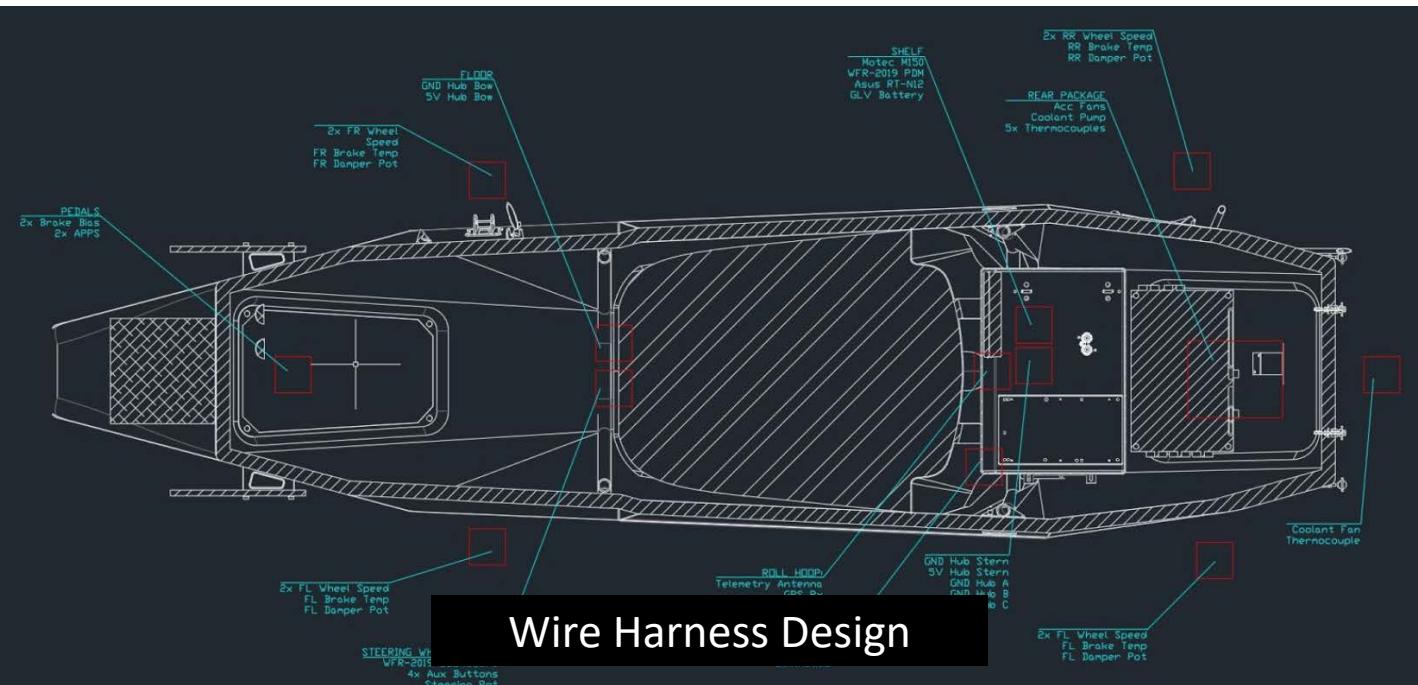
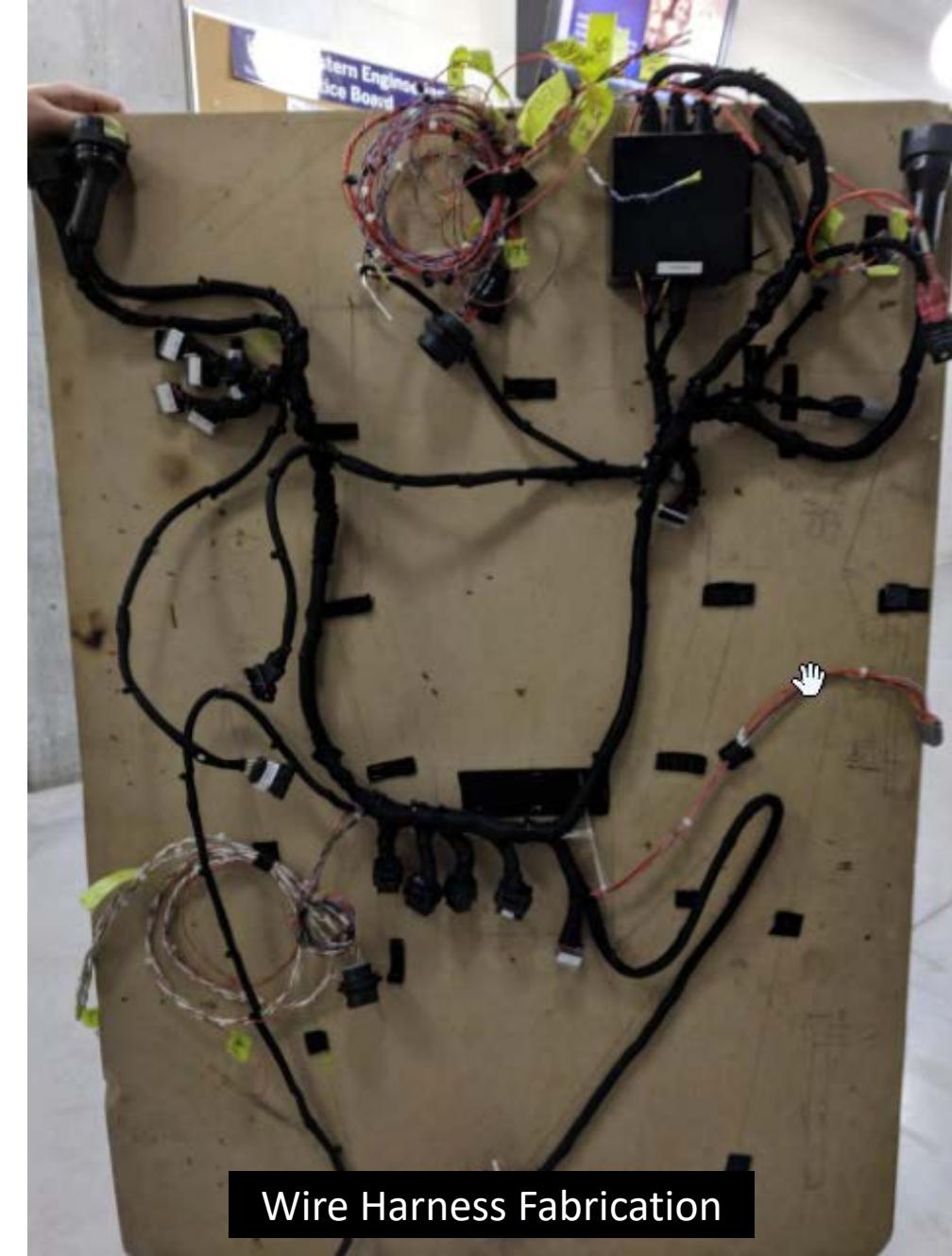
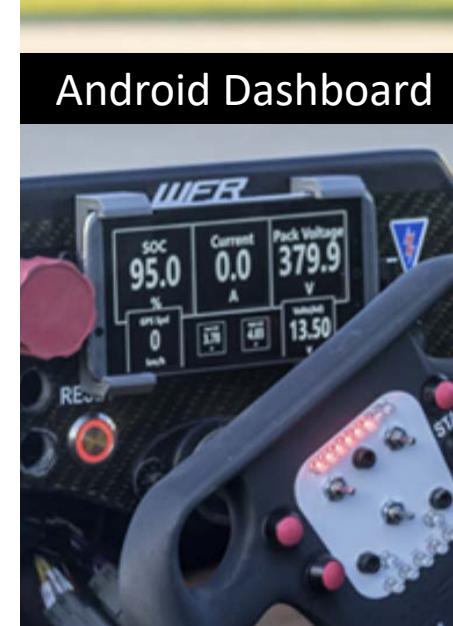
Workshop on

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 100-000-000





WFR19-E Glamour Shots

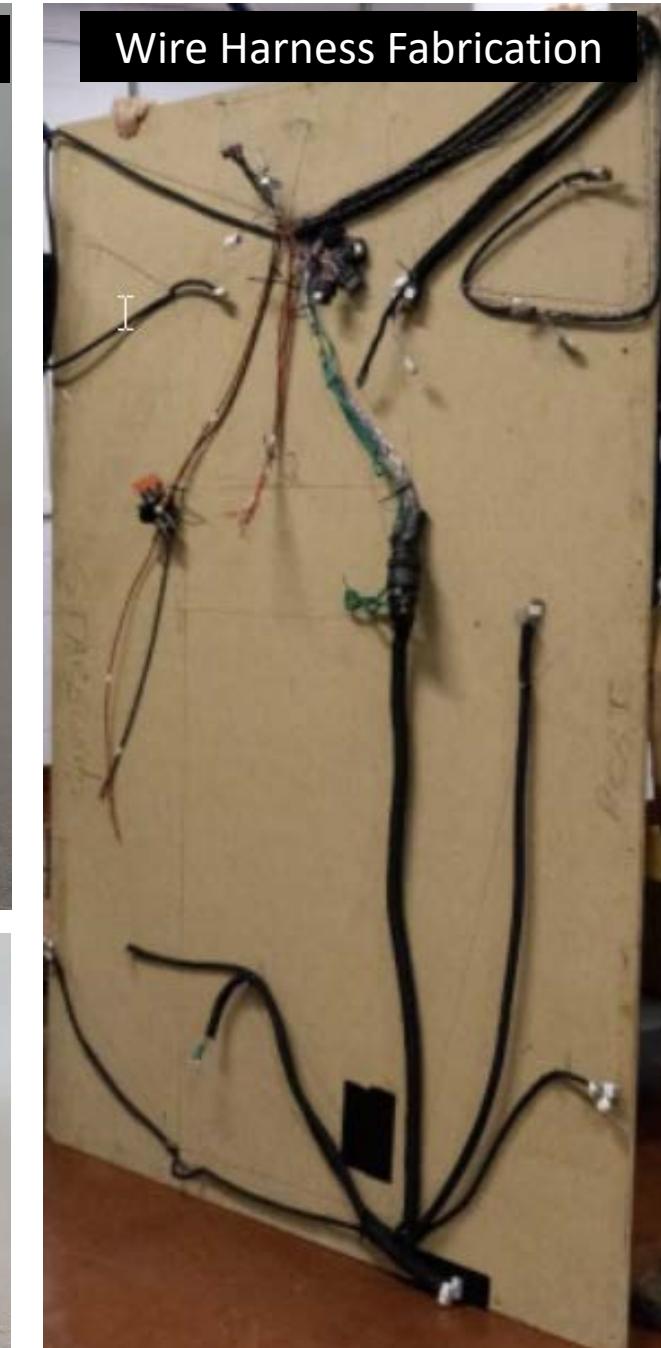
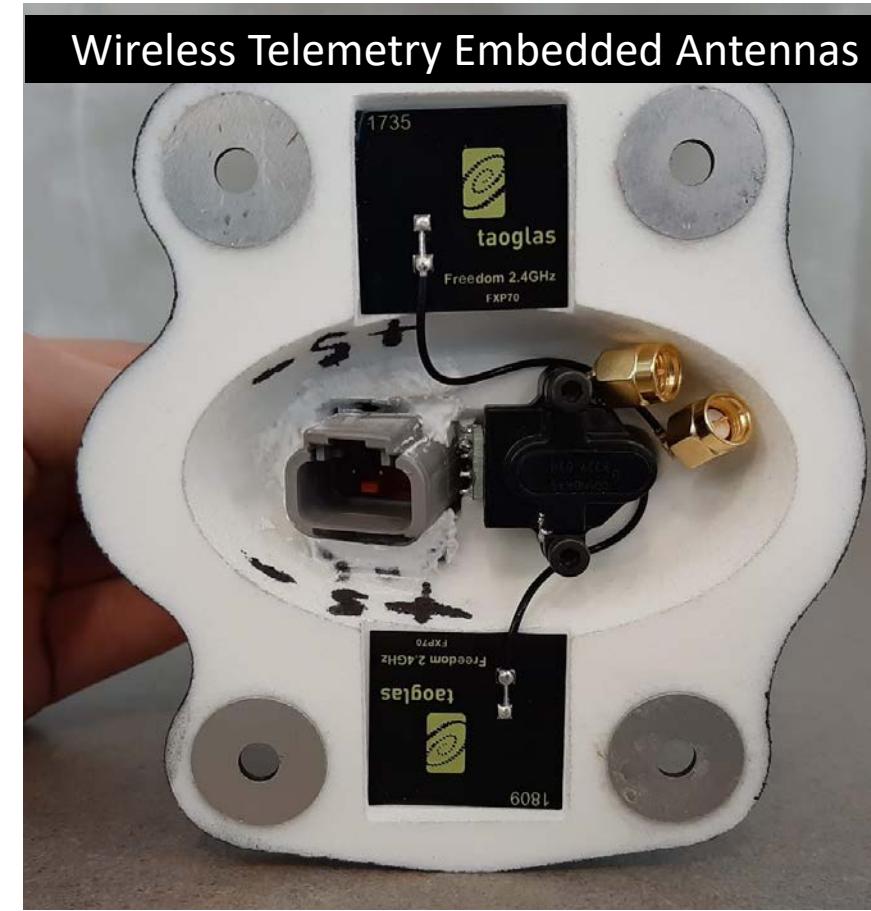
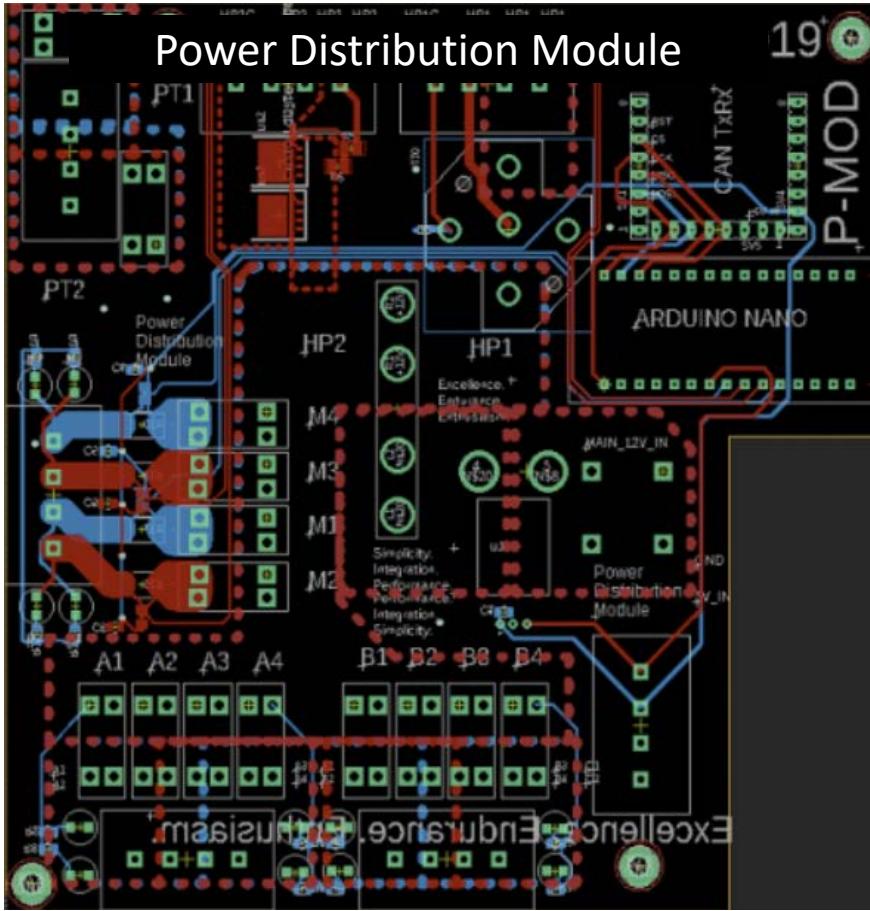




2018 WFR Electrical Member

- 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

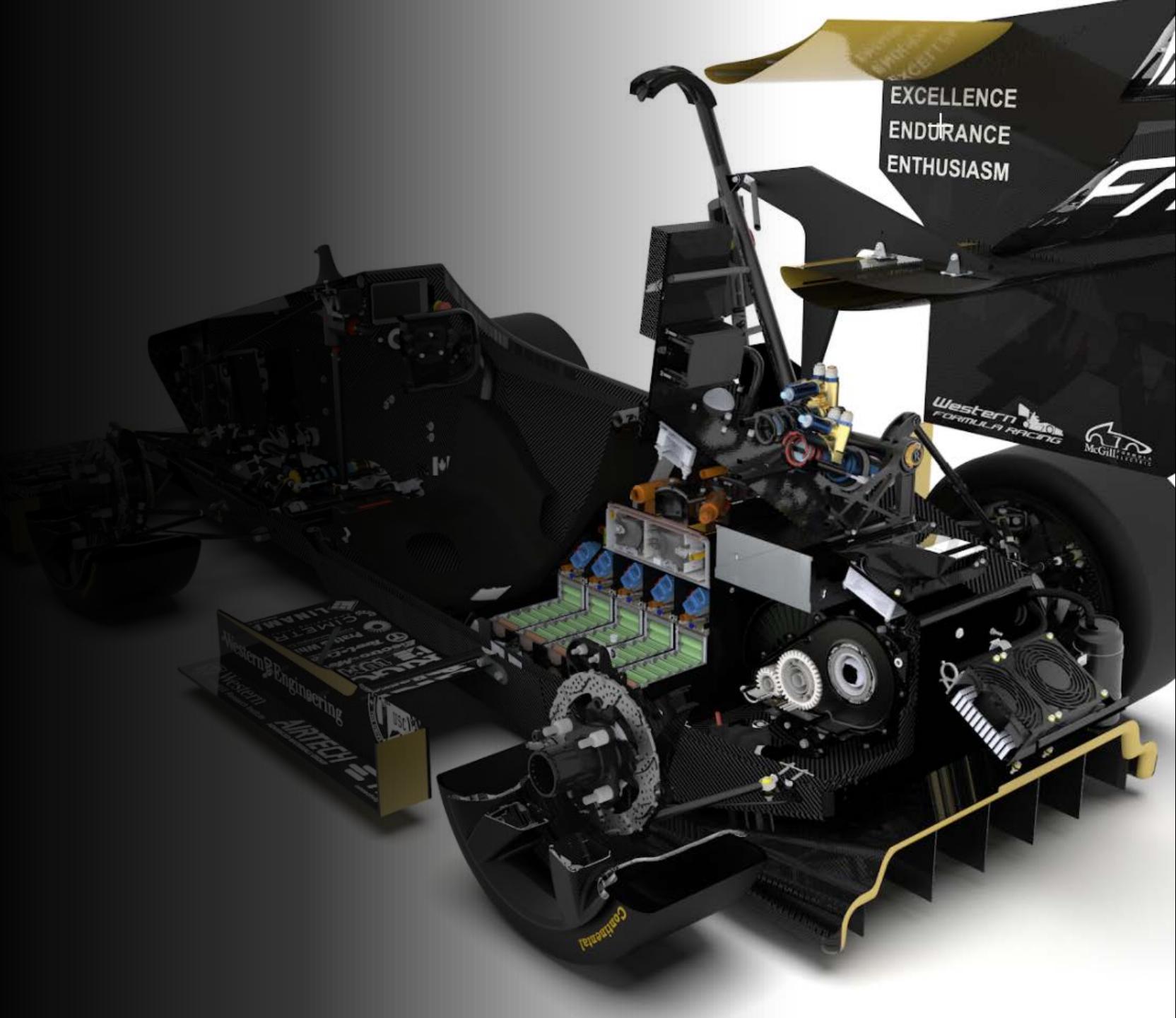
Photorealistic renderings of
Solidworks models via Keyshot

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

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





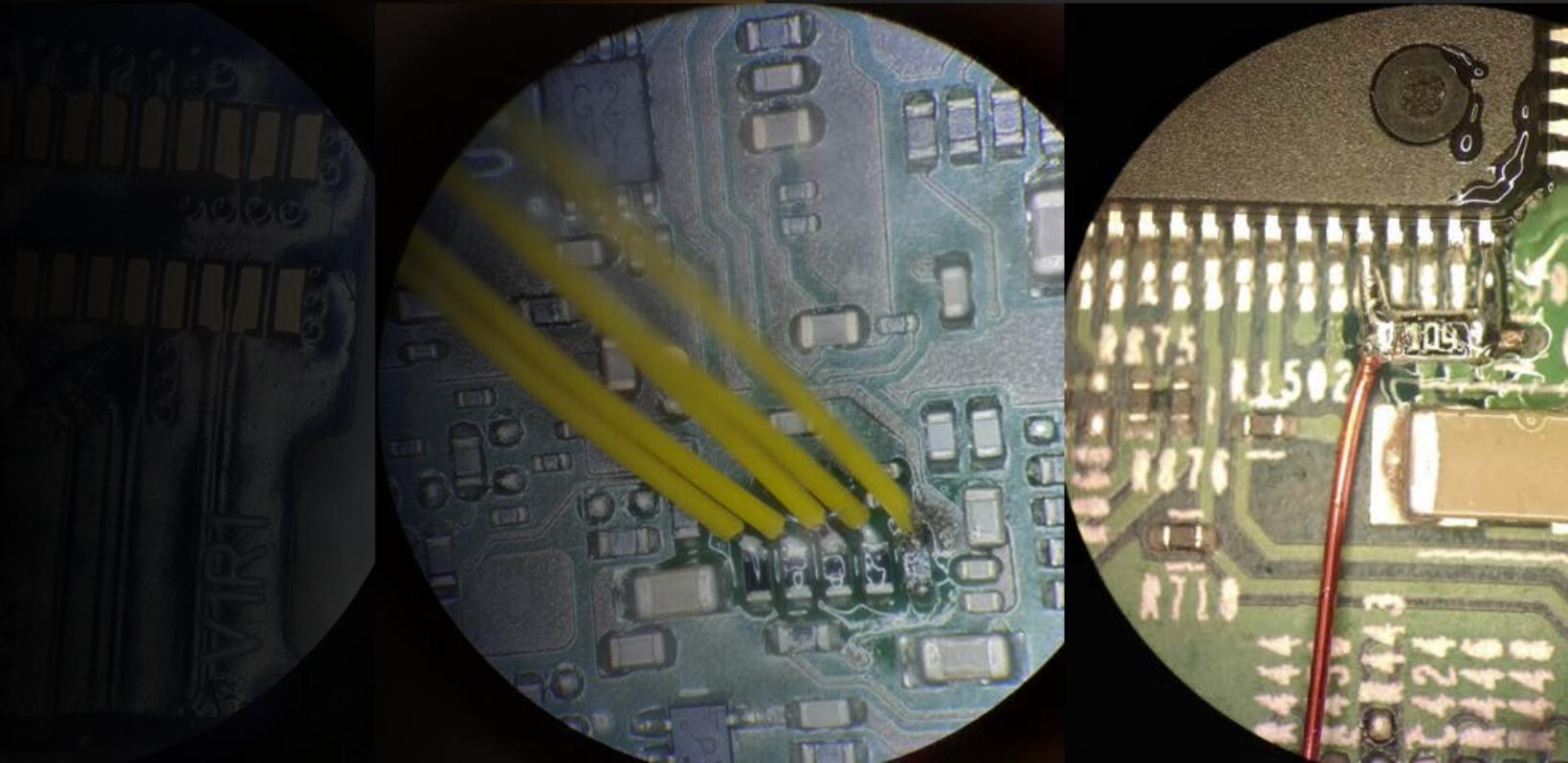
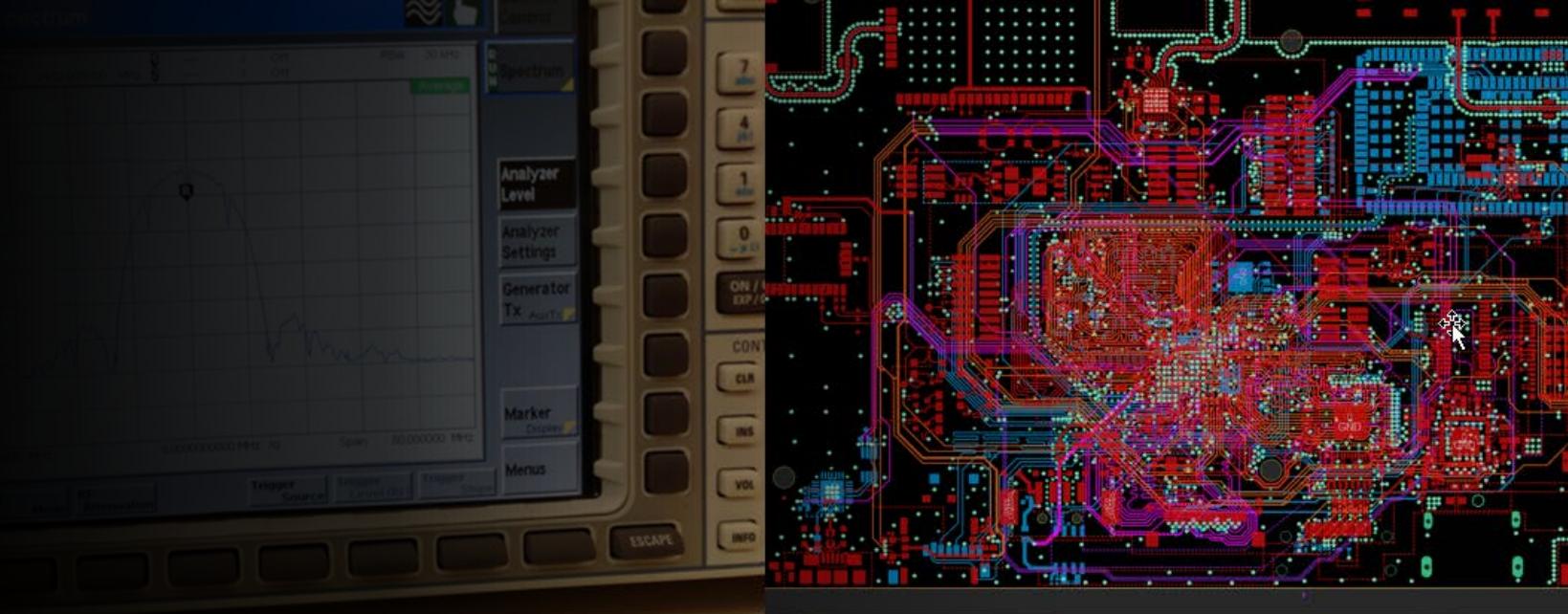
Swift Labs 8-month Co-op

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

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

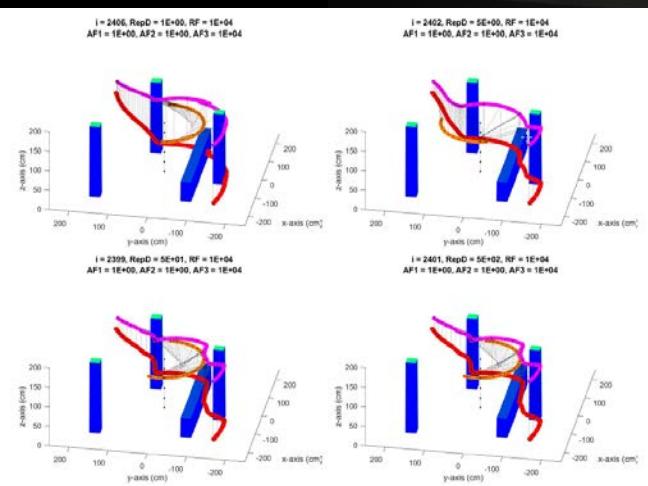
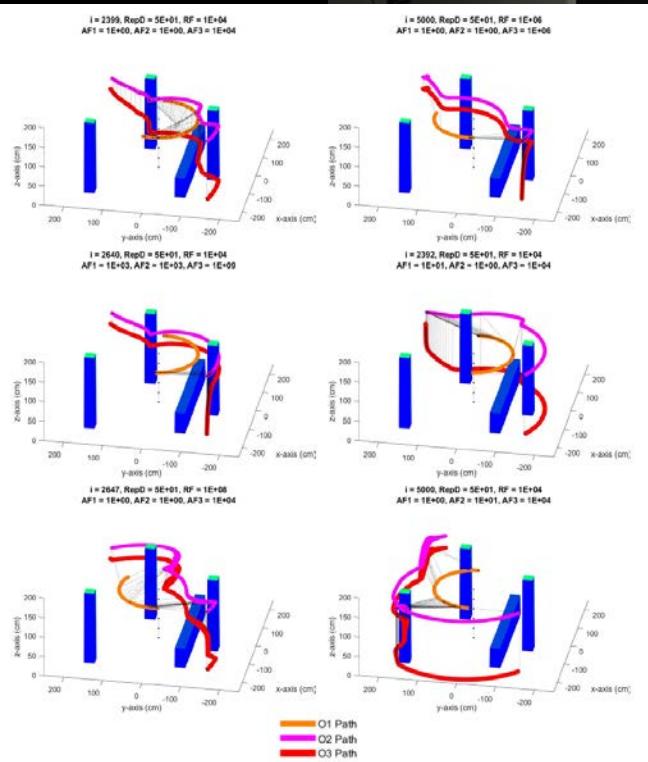


Bachelor of Engineering Science
Mechatronics Engineering 2021
Dean's Honour List



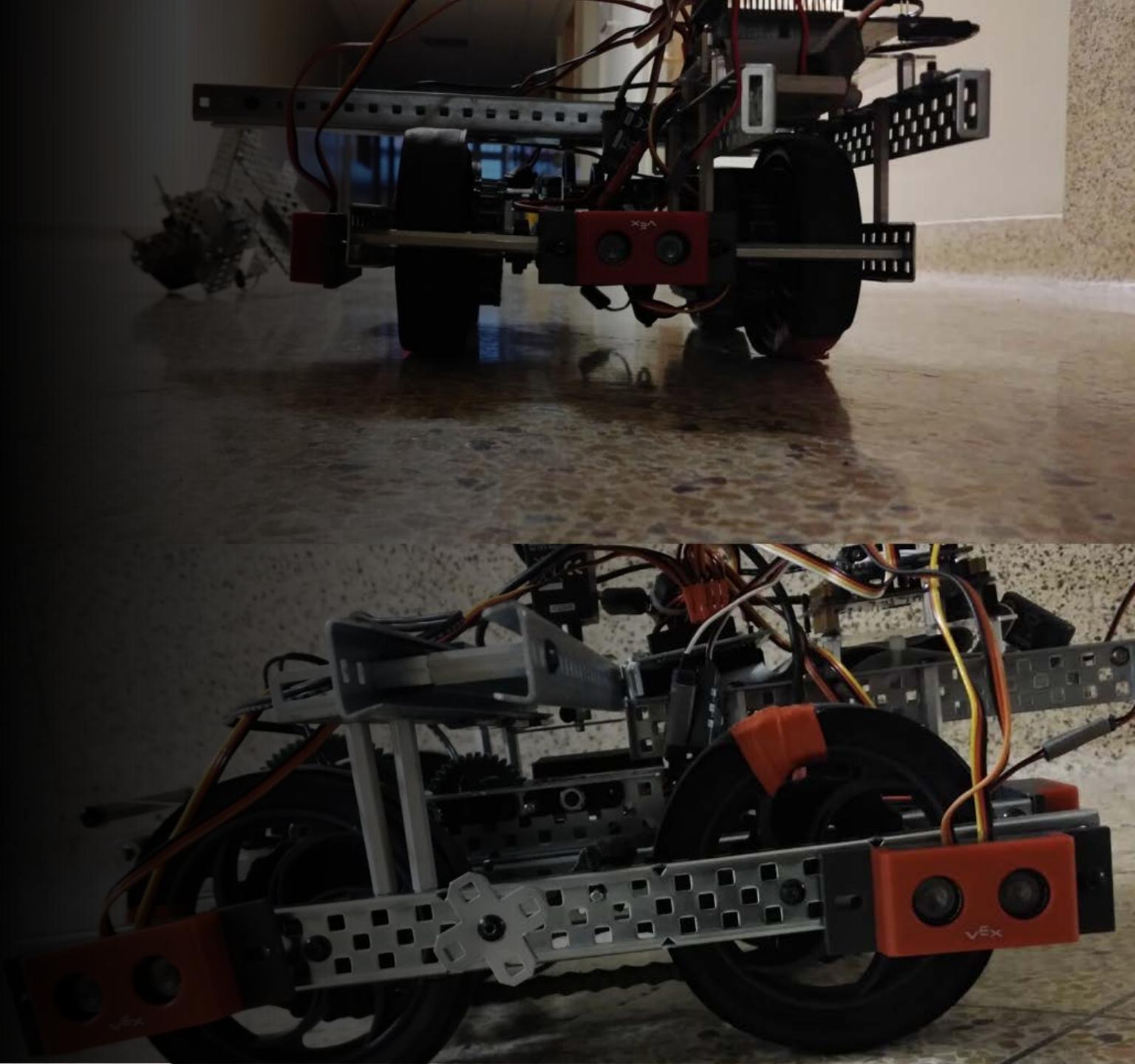
MSE4401 Path Planning

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

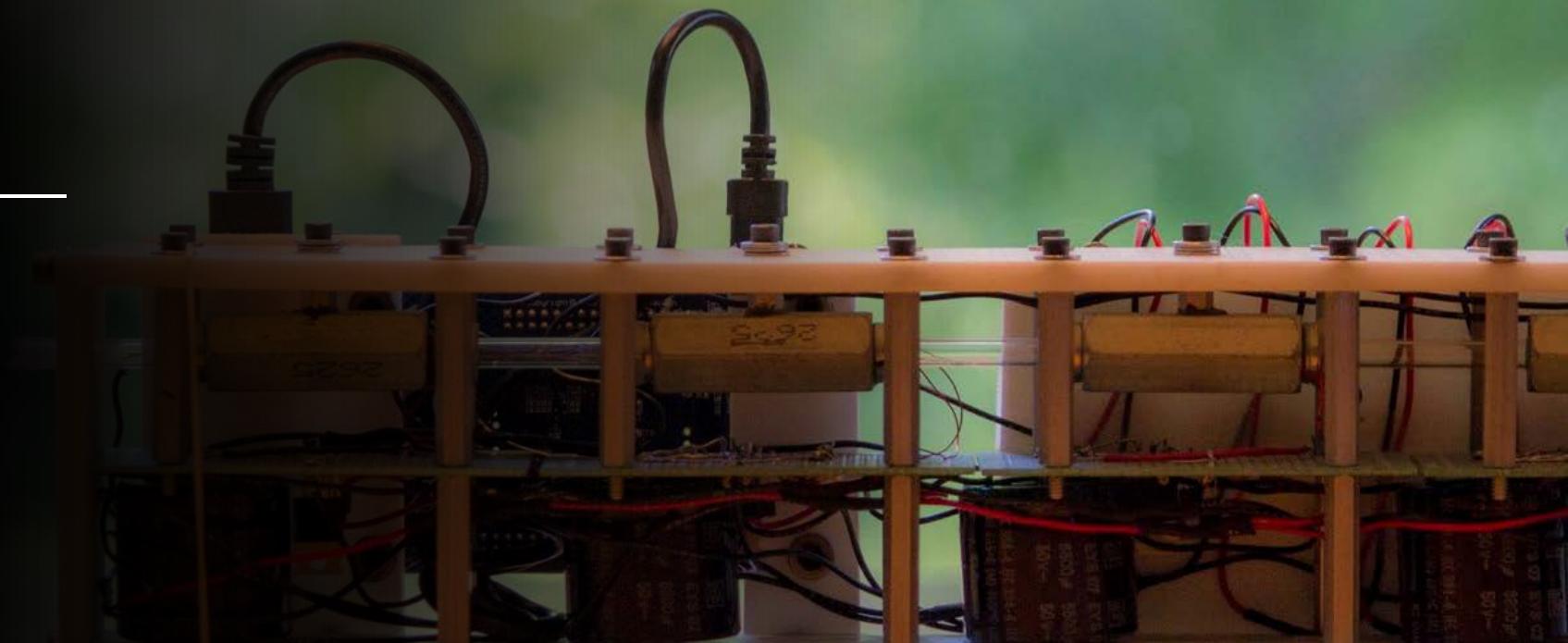
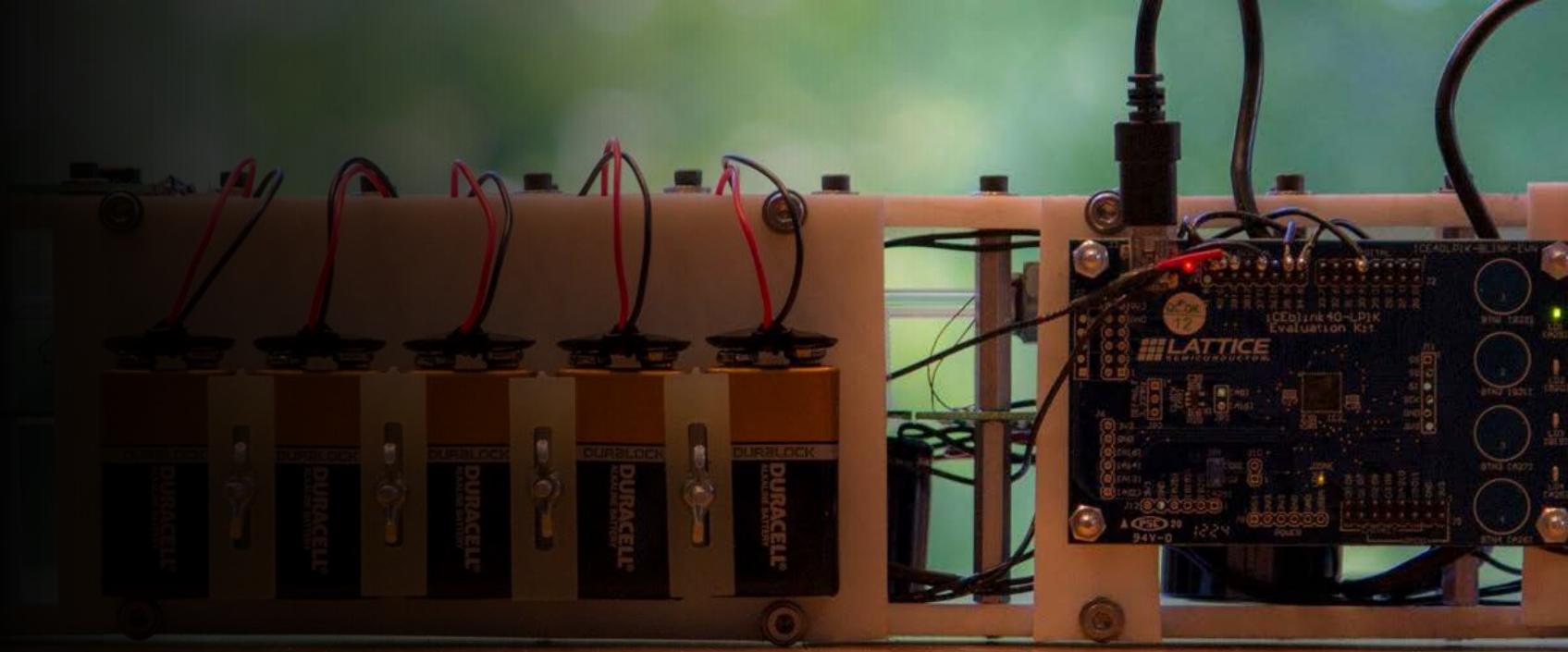


MSE2201 Autonomous Robot

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

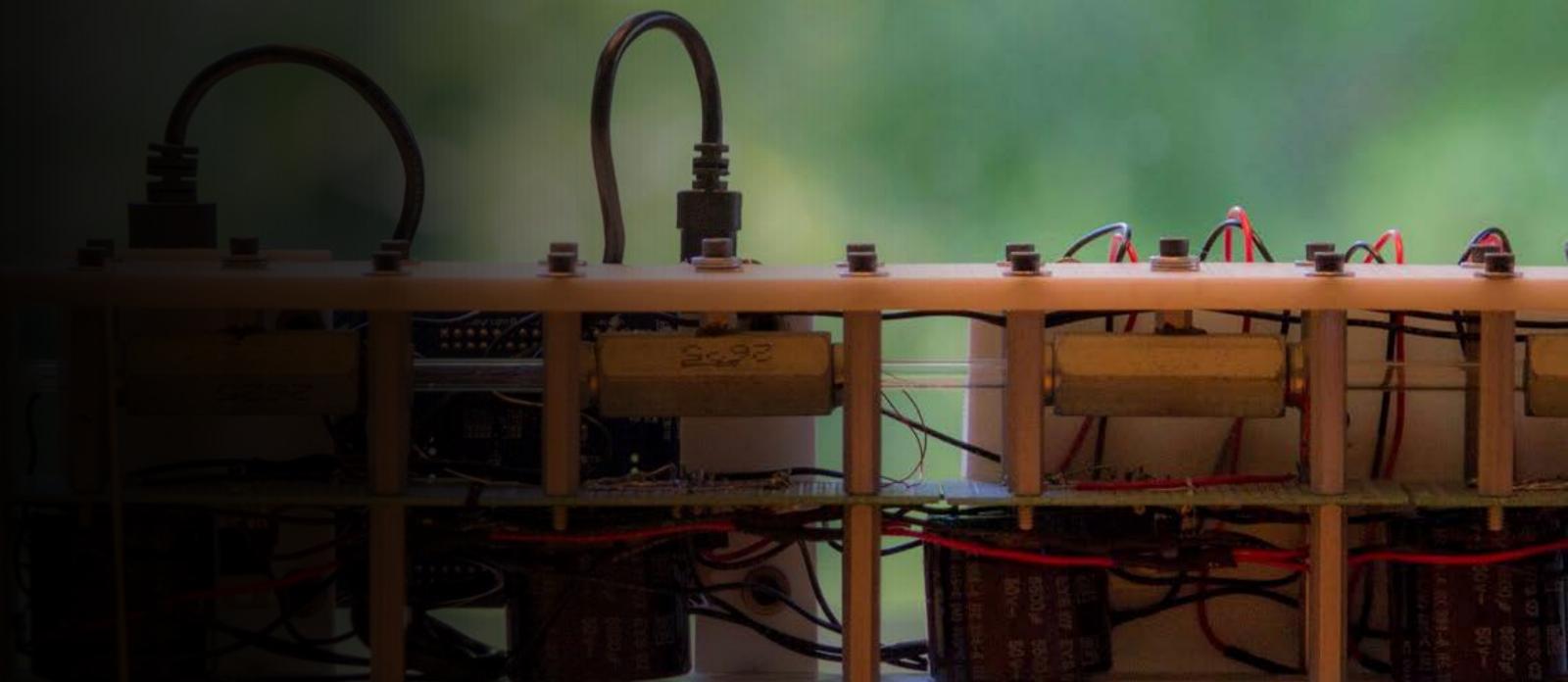
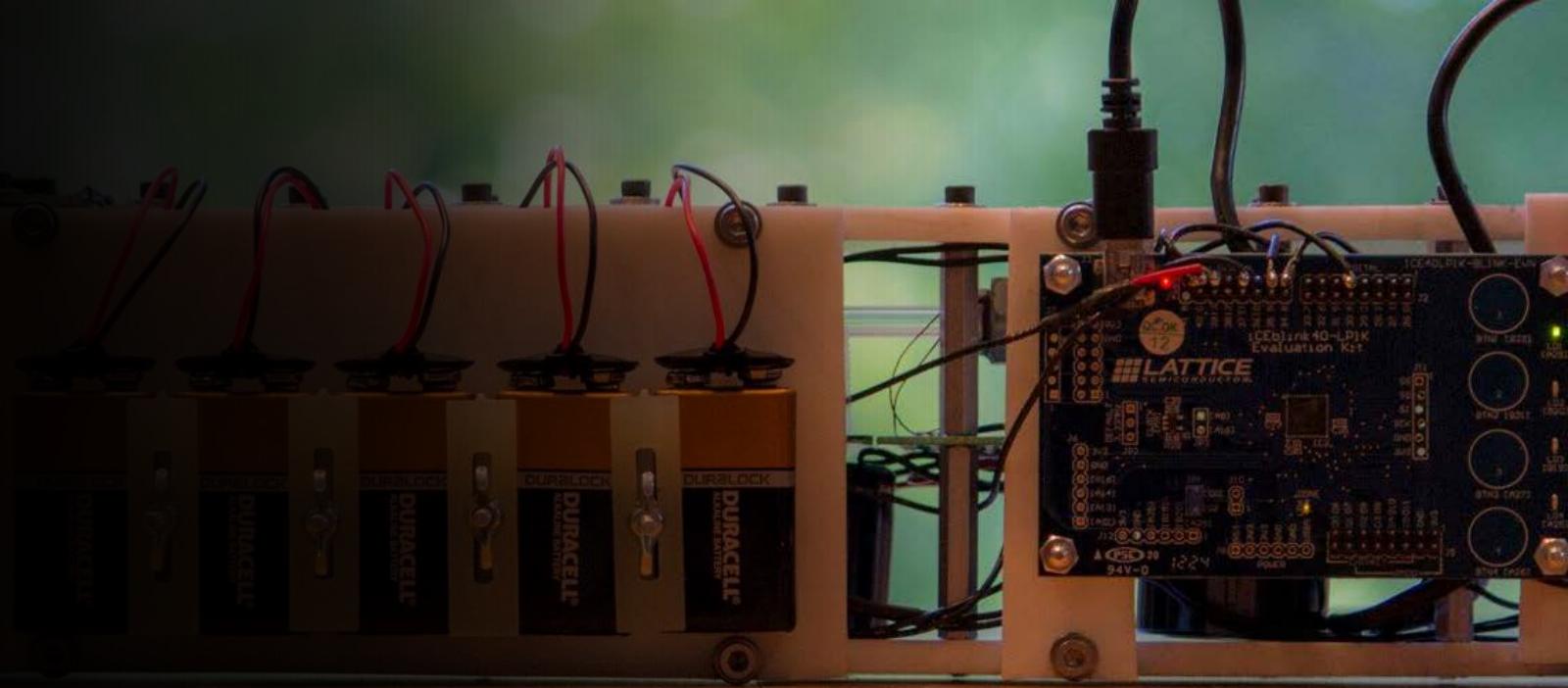


Personal Projects



Home-built Linear Accelerator

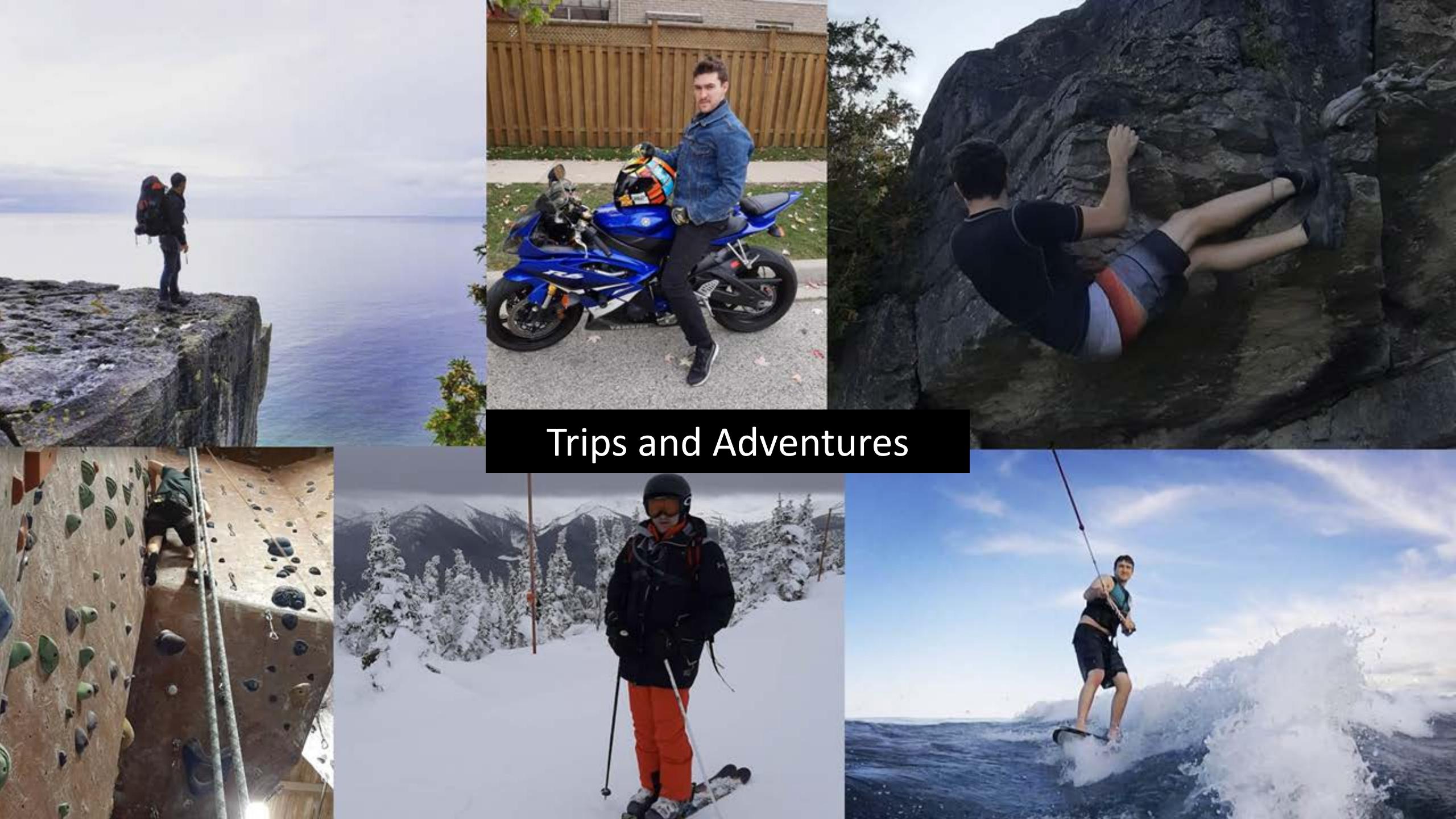
- Four-stages
- 6800uF Caps
- 48V
- MOSFET Switches
- FPGA Controlled
- [YouTube Video](#)



Computers and Networking

- 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
 - Hosted on Github Pages
 - Modified HTML5 template





Trips and Adventures