# PATRICK SINGAL

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## EDUCATION

**Queen's University, Faculty of Engineering and Applied Science** **Sep. 2018 – Apr. 2022**
*BASc. Mechanical Engineering, GPA 3.72*

- Awards: Dean's Scholar (August 2021).
- Capstone: Thermal management system optimization for heavy-duty electric vehicles (Fall/Winter 2021–22).
- Thesis: Numerical simulation of turbulent, compressible flow through rotating detonation engine supply valve (planned for Winter 2022).
- Grants: DDQIC Fall 2020 Sponsorship Fund ($1,000), Faculty of Arts & Science Student Initiatives Fund 2020 ($900).

**Queen's University, Faculty of Arts and Science** **Sep. 2016 – Apr. 2018**
*BSc.H. Mathematics, Political Studies (planned; no degree awarded)*

- Awards: Dean's Admission Scholarship (July 2016).

## RESEARCH EXPERIENCE

**Rival Lab, Queen's University** **Oct. 2021 – Present**
*Aerodynamics Research Assistant*

- Designed a NACA0012 airfoil in SolidWorks, which contains 16 internal pressure-measurement channels, taps, and transducer ports that are geometrically optimized to reduce noise and signal error. The model is now being 3D-printed by partners at EPFL in Switzerland, where it will be used to perform water-tunnel testing.
- Currently running towing tank experiments on airfoils across a range of boundary conditions to collect data for training a predictive algorithm for sparse pressure data in gusty, turbulent flows.
- Will design a sealed testing rig that will allow for dynamic calibration of pressure transducers, with the goal of reducing signal error and phase lag (Winter 2022).

**Capstone: Thermal Management System Optimization for Heavy-Duty EVs** **Sep. 2021 – Present**
*Engineering Student*

- A year-long industry partnership project with a designer and manufacturer of heavy-duty electric vehicles for open-pit and underground mining applications.
- Designing an optimized thermal management system that minimizes redundancy while maintaining the sensitive operating temperatures of Li-ion batteries, motors, and auxiliary components throughout various drive cycles and loading conditions.
- Developed a Python-based thermal model that computes required heat removal rate in response to transient fluctuations in battery heat generation. Currently using Simulink to model the proposed TMS as a feedback control system that uses solenoid valves to modulate coolant flow rate in response to measured temperature changes in the battery packs.

**Explosion Physics and Prevention Lab, Queen's University** **Sep. 2021 – Present**
*Combustion Research Assistant*

- Assisted with ongoing single-shot analog experiments involving a Rotating Detonation Engine (RDE), in which propagating detonation waves are captured using high-speed Schlieren imaging and built-in pressure transducers.
- Invited by supervisor Dr. Gabriel Ciccarelli to complete an undergraduate thesis project over the Winter 2022 term, which involves simulating turbulent, compressible flow through the RDE fuel supply valve using ANSYS Fluent.

**Code Life Ventilator Challenge (McGill University, MGH Foundation**) **Mar. 2020**
*R&D Team Member*

- Collaborated with a team of professional engineers and academics to develop the "AirMax Dual-Mode Ventilator", a low-cost, oxygen-generating mechanical ventilator intended to address shortages caused by COVID-19 in developing countries.

- Ranked in the top 65 of 1,029 submissions at this international innovation challenge.
- Oversaw biomechanical research, technical report writing, and modelled pressure-swing adsorption of ambient air across zeolite cylinders by simulating the Darcy–Brinkman equations for turbulent flow through porous media.

## LEADERSHIP EXPERIENCE

**Queen's Vertical Farming Team** **Sep. 2019 – Present**
*Founder, Manager [Link]*

- Founded Canada's first undergraduate vertical farming R&D team, which aims to design and build a functional software-automated aeroponic farm on Queen's campus. Led, trained and coordinated the diverse projects of 40 past and present members.
- Established a network of partners in industry and academia, including GoodLeaf Farms, Vertico Farms, the Queen's Phytotron, University of Guelph, and the Ontario Ministry of Food, Agriculture, and Rural Affairs. Obtained permission from the Dunin-Deshpande Queen's Innovation Centre to build and store the initial vertical farm prototype inside their on-campus facilities.
- Created a comprehensive model of the farm prototype using SolidWorks. Strategically placed check valves, pressure release valves, and other fittings to prevent backflow, cavitation, and excess pressure buildup. Used fluid mechanics principles and MATLAB to determine the pump size and pipe dimensions that sufficiently pressurize the sprinkler nozzles; added intermediate reservoirs with gravity-fed inlets and submerged outlets to reduce the pump suction line's length and maintain watertightness. Flowcharted and wrote Arduino code for a feedback control system that automatically maintains optimal growth conditions with sensors, actuators, and microcontrollers.

## WORK EXPERIENCE

**MECH 210: Electronic Circuits & Motors for Mechatronics** **Jan. 2022 – Present**
*Teaching Assistant*

- Will supervise hardware- and Arduino-based labs, grade reports, and teach at weekly active-learning sessions.
- One of only two undergraduates on a ten-member teaching team consisting mainly of master's and PhD students.

**Front Row Ventures** **Apr. 2021 – Present**
*Investment Associate*

- Member of Canada's most prominent student VC fund, which collectively controls >$800K in investible funds and administers $25k cheque sizes to student-founded technology start-ups.
- Responsible for deal sourcing, deal screening, performing due diligence, and making investment decisions. Sourced and led deals for three pre-seed technology companies developing, variously, a polymer-based passive industrial wastewater filter, a productivity management software and an online entertainment platform.

**MCW Consultants, Ltd.** **May – Aug. 2019**
*Mechanical Engineering Intern*

- Conducted environmental scans of energy trends, statistics, and regulations; assessed stakeholder impacts.
- Created HVAC schematics for 85 public buildings in remote Arctic communities by overlaying decades of historical building plans and datasheets to produce accurate, detailed, and meticulous final drawings. Reduced drawing time from roughly 120 to 40 minutes per HVAC sub-system by developing a custom MS Visio stencil set, which is still used by MCW today.

## TECHNICAL SKILLS

Advanced: SolidWorks, Python (Scipy, Numpy, Matplotlib, Pandas), MATLAB, Arduino/C++, R; Intermediate: LabVIEW, Simulink, ANSYS Mechanical APDL; Novice: Svelte, HTML, CSS, Javascript