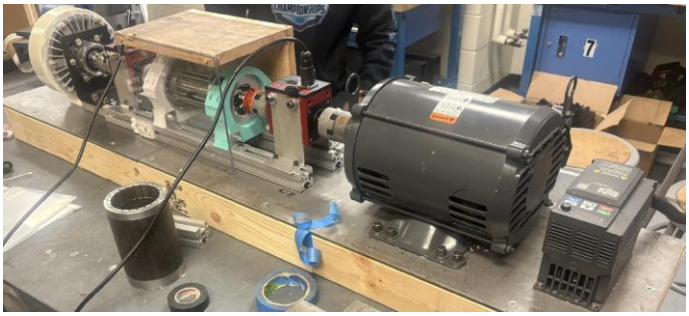
Paul-Elliot Foy Mechanical Engineering Portfolio

About Me Virginia Tech Mechanical Engineering graduate (B.S., 3.9 GPA, May 2025) with hands-on experience in structural design, Ansys FEA, prototyping, and testing for aerospace and mechanical systems. Passionate about innovative solutions and high-performance hardware. Proven in project management, fabrication, and problem-solving through capstone, personal projects, and software development.

Project 1: Magnetic Gearing for Centrifugal Pumps (Senior Capstone, Virginia Tech & Flowserve, 2024-2025)

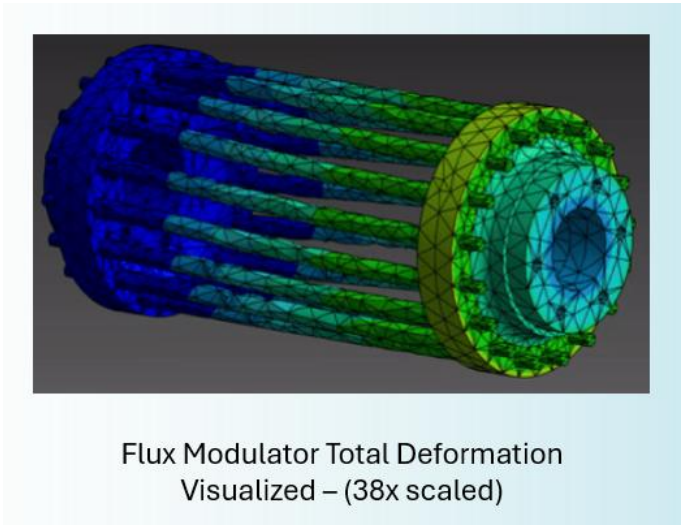
Role: Project Manager & Lead Designer (Team of 5) **Overview:** Led the design, analysis, build, and testing of a Concentric Magnetic Gear (CMG) prototype to replace traditional planetary gears in industrial centrifugal pumps, reducing cavitation, maintenance, vibrations, and lubrication needs. Achieved 2.83:1 gear ratio, 55 Nm max torque (exceeding 6 Nm requirement), 89% (and later 93%) peak efficiency (near 95% target), and operation up to 188°C (near 205°C max). All requirements met except full efficiency due to eddy currents: future designs could insulate flux modulator. Demonstrates clean-sheet structural design, FEA for loads/centrifugal forces, test stand development, data analysis, and mechanism design. **Key Contributions:**

- Redesigned flux modulator using 17 circular 1018 steel poles (6 mm dia., 167 mm long) in cage configuration with 6061-T6 aluminum endcaps, nuts/washers for radial stability.
- Conducted Ansys FEA for centrifugal (1200 RPM), thermal (208°C), and torque (35 Nm) loads; achieved FOS > 4.06 for realistic scenarios, deformations <0.187 mm.
- Built and tested on custom rig with AC motor, VFD, torque sensors, magnetic brake; analyzed data in Excel for efficiency, power, and loss.
- Managed timelines, sourcing, stakeholder presentations; incorporated prior parts for cost-efficiency. **Tools/Technologies:** SolidWorks (CAD), Ansys (FEA), MATLAB (magnetic sim), Excel (data analysis), machining for fabrication. **Outcomes:** Prototype ramped to 3600 RPM in 13 sec; efficiency map showed losses tied to speed (eddy currents). Report presented at VTMECAP-2025-207.
- Video Demonstration: https://youtu.be/hfY3XEzu6js
- **Images of Gear Test Rig Assembly and Torque-Speed-Efficiency Graph**



Torque Output, Speed Input, and Efficiency										
Torque Output (N*m)	20	89%	84%	80%	78%	77%	75%	74%	73%	73%
	15	85%	81%	76%	73%	71%	69%	67%	67%	66%
	10	86%	74%	70%	66%	64%	61%	60%	58%	58%
	5	68%	56%	49%	45%	42%	41%	40%	38%	38%
	0	17%	9%	5%	2%	3%	3%	3%	4%	4%
		234	484	736	981	1232	1491	1734	2001	2237
		Speed Input (RPM)								

Figure 16: Torque Output over Speed with Efficiency Readings for Each Condition



(From report/poster: Full details at https://paulelliotfoy.com/seniordesign/)

Project 2: Polycarbonate-Walled 400 sq-ft Workshop (2023)

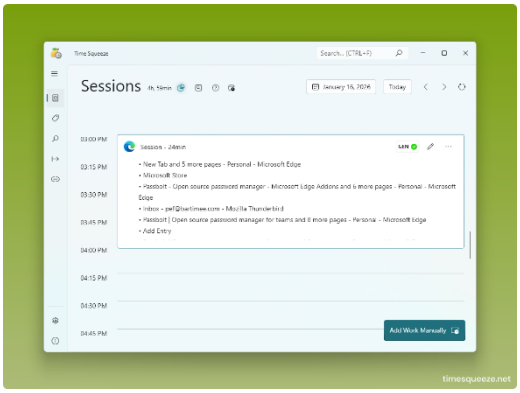
Role: Conceptualizer, Designer, & Builder **Overview:** Designed and constructed a 400 sq-ft workshop with polycarbonate walls for durability and natural light. Demonstrates: Structural design, material selection, and fabrication for infrastructure-like projects. **Key Contributions:**

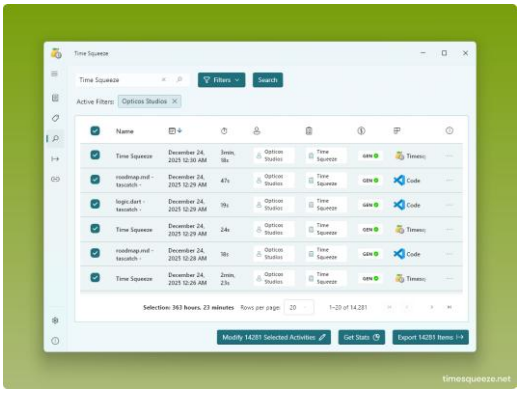
- Conceptualized layout; selected materials for load-bearing and environmental resistance.
- Built from ground up, including framing and electrical integration. **Tools/Technologies:** Hand tools, construction, surveying existing layout and designing structure in SketchUp. **Outcomes:** Functional space used for other Projects.
- **Photos of construction.**

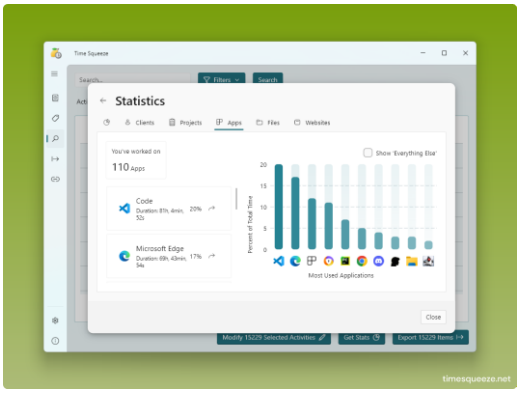
Project 3: Time Squeeze B2B SaaS Platform (2022-2025)

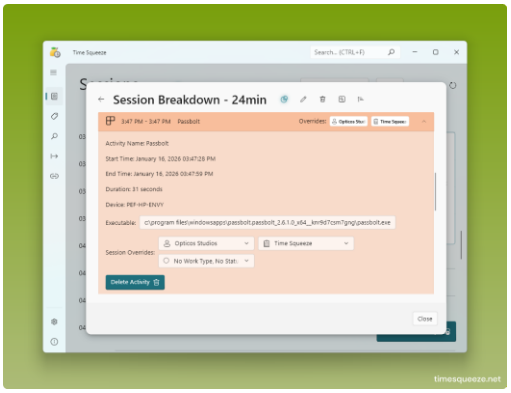
Role: Founder & Developer **Overview:** Developed scalable time-tracking software for consulting firms, demonstrating software engineering alongside mechanical skills. Shows project management, user-focused design, debugging, and tools for engineering workflows. **Key Contributions:**

- Built in Python/Dart/Flutter. Integrated feedback for iterative improvements. **Tools/Technologies:** Dart, Flutter, Python. **Outcomes:** Used by engineering firms; funded studies.
- https://www.timesqueeze.net
- **Screenshots of app interface.**









Project 4: GWSL & OpenInWSL Open-Source Tools (2019-2025)

Role: Founder & Developer **Overview:** Created Python-based tools for running Linux GUI apps on Windows, used by 180,000+ users including engineers. Shows: Problem-solving to bridge technical gaps, user support in fast-paced environments. **Key Contributions:**

- Identified market need; incorporated developer feedback. **Tools/Technologies:** Python. **Outcomes:** Global adoption; continuous updates
- **GWSL Demo Video:** https://youtu.be/S6GXBEQ5KzA
- https://opticos.github.io/gwsl/

Additional Skills & Coursework

- Proficient in: SolidWorks, Siemens NX, Ansys FEA, MATLAB/Simulink, Python, GD&T foundations.
- Additional Relevant Courses: FEA in Mechanical Design, Robotics/Automation, Additive Manufacturing, Welding.

This portfolio showcases my ability to lead from concept to testing in mechanical and software contexts.