Mischa Johal

Project Portfolio

Electrical Lead at UBC Solar

Led the Electrical division of an 80-person engineering design team building solar-powered race cars

Managed 30 members and 4 team leads across the BMS, Power and Signals, Strategy, and Embedded Firmware subteams. Proud to have fostered an agile development environment through collaboration with the team's Captain and Mechanical Lead to create and uphold realistic timelines for a 2-year vehicle design cycle.

Accomplishments

- **Responsible for a $60,000 budget** - including international importing and customs brokerage - along with outreach and maintenance of relationships with 12 corporate sponsors.
- Spearheaded the hardware and firmware design of a **135 V, 5.4 kWh lithium-ion battery pack**, including development of a testing and safety validation pipeline.
- Led bring-up and integration of the car's **900 MHz radio telemetry system** implemented with a custom Python RESTful API to persist and visualize mission-critical CAN bus data.
- Coordinated **three recruitment cycles** (400+ applicants) and managed leadership transitions of 6 subteam leads while documenting and transferring knowledge to maintain team continuity.

Results: UBC Solar's 3rd generation car, Brightside, placed 6th out of 24 teams at FSGP 2024 and qualified for the 2024 American Solar Challenge.

- FSGP and ASC 2024 Competition Recap
- Github repository for third-generation vehicle firmware

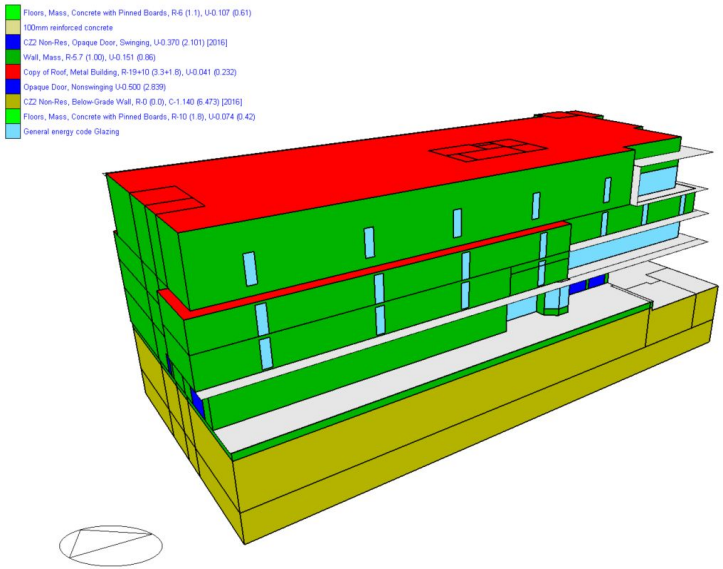
Building Energy Modelling in Taiwan

Leap-of-faith internship at RCI Sustainability, one of Taiwan's largest sustainable building consulting companies

Lead the buildout of energy modelling services within RCI Sustainability's Solutions Department, collaborating with an international team of architects, MEPs, and green building professionals while learning about the Taiwanese construction industry and East-Asian culture.

Accomplishments

- Reverse-engineered legacy eQuest models for a commercial office project and identified inaccuracies in previous modelling assumptions, rebuilding **ASHRAE 90.1 Appendix G-compliant simulations** in DesignBuilder to boost energy modeling accuracy by 15%.
- Created EnergyPlus models for a 6-storey LEED v4.1 BD+C mixed-use commercial project to support early-stage integrative design, value engineering, and sustainability objectives with HVAC and lighting engineers to unlock **45% yearly energy savings**.
- Developed applied understanding of ASHRAE 62.1's ventilation requirements through supporting on-site **IAQ testing for the UL Healthy Building** certification for a Taipei-based electronics manufacturing facility, including AHU and cooling tower inspections.



Results: Gained invaluable experience in Taiwan's sustainable construction industry working within a multinational and interdisciplinary high-performance-building consulting and design firm.

Tactile Sensing for Humanoid Robots

Developed an end-to-end data acquisition pipeline to unlock dexterous in-hand manipulation

Created a data pipeline for collecting, processing, and transmitting data from Sanctuary AI's tactile sensors, enabling the AI and teleoperation teams to integrate critical data into their dexterous piloting systems and ML models.

Accomplishments

- **Architected real-time data pipeline** for tactile sensing on a robotic hand, extracting measurements over I2C from 35 pressure sensors and transmitting data on a 8 MHz CANFD bus.
- Developed C firmware for a CANFD-EtherCAT converter implemented on a dual-core STM32 ARM MCU, achieving a 1 kHz update rate for tactile data resulting in **35% improved accuracy** of hand teleoperation tasks.
- Contributed to internal documentation on the development process for the custom EtherCAT slaves, providing feedback to team leads during integration process that streamlined **future retrofits of custom hardware.**

Results: Led integration of the robot's tactile sensors to deliver a system meeting 100% of stakeholder requirements with minimal downtime during key Series-B investor demos.

- Press release on tactile sensors for Sanctuary's next-gen humanoid

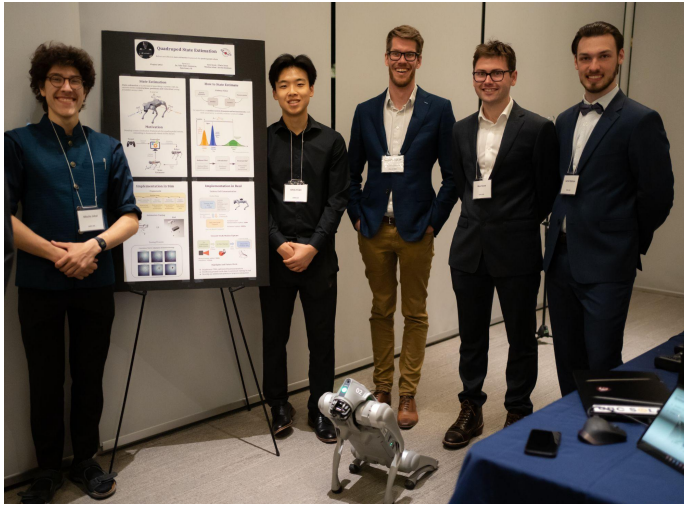
Quadrupedal State Estimation

Investigated and implemented a state-of-the-art state estimation algorithm on a Unitree Go2 robot

In a four-person team, developed a robust state estimation framework in Drake using an Invariant Extended Kalman Filter (IEKF) in simulation and real to inform the future scaling and implementation of a similar framework on Sanctuary AI's humanoid robot.

Accomplishments

- Conducted a literature review of classical and modern robotic state estimation techniques, as informed by project sponsor Dr. Nils Smit-Anseeuw, Sanctuary AI's Principal Controls Engineer.
- Adapted Sanctuary AI's existing Drake dynamics simulation framework with **Python bindings for C++ IEKF libraries** to unlock rapid tuning of IEKF hyperparameters in *sim*.
- Modified Drake state estimator with functions from Unitree's Legged SDK to **integrate foot-contact and IMU sensor data** from real Go2 robot, and updated low-level control framework to enable sending torque and position commands to the Go2's joints in *real*.
- Developed a **1mm-accurate ground-truth pose capture system** based on HTC Vive VR technology and the libsurvive Python package to bridge the project's *sim-to-real gap*. Achieved data streaming at 1kHz over websockets to a Grafana GUI, enabling evaluation of state estimator performance in real-time.



Results: Achieved 1 deg/s, 0.01 m/s tracking error, rapid (0.5 s) convergence, and a pose estimation rate of 250Hz for all states of interest (roll, pitch, yaw, etc.) to unlock improved walking performance on rough terrain.

- Github Repository and Final Report