Gavin Tranquilino

Mechatronics Engineering Student

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Education

University of Waterloo **June 2028**
Candidate for BASc in Mechatronics Engineering *Waterloo, ON*

- **Coursework**: Data Structures, Algorithms, Linear Algebra, Circuits, OOP, Microprocessors, Digital Logic (FPGA, PLC), Mechanics of Deformable Solids, Structure and Properties of Materials, Statistics, Ordinary Differential Equations

Experience

Humanoid Robotics Engineering Co-op May 2025 – Present
WATonomous *Waterloo, ON*

- Designing and prototyping **dexterous humanoid arms** with the goal of autonomous keyboard typing.
- Developing software interface to bridge high-level **ROS2** control and low-level embedded systems over a **CAN bus**.
- Containerizing ROS2 system in **Docker**, mounting CAN transceivers to enable communication between subsystems.
- Developing **URDF** models to define kinematic chains and hardware specifications for humanoid robot sim and control.
- Implementing embedded **C++** firmware on **STM32** microcontrollers for sensor data acquisition and feedback control loops.
- Designing **PID controllers** and **Kalman filters** for control and state estimation of robotic arm joints.

Undergraduate Research Assistant September 2024 – December 2024
University of Waterloo - Engineering IDEAs Clinic *Waterloo, ON*

- Instrumented a wearable knee crutch, allowing force readings for gait analysis and material selection via **FEA**.
- Built swarm robots in **Gazebo** using **ROS2** and **TurtleBot4**, showcasing **LiDAR** integration and **odometry** in Python.
- Implemented **adaptive cruise control** on physical robots using **PID** controllers in **C++** and **Python** packages.

Mechanical Engineering Associate January 2024 – April 2024
Sheartak Tools Ltd. *Waterloo, ON*

- Designed 15 third party woodworking machinery upgrades with **DFMA** in **SolidWorks** to meet OEM specifications.
- Applied **GD&T** principles to guarantee manufacturing accuracy for custom machine parts.
- Created 25 detailed installation manuals, including parts lists and assembly instructions, ensuring ease of use for customers.
- Built a **Python/Selenium** web scraper to automate competitive analysis and product uploads, processing 2000+ products.

Projects

Autonomous LiDAR Navigation for Mobile Robot

- Developed **C++ ROS2** nodes to convert **LiDAR** data into a **2D costmap** for obstacle detection and perception.
- Generated a **world model** from costmap and odometry data to represent the current environment.
- Implemented **A* algorithm** to compute obstacle-aware paths through the mapped environment.
- Applied **Pure Pursuit** to follow planned paths for smooth differential drive navigation.
- **Dockerized** the system and integrated with **Gazebo** and **Foxglove** for simulation, debugging, and real-time visualization.

Instrumented Knee Crutch

- Designed a digital CAD twin of an existing knee crutch in **SolidWorks**.
- Developed a **data aquisition** system using **I2C** and Arduino, converting a bathroom scale for real-time load measurements.
- Prototyped **3D-printed** mounts and knee platforms for strain gauges, ensuring user comfort.
- Built **Python** scripts for force distribution visualization in **Matplotlib**, with data logging for **gait analysis**.

Self-Balancing Unicycle

- Built a simulator from scratch using **C++** and **CMake**, integrating **OpenGL** to create a custom physics environment.
- Implemented **cascading PID controllers** to control: balancing and achieving precise position tracking.

Technical Skills

Mechanical: SolidWorks, Fusion360, AutoCAD, GD&T, CAD, FEA, DFMA, 3D Printing, Machine Tools, Onshape
Electrical: I2C, SPI, UART, CAN Bus, Arduino, ESP-IDF, Soldering, Oscilloscope, LiDAR, PLC, LAD, VHDL, FPGA
Software: Python, C, C++, CMake, SSH, Bash, TypeScript, JS, HTML, CSS, SQL, LaTeX, Gazebo, Foxglove
Libraries/Frameworks: ROS2, Docker, OpenCV, Linux, Ubuntu, Git, MediaPipe, Flask, Selenium, NumPy, OpenGL