Mischa Johal

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Education

University of British Columbia Vancouver, BC

Bachelor of Applied Science in Engineering Physics *Sept 2020 – May 2026*

Work Experience

Sanctuary AI May 2023 – December 2023

Embedded Firmware Engineer *Vancouver, BC*

- 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 8MHz CANFD bus
- Developed firmware for a CANFD-EtherCAT converter, implemented on a dual-core STM32 ARM MCU in C, achieving a 1kHz update rate for tactile data, resulting in 35% improved accuracy of hand teleoperation tasks
- Directed embedded bringup of an omni-wheeled mobile SLAM development platform, facilitating communication between 4 machine learning researchers and 5 hardware engineers to ensure alignment with project requirements
- Created data collection frameworks in ROS2's Python framework to validate the platform's industrial LiDAR safety systems
- Integrated new DDS backends into three 50GB Docker images for the platform, reducing network latency by 20%

Ciena Jan 2022 – April 2022

Hardware Engineer *Ottawa, ON*

- Executed component validation and second sourcing within Ciena's lifecycle management team, responsible for 3 generations of WaveLogic fiber optic datacenter modems
- Presented corrective actions to factory testing teams after identifying 8 instances of improper fault behavior through conducting fault-injection testing on 40 power rails
- Reduced component shortages and unlocked $20M in revenue by coordinating with Renesas power engineers to qualify new voltage regulators for low-current FPGAs

Technical Projects

UBC Solar Design Team Jan 2021 – Present

Electrical Team Lead *Dec 2022 – Present*

- Lead of the Electrical team at UBC Solar, an 80-person engineering design team designing and building solar-powered race cars competing in the American Solar Challenge
- Managing 30 members and 4 team leads across the BMS, Power and Signals, Strategy, and Embedded Firmware subteams
- Directly responsible for a $60,000 budget - including international importing and customs brokerage - along with outreach and maintenance of relationships with 12 corporate sponsors
- Fostering an agile development environment through collaboration with the team Captain and Mechanical Lead to create and uphold realistic deadlines for a 2-year design cycle

High Voltage Battery Pack Designer *Jan 2021 – Nov 2022*

- Spearheaded the hardware and firmware design of a 135V, 5.4kWh lithium-ion battery pack to power UBC Solar's 3rd generation solar vehicle
- Designed a 4-layer PCB in Altium Designer to control the safe startup and shutdown of the pack, including a 1MHz CAN transceiver and Cortex M3 MCU, while maintaining proper high-voltage isolation
- Lead the development of a test-case and issue tracking workspace, increasing issue documentation by 60% and successfully completing 58 safety validation tests
- Managed firmware version control using Git, implementing automated CI/CD build workflows with Make and Python

Quadruped State Estimation Sept 2023 – May 2024

- Implemented an invariant extended Kalman filter (IEKF) using sensor fusion to estimate the pose of a quadrupedal robot
- Integrated custom Python bindings for C++ IEKF libraries into a multi-processed sim2real Drake framework to achieve a 250Hz pose estimation rate, resulting in 40% improved walking preformance on rough terrain

Technical Skills

Languages: C, C++, Python
Frameworks/Libraries: ROS2, ARM, FreeRTOS, RealTime Linux, EtherCAT, DDS, Drake, Matlab/Simulink
Developer Tools: Git, Docker, Linux, CMake, Valgrind, Ceedling
Electrical Hardware: Altium Designer, Oscilloscope, THT and SMD soldering, SPICE simulation

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Project Portfolio

Electrical Lead at UBC Solar

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

Description

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

- Directly 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 135V, 5.4kWh lithium-ion battery pack, including development of a testing and safety validation pipeline.
- Lead bringup of the car's 900MHz radio telemetry system, as well as its integration with a custom Python RESTful API to persist and visualize mission-critical CAN bus data
- Coordinated three successful recruitment cycles (400+ applicants total), and managed the leadership transitions of 6 subteam leads, effectively 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 competed in the American Solar Challenge

Links:
FSGP and ASC 2024 Competition Recap
Github repository for 3rd generation vehicle firmware

Tactile Sensing for Humanoid Robots

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

Description

Architected and implemented 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 machine learning models. Gathered requirements from stakeholders including tactile sensor researchers, electrical and mechanical hand designers, and controls engineers to generate maximal value for all teams.

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 8MHz CANFD bus
- Developed firmware for a CANFD-EtherCAT converter, implemented on a dual-core STM32 ARM MCU in C, achieving a 1kHz update rate for tactile data, resulting in 35% improved accuracy of hand teleoperation tasks
- Contributed to company 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

Lead integration of the tactile sensors on the humanoid, delivering a 100% operational system while minimizing downtime during key Series-B investor demos.

Links

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

Quadruped State Estimation

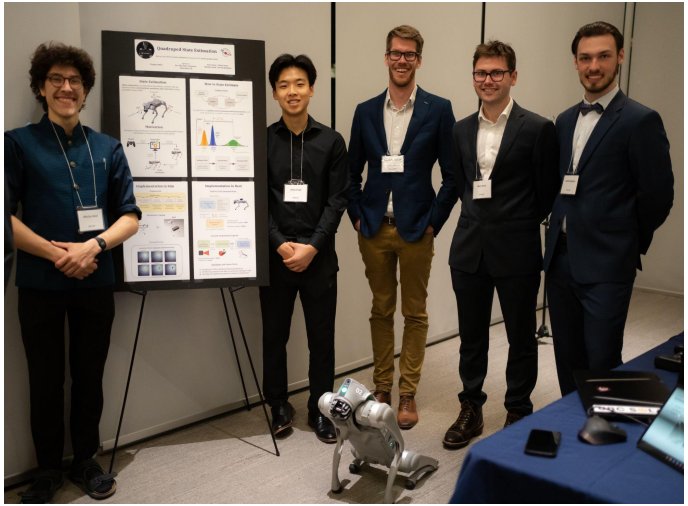
Investigated and implemented a state-of-the-art state estimation algorithm on a Unitree Go2 robot

Description

In a four-person team, developed a robust state estimation framework based on an Invariant Extended Kalman Filter for quadrupedal robots in simulation and real, with the intention of later scaling and implementing this 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 *sim2real gap*. Achieved data streaming at 1kHz over websockets to a Grafana GUI, enabling evaluation of state estimator performance in real-time.



Project showcase with team, robot, and project sponsor

Results

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

Links

Github Repository
Final Report