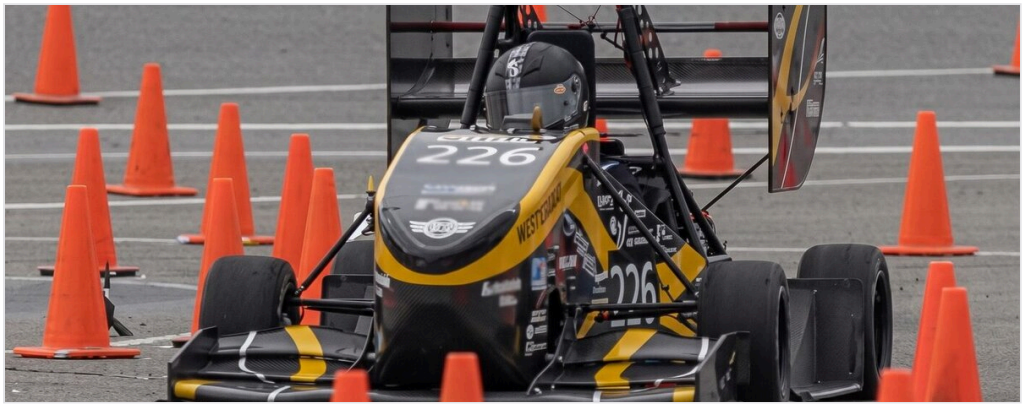
MECHANICAL ENGINEERING PORTFOLIO

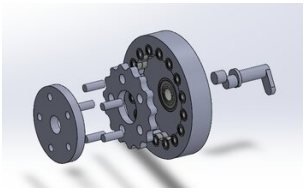
Anjan Melkote

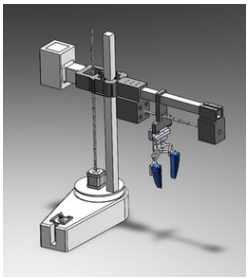
Mechanical Engineering student at the **University of Waterloo** (B.A.Sc. Honours Co-op, GPA 3.8/4.0, President's Scholarship), graduating **May 2027**. Six co-op terms in automotive, manufacturing and product design, most recently at **Tesla**.

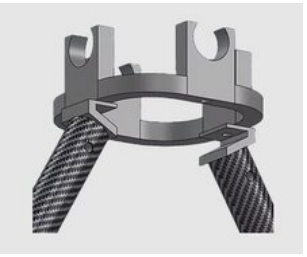
(226) 899-7506 amelkote@uwaterloo.ca linkedin.com/in/amelkote anjanmelkote.me











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Owens Corning

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Alchemy Nano

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Personal Project

07 Drag Reduction System Aerodynamics
UW Formula Electric (Formula SAE)

08 Weigh Hopper Protective Cover
Owens Corning

09 Electric Drive Assembly Line 3D Layout
Skyjack Inc. (Linamar)

CO-OP EXPERIENCE

- Tesla
- Alchemy Nano
- Owens Corning
- BIMQP
- Delta Elevator
- Skyjack (Linamar)

DESIGN TEAMS

- UW Automotive Future Team (UWAFT)
- UW Formula Electric
- Waterloo Aerial Robotics Group (WARG)

TOOLS

SolidWorks · CATIA V5 · 3DEXPERIENCE · Siemens NX · Inventor · Onshape · ANSYS · HyperMesh · GD&T (ASME Y14.5) · DFM/DFA/DFR · Python · C/C++ · MATLAB Simulink

RESEARCH

Undergraduate Research Assistant, Nishida Lab

Supervisor: Dr. Robert Nishida, University of Waterloo

Modeling and Validation of Particle Sensor Time Response Characteristics using CFD

ANJAN MELKOTE

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PROJECT 01

Triaxial UV Sensor Detection Assembly

Owens Corning · Manufacturing Engineer Intern · Scarborough, ON · Jan to Apr 2025

+75%	−40%	Site-wide
DETECTION RATE	MTTR	ROLLOUT

WHAT

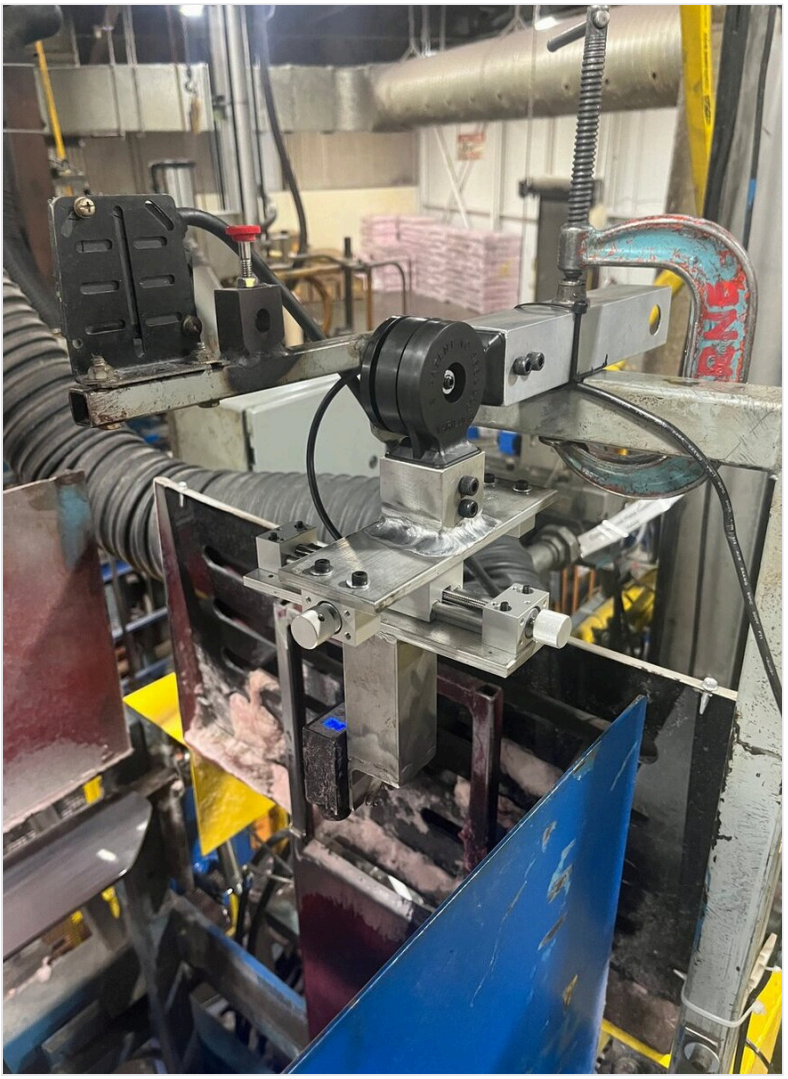
- Adjustable mount that lets a **UV sensor** detect glue strips on insulation before packaging
- **Triaxial** positioning with **XY lead screws** plus a hinge for angular adjustment
- Built to survive line vibration, corrosion and glass fibre build-up

HOW

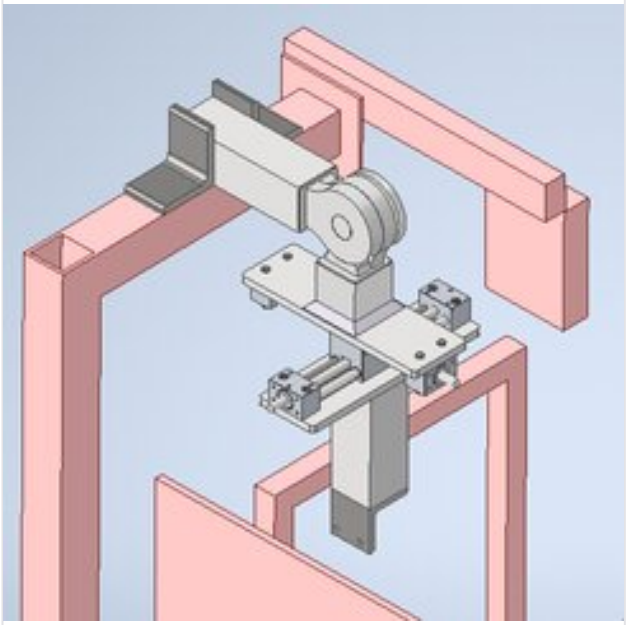
- Owned the design from concept through CAD, prototyping, drawings, install and ops validation in **Autodesk Inventor**
- Built **3D-printed** proof-of-concept prototypes before committing to fabrication
- Ran **FEA** on the main arm to check deflection under load
- Applied **DFM/A**: planned spares, welds, fasteners and material choice to minimize BOM and machining cost
- Released detailed fabrication and assembly **drawings**

RESULTS

- Raised sensor detection rate **75%** in operations trials
- Cut **MTTR 40%** and increased **OEE** and **MTBF**
- Implemented **site-wide** after validation, with positive operator and supervisor feedback



Installed assembly on the production line



Inventor model of the triaxial mount

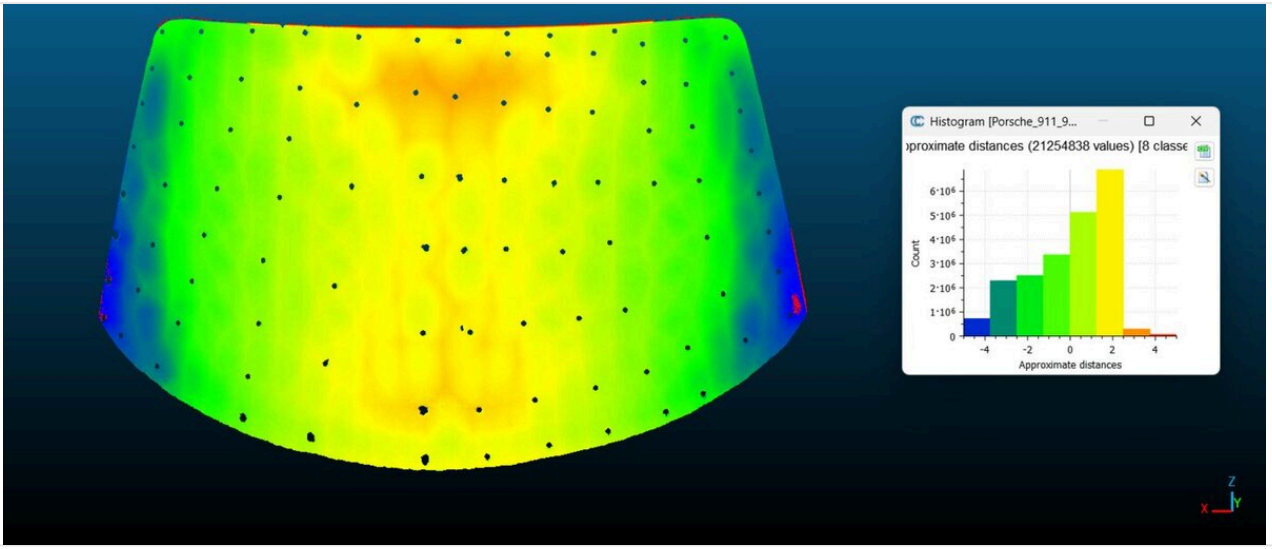
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PROJECT 02

Windshield Protection Film Thermoforming Moulds

Alchemy Nano · Mechanical Design Engineer Intern · Kitchener, ON · Sep to Dec 2025

8+	−15%	+10%	−20%
PRODUCTION MOULDS	CYCLE TIME	FIRST-TIME YIELD	SCAN PROCESSING TIME



CloudCompare check of the mould against the windshield scan, 21.25 million points

WHAT

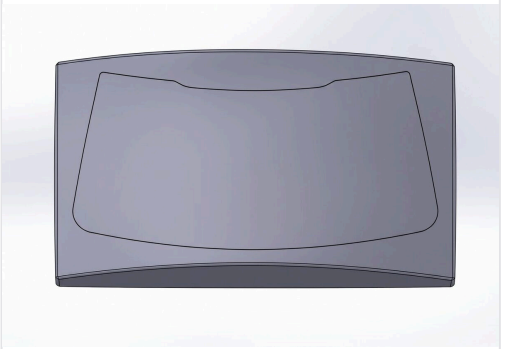
- Production thermoforming moulds for **Tesla** and **BMW** windshield protection film (WPF) programs
- Reverse engineered windshield geometry from high-precision **3D scan** data
- Owned each mould end to end: scan mesh, CAD, **PLM** release, validation and final product testing

HOW

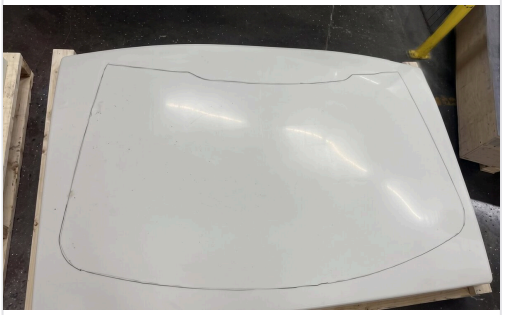
- Captured glass geometry with **Einstar 3D scanners** and verified repeat scans in **CloudCompare** with deviation maps and histograms
- Surface-modelled the windshield and designed production moulds in **SolidWorks**, released through **PLM**
- Automated scan refinement and meshing with a **Python** pipeline
- Ran forming trials, tuned **temperature and pressure profiles** and revised dies from the test results

RESULTS

- **8+ production-grade moulds** released and manufactured from the CAD drawings
- Cut cycle time **15%** and raised first-time yield **10%** through trial-driven process and die changes
- Cut manual scan refinement and meshing time **20%**; workflow adopted for ongoing production



SolidWorks mould model built from verified scan data



Manufactured thermoforming mould

PROJECT 03

Autonomous 3-DOF Crane Robot

University of Waterloo

3 mm	95%	3 DOF
PLACEMENT PRECISION	TRIAL SUCCESS RATE	MOTION

WHAT

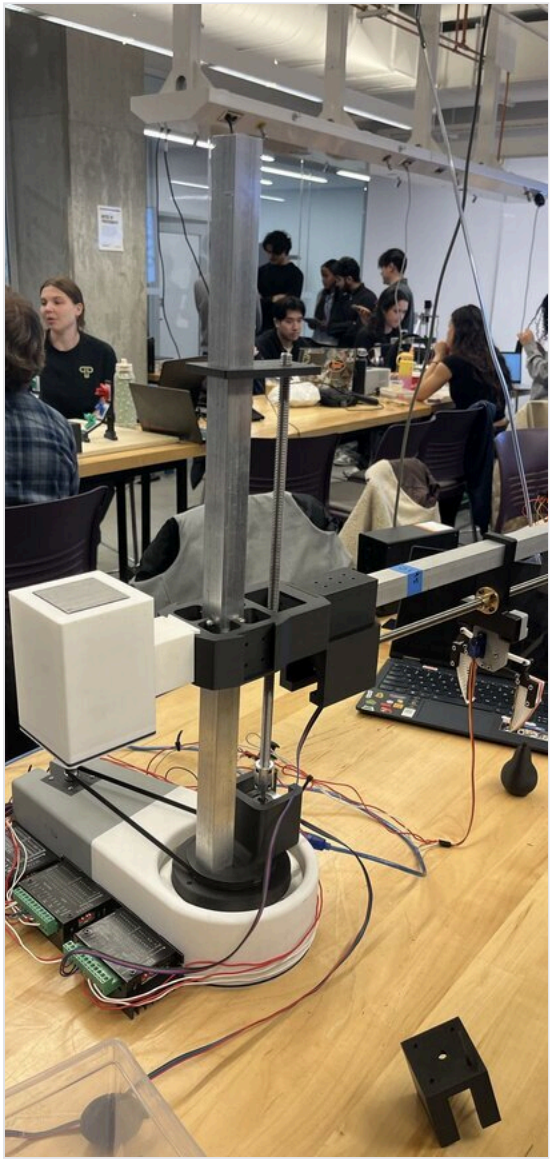
- Autonomous **3-DOF pick-and-place crane** that locates, grips and moves payloads without human input
- Designed for precision, range of motion and gripping irregular surfaces

HOW

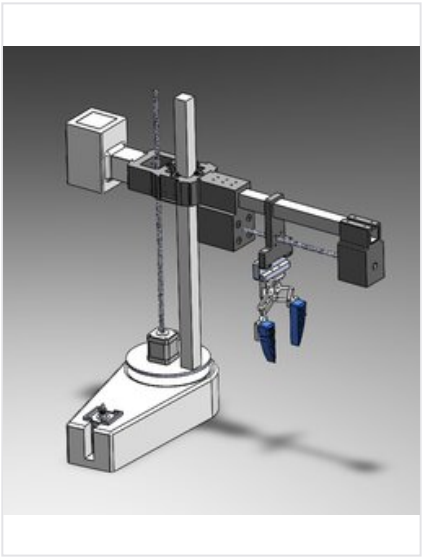
- Designed the full assembly in **SolidWorks** and programmed it in **C++** on an **Arduino Mega**
- **NEMA 17** steppers drive the lead-screw axes, a high-torque **NEMA 23** rotates the base and an **SG90** servo actuates the gripper
- Designed a custom **bearing carriage** in place of standard linear rails to cut mass
- Developed compliant **"Ray Fin"** end-effectors with **load-cell** force feedback
- Made drivetrain parts by **3D printing** and **machining** for reliable torque transfer

RESULTS

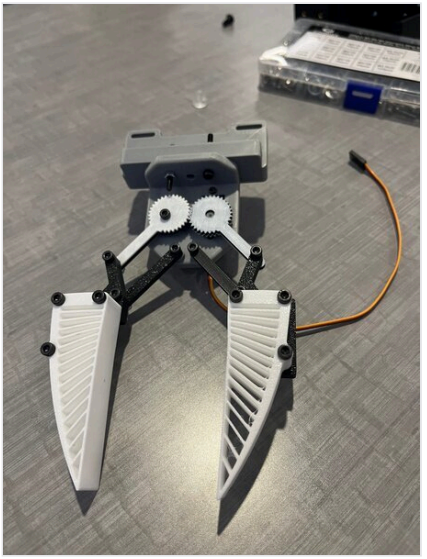
- **3 mm** placement precision with a **95%** success rate across trials
- Gripped complex shapes reliably with the custom ray-fin gripper



Final build at the design showcase



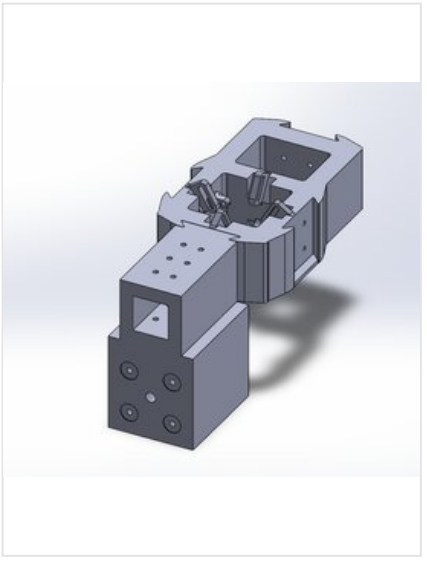
Full SolidWorks assembly



Printed ray-fin gripper



Ray-fin end-effector model



Custom bearing carriage

PROJECT 04

High-Torque Cycloidal Gearbox (15:1)

Personal Project · Robotics drivetrain

15:1	2
REDUCTION	OUT-OF-PHASE ROTORS

WHAT

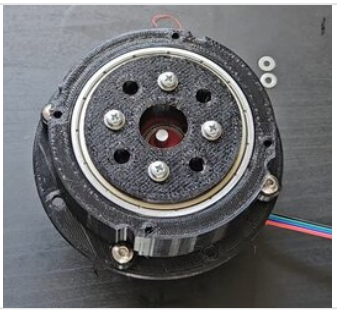
- Compact **15:1 cycloidal drive** for precision robotics with minimal backlash
- Two **out-of-phase rotors** cancel vibration and balance the load

HOW

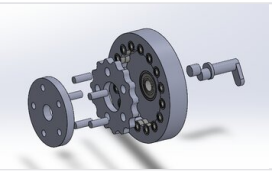
- Generated the cycloidal rotor profile in **SolidWorks**
- Ran static **FEA** on the disk under high bearing load from the motor input

RESULTS

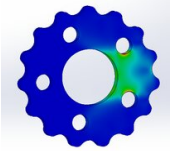
- Located fatigue-critical regions from **von Mises** stress and true-scale deformation plots
- Modular, manufacturing-ready design for **3D-printed** or **CNC-machined** parts



Printed prototype



Exploded assembly



Von Mises stress on the disk

PROJECT 05

Drone Landing Gear Assembly

Waterloo Aerial Robotics Group (WARG) · University of Waterloo

<400 g	3 g
TOTAL MASS	BREAKAWAY LOAD

WHAT

- Carbon-fibre landing gear for an x-frame drone with a **sacrificial joint** that fails first to protect the carbon tubes

HOW

- Designed in **SolidWorks** with material densities to hold the mass budget
- Sacrificial joint sized to snap above **3 g**; checked joint stresses with **FEA**
- Mounting points designed around standard **carbon fibre** tubing

RESULTS

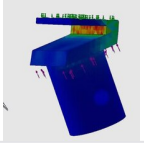
- Under **400 g** total, meeting flight-efficiency requirements
- Hard landings break a cheap printed joint instead of the frame; modular for quick replacement



Drone in the WARG bay



Mount and sacrificial joint



Joint stress study

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PROJECT 06

Smart E-Paper Display Module

Personal Project · Mechanical, electrical and firmware design

ESP32	10 to 14 days	3-part
CUSTOM PCB	STANDBY (EST.)	PRESS-FIT ENCLOSURE

WHAT

- Battery-powered photo frame built around a **Waveshare 4.2″ e-paper** display (400 × 300)
- microSD slideshow with one-button control, plus a **Wi-Fi** upload page with crop, portrait and rotate options

HOW

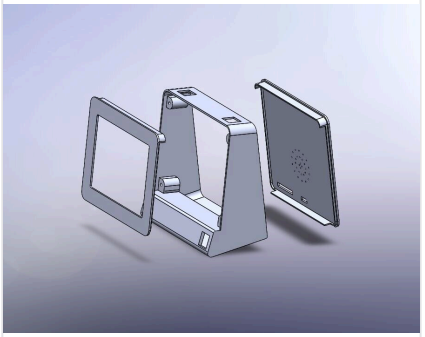
- Designed the **ESP32** schematic and PCB layout in **KiCad**, then hand assembled the board
- Power: **3.7 V 1000 mAh Li-ion** pack, **TP4056 USB-C** charging and an on-board boost converter
- Firmware puts the ESP32 in **deep sleep** between image changes to stretch battery life
- Iterated the enclosure three times in **SolidWorks** to a **3D-printed** 3-part press fit with USB-C and microSD access
- Debugged a refresh failure, a failed charger module and a serial baud mismatch on the bench

RESULTS

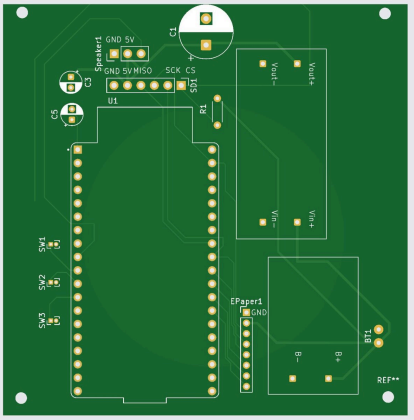
- Working frame with slideshow, pushbutton control and Wi-Fi photo upload
- Full charge in about **2 hours** at about 500 mA; standby **10 to 14 days** (estimate)
- Compact **108 × 114 × 58 mm** enclosure that charges and swaps cards without opening



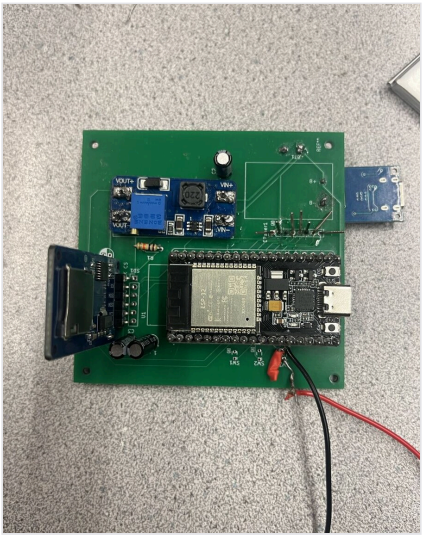
Finished frame



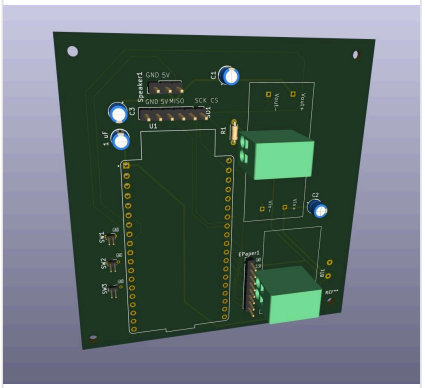
SolidWorks exploded view, 3-part enclosure



KiCad PCB layout



Hand-assembled ESP32 board



KiCad 3D render

ANJAN MELKOTE

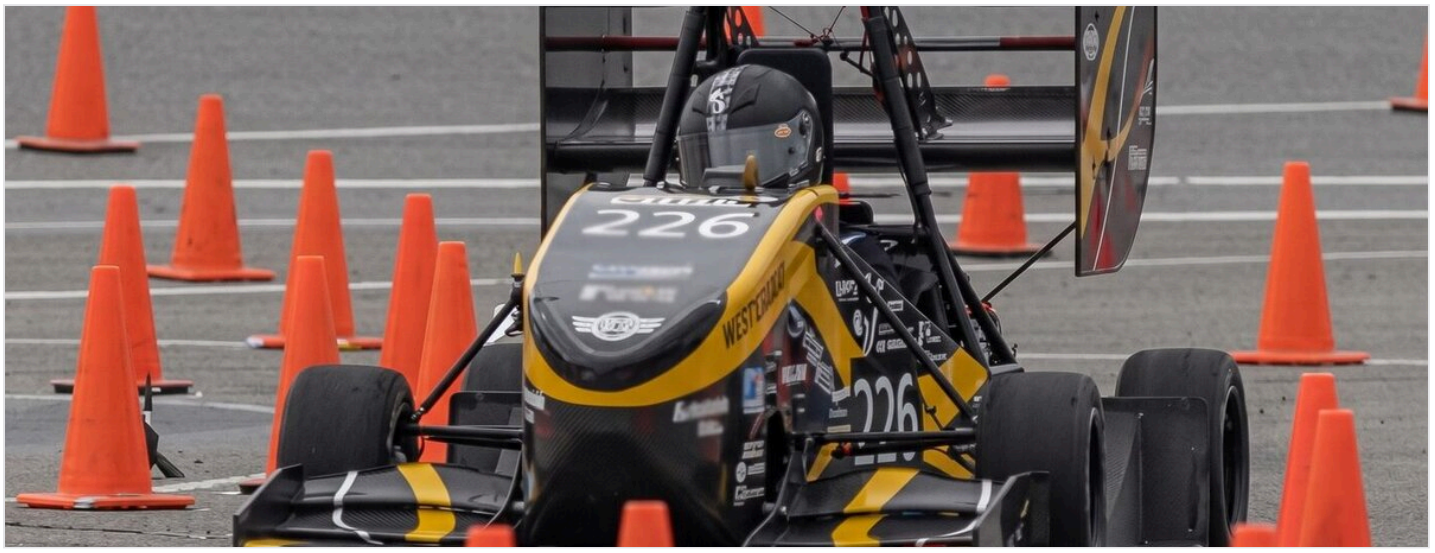
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PROJECT 07

Drag Reduction System Aerodynamics

UW Formula Electric (Formula SAE) · University of Waterloo

70.5%	1.58 → 0.47	46%
DRAG REDUCTION	DRAG COEFFICIENT	DOWNFORCE TRADE-OFF



UW Formula Electric car on track

WHAT

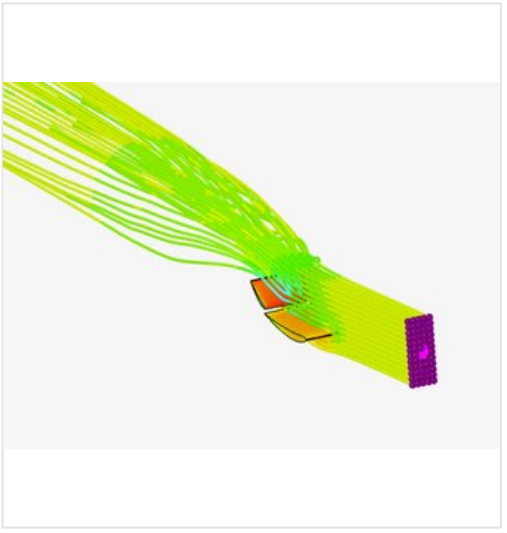
- Aerodynamic study to quantify the advantage of a **Drag Reduction System (DRS)** for the UW Formula Electric car
- Multi-element rear wing modelled within regulation limits on slot gap and angle of attack

HOW

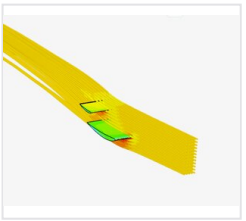
- Modelled baseline and DRS-open configurations in **SolidWorks** from a high-lift **NACA N6409** airfoil
- Added a trailing-edge **gurney flap** to capture realistic rear-wing downforce
- Ran incompressible, steady-state **CFD** comparisons in **SimScale**
- Studied **COMSOL Multiphysics** parameters and examined velocity particle traces
- Derived boundary conditions from **track data** and regional fluid properties

RESULTS

- Cut the drag coefficient **70.5%**, from **1.58 to 0.47**, at constant reference area
- Quantified the cost: **46%** less total simulated downforce
- Showed the open flap neutralizes pressure gradients and compresses the turbulent wake, raising top speed



Velocity particle trace, baseline



Velocity particle trace, DRS active



NACA N6409 elements, flap closed



NACA N6409 elements, flap open

PROJECT 08

Weigh Hopper Protective Cover

Owens Corning · Manufacturing Engineer Intern · Jan to Apr 2025

$40K	+12 yr
RESIN PROTECTED	SERVICE LIFE (EST.)

WHAT

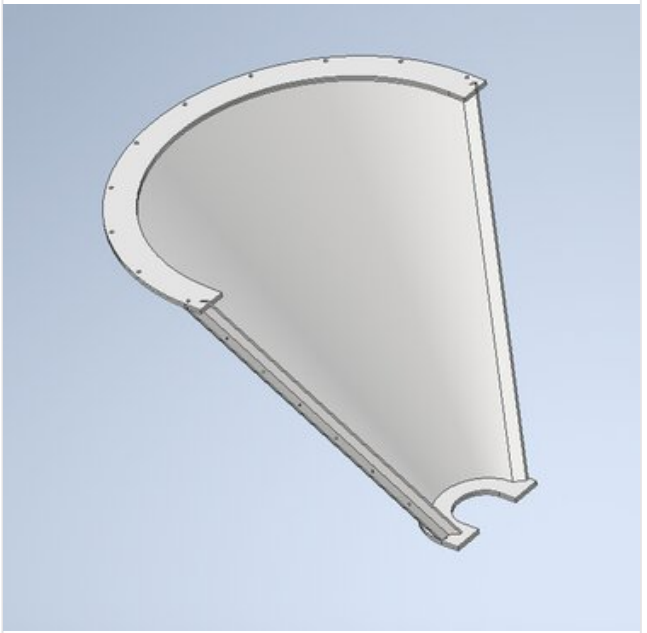
- Sealed cover that shields a weigh hopper's **epoxy resin** lining from glass cullet impact
- Managed delivery end to end, including **contractor scheduling** for fabrication and install

HOW

- Modelled in **Autodesk Inventor**, optimizing bolted and welded joints for **manufacturability**
- Added a **compression seal** and set bolt spacing to eliminate flange bowing
- Released complete **drawings** for external fabrication

RESULTS

- Protected **$40,000** (40 L) of critical epoxy resin
- Extended hopper life by an estimated **12 years**



Cover assembly in Inventor

PROJECT 09

Electric Drive Assembly Line 3D Layout

Skyjack Inc. (Linamar) · Manufacturing Engineer Intern · Jan to Apr 2023

300+	−12%
COMPONENTS	STATION CYCLE TIME (EST.)

WHAT

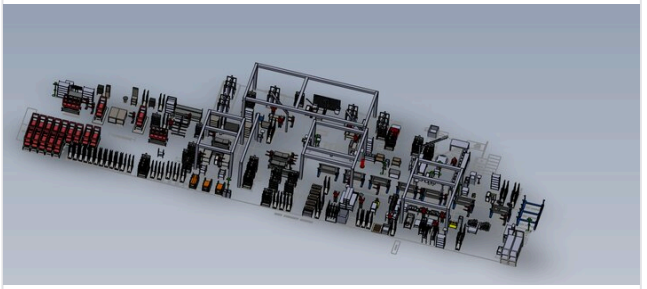
- 3D layout of an **electric drive assembly line** for high-volume production
- Led multiple detailed **design reviews**

HOW

- Built the layout in **SolidWorks** with **300+** assembly components
- Applied **GD&T** principles to keep the layout buildable
- Balanced operations and redesigned material flow

RESULTS

- Cut non-value-added time and resolved a line **bottleneck**
- Reduced station cycle time by an estimated **12%**



Full assembly line layout