# Kyle Mackenzie

1mackenziekyle@gmail.com | 1mackenziekyle.github.io | github.com/1mackenziekyle | linkedin.com/in/kdmackenzie

## TECHNICAL SKILLS

**Software**: FreeRTOS, STM32 Firmware, Operating Systems, Python (numpy, pandas, scipy, tensorflow)
**Modelling & Controls**: Laplace-domain physical system modelling, Simulink, Vehicle Dynamics, BLDC motor controls
**Tools/Environments**: Git, Docker, Linux, Bash scripting, Data wrangling & automation

## TECHNICAL PROJECTS

**OS161 Operating Systems Kernel Development ([link](link)) | *C***     Sept. 2024 – Dec. 2024
- Implemented high-level synchronization primitives such as locks, condition variables, and semaphores, which were later used to implement thread-safe system calls, a file system, and virtual memory.
- Designed and implemented a thread-safe file system architecture to support file-related syscalls such as open, close, dup2, and more. (more details in personal website)
- Implemented a virtual memory system that manages a page table to keep track of the state of RAM pages, and a TLB to cache page table entries. Additionally implemented swap-space support.

**Uni-wheeled Robot Drive Controls ([link](link)) | *Python***     Sept. 2023 – Present
- Derived non-linear equations of motion for 3-axis wheeled unicycle robot using Lagrangian Mechanics.
- Brought up the software system on a Jetson Nano to facilitate the development of LQR, MPC, and reinforcement-learning controllers.
- Developed the cost function for an LQR controller, and subsequently obtained the linearized motor controller to balance the robot upright.

**Machine Learning Self-Driving & Character Recognition ([link](link)) | *Python***     Jan. 2023 – Apr. 2023
- Developed a novel SAIL (Selective Aggregation for Imitation Learning) method to improve dataset efficiency for imitation learning, selectively adding only informative training samples to enhance model performance.
- Designed and trained a custom CNN for character recognition using OpenCV-based preprocessing techniques, including binary masking, perspective warping, and data augmentation for robust license plate identification.
- Implemented a self-driving control model in a ROS-based simulation, optimizing trajectory learning with expert-labeled datasets and debugging tools to refine navigation accuracy.

## RELEVANT EXPERIENCE

**Vehicle Dynamics & Controls Developer & Team Lead**     Sept. 2022 – Dec. 2024
*UBC Formula Electric FSAE Design Team*
- Led the research & design of quad-motor torque vectoring drive algorithm, utilizing state-of-the-art sensor fusion, cornering response design, and four-wheel slip control.
- Built a physics-based dynamics model of the car in MATLAB Simulink, to evaluate stability and performance of the controller, and allow year-wide testing, instead of simply during Summer months, improving prototype cycle.

**Reliability Test Engineer Co-op**     May 2024 – Aug. 2024
*Corvus Energy*
- Developed a certification-level test plan to isolate a single failure mode for power-path connectors.
- Crimped, bolted, and torqued bolted voltage pickup connections.
- Performed an analysis on test data to numerically characterize the reliability of busbar components, providing the company with concrete data supporting the lifespan reliabiltiy of our product.

**Battery Controls Systems Co-op**     Sept. 2023 – Dec. 2023
*Corvus Energy*
- Developed a thermal model in Simulink of the precharge circuit of a 1MWh energy storage system.
- Developed coulomb-counting algorithm and automated test scripts to validate SOC algorithm and track cell health.
- Developed a PCB to emulate temperature sensors to extend test coverage for a battery cell test bench.

**Research Assistant**     May 2023 – Aug. 2023
*Cognitive Neuroscience of Schizophrenia Lab, BC Children's Hospital*
- Streamlined a MATLAB implementation of CPCA, a regressive dimension-reduction algorithm to handle 10s of GB of brain fMRI data, and refactored into python while removing over 300 lines of code and providing data visualization.

## EDUCATION

**University of British Columbia**     Sept. 2020 - May 2026
*Engineering Physics*