

## Faculty of Engineering

### Summer Research Program 2023-2024

Project Title: Tail-Wagging Technology:  
Building an Expressive Tail and Ears for a RoboDog Companion

Supervisor(s): Dr. Dana Kulic (Main - ECSE Professor) and Liam Roy

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### Objective

Design, build and integrate an expressive robotic tail and/or ears on a 4-legged robot dog ([UniTree Go1 Quadruped](#)), enhancing its capacity to generate complex expressive gestures.

### Project Details

Expressive motion is an effective means for collaborative robots to convey their internal state and intent to humans. With more degrees of freedom (DOFs), robots can execute more complex expressive gestures. Increasing a robot's available degrees of freedom can be achieved by equipping it with actuated peripherals such as grippers, ears, etc. The Monash Robotics Lab is conducting research focused on leveraging learning-based techniques to autonomously learn expressive gestures based on a robot's available DOFs. This research is being conducted with the [UniTree Go1 Quadruped](#) platform.

This summer research project aims at designing and building a peripheral control board along with an under-actuated expressive peripheral (i.e. tail and/or ears) to increase the Go1's available DOFs. The student selected for this project will review existing under-actuated mechanisms used for expression, and subsequently design and prototype an expressive peripheral based on their findings. The student will evaluate and refine their design to meet a list of design requirements and extend an existing control codebase to support their control board and peripheral(s). The outcomes of this project will contribute to research being conducted by **Ph.D. student Liam Roy** and **ECSE Professor Dr. Dana Kulić**.

### Prerequisites/Skills

- **Programming:** Python skills are needed for this project. Experience with ROS2 is an asset but not necessary (~20hrs to learn if you understand the fundamentals of computer programming)
- **Robotics:** Fundamental understanding of kinematics, dynamics, and control systems. Courses such as ECE4078, ECE4191 and TRC4800 provide great background knowledge for this project.
- **Mechanical Design:** Fundamental understanding of engineering materials and CAD software (e.g. Solidworks). Experience with 3D modelling and 3D printing is an asset.
- **Electronics:** Fundamental understanding of circuit design, actuators and power management. Experience designing PCBs (Printed Circuit Boards) using PCB software (e.g. Altium) is an asset.

### Relevant References

- **Expressive Motion:** G. Venture and D. Kulić, "Robot Expressive Motions", 2019. ([Paper Link](#))
- **Underactuated Robotics:** R. Tedrake MIT Course [Notes](#) with [YouTube Lectures](#) and [Slides](#)

### Additional Information

**Submit and [email me](#) indicating why you are interested in the project.** Include a short CV and a copy of your unofficial academic record. Please list any interesting prior projects you have worked on and/or evidence that you have the skills required for this project. Links to photos or Git repositories are great additions. Once I have received these documents, I will arrange an interview.