

# WATurbine

## F24 First General Meeting

Thursday, October 3<sup>rd</sup>, 2024



# Agenda

- Icebreaker
- Introduction to WATurbine
  - Engineers Without Borders
  - The Team
  - Small Wind Turbines
  - The Competition
  - Team Progress
- Sub-Teams
  - Aerodynamics
  - Controls
  - Mechanical
  - Power
  - Structural

# F24 Executive Team



Katherine Nguyen  
*Project Manager*



Jun Woo Oh  
*Project  
Manager/Mechanical Lead*



Steven Armstrong  
*Embedded  
Systems Director*



Alan Hu  
*Aerodynamics  
Lead*



Violet Hu  
*Aerodynamics Lead*



Katherine Liu  
*Aerodynamics  
Lead*



Xander Hayhoe  
*Controls Lead*



Ben Liu  
*Power Lead*



Evan Kwon  
*Mechanical Lead*



Robert List  
*Mechanical Lead*

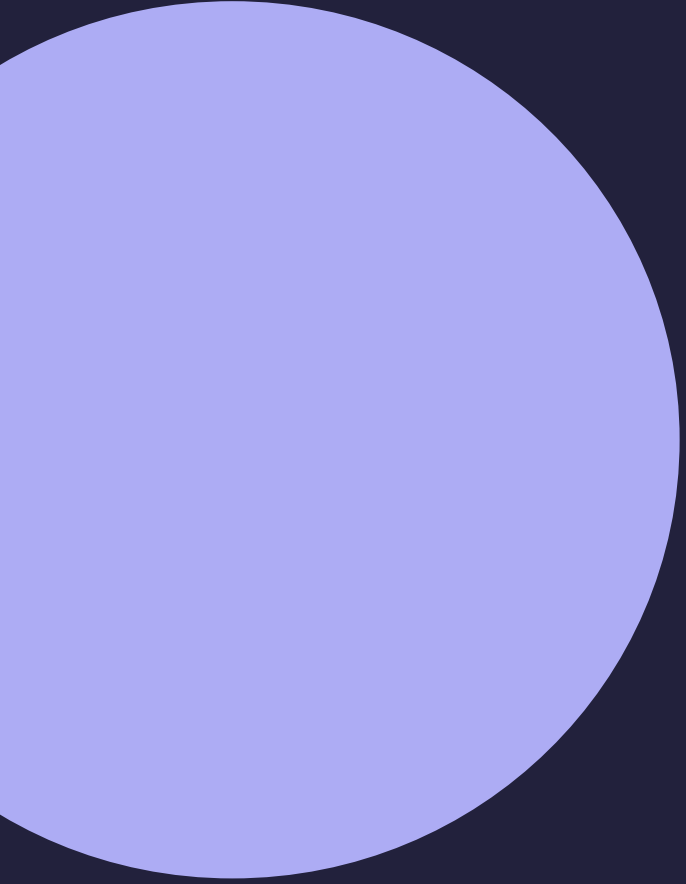


Laasya Rajgopal  
*Structural Lead*

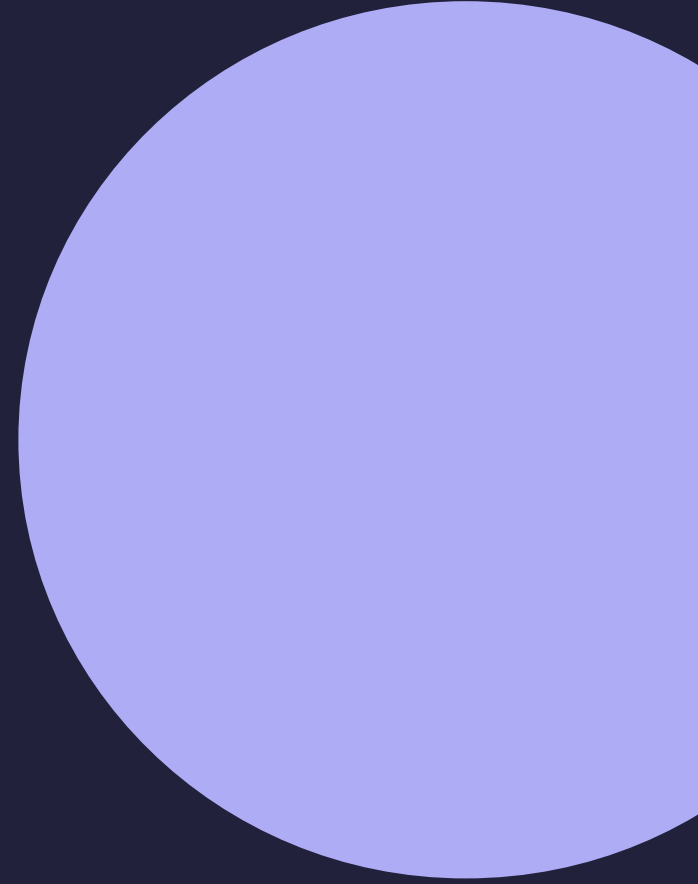


Chantel LeClerc  
*Structural Lead*

# Icebreaker



PICK A SIDE



# Project Managers



**Katherine Nguyen**  
Project Manager



**Jun Woo Oh**  
Project Manager  
(On-Site F24)

# Engineers Without Borders

# Engineers Without Borders

est. 2000

*"Our vision is to engineer an equitable and sustainable future for marginalized people and the planet.*

*Our mission is to create systemic change through community-driven collaboration. We mobilize the engineering community and leverage technological innovation to address urgent and important global challenges, both within Canada and beyond."*

People

Ventures

Advocacy



engineers without borders  
ingénieurs sans frontières  
Canada



# University of Waterloo Chapter

- 32 chapters of Engineers Without Borders across Canadian colleges and universities
- Carries EWB mission at the post-secondary level
- Sustainable engineering design competitions
- CAIF: Canada-Africa Innovation Fellowship
- XChange conferences
- Registered club & design team

Education

Fundraising

Communications

Podcasts

Design

OpenAir Carbon  
Capture

Small Wind



engineers without borders  
ingénieurs sans frontières  
Canada

# The Team

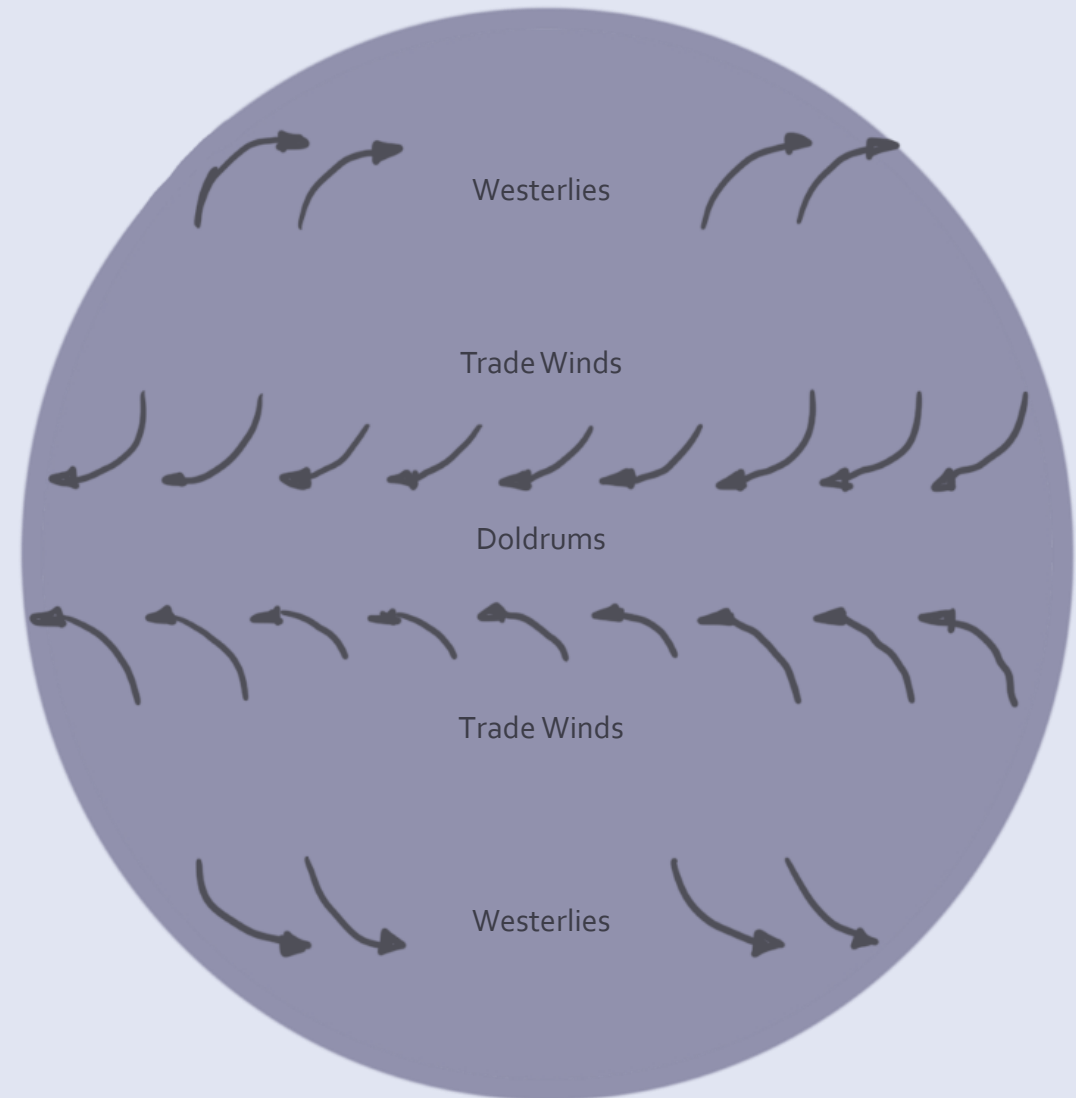


# Core Values

- Our mission is to engineer a small wind turbine that demonstrates the best sustainability and efficiency for the International Small Wind Turbine Contest in summer 2025.
- Our vision is to push the boundaries of sustainability and accessibility within the renewable energy industry, while attracting more students to join Engineers Without Borders.
- Our team values innovation, passion for sustainable engineering, and inclusivity within our community. We strive to bring bright minds together to work on challenging problems in one of the world's most important industries! Respect and inclusion are at the core of our team.

# Structure

- Westerlies: Team members!
  - Attend meetings
  - Participate in sub-team tasks
- Trades: Exceptional Team Members!
  - Completing multiple important tasks
  - Being mentored by team leads to become next Doldrums
- Doldrums: Team Leads!
  - Managing sub-teams or team as whole
  - Leading design of turbine



# Communication Channels

- Engineers Without Borders
  - **Slack**
  - @uwewb
- WATurbine
  - **Discord**
  - **Notion**
  - @uwwaturbine
- Fill out the form in the QR code and find all communication access through #resources



# Why join WATurbine?

## Small/New Design Team

- Easier to have more 1:1 time with team leads and other members
- The work you do is immediately valued & recognized!
- Lots of opportunities to take initiative/ gain leadership roles
  - More opportunities to contribute to the research & development stages of a project
- Learn by doing!

## Large/Established Design Team

- Higher complexity and size of projects (ie. small wind turbine vs. a car)
- More funding → Access to resources & tools
- Lots of well-designed onboarding/training already in place
  - CAD workshops
  - FEA workshops
  - PCB Design
  - Etc.
- Opportunities to network with more people

# Onboarding

1

Fill out the recruitment form!

2

Join the Discord, Slack, and Notion!  
All found under #resources of the Discord channel.

3

Start attending meetings!  
Will be posted under each sub-team and in #meetings.

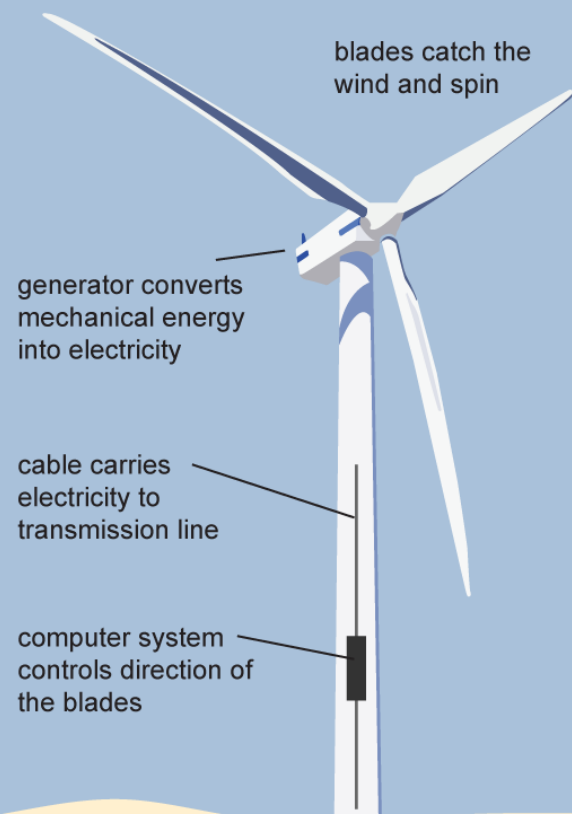


# Small Wind Turbines

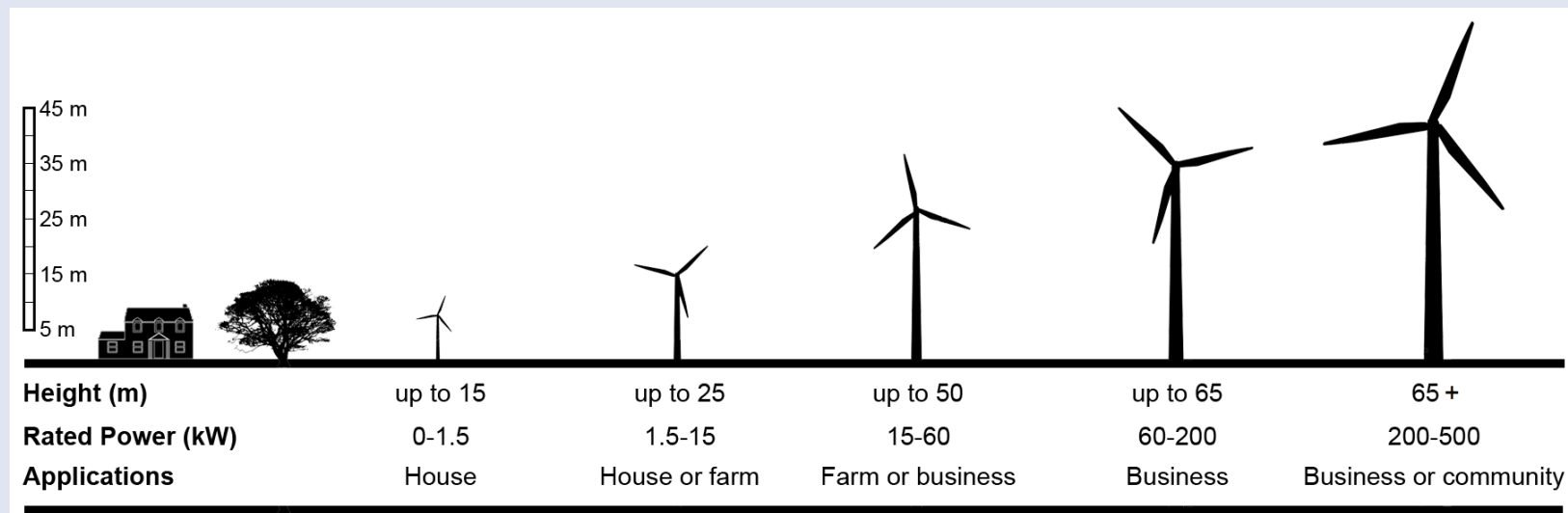


# Wind Turbines

## Horizontal-axis wind turbine



- One of the major forms of renewable energy
- Wind's kinetic energy → Electricity



# Wind Turbines



- Commercial wind turbines (2-3 MW)
  - Onshore vs. Offshore
- Small wind turbines (0-500 kW)
  - Rural and rooftop applications

# Sub-Teams



## Aerodynamics

Design and manufacturing of the blades. Involves research of the newest materials, collaboration with research groups, simulations and hands-on composite work.

## Mechanical

Design and manufacturing of all mechanical parts. Includes rotational, pitching and yawing mechanisms of the turbine. Involves computer-aided design, prototyping and manufacturing.

## Structural

Design and construction of the tower and nacelle. Involves research of most sustainable materials, finite element analysis and hands-on building.

## Power

All things to do with the generator! Design and assembly of all power electronics. Involves PCB design, soldering and testing.

## Controls

Design and assembly of all control systems: performance measurement, pitch control, etc. Involves microcontroller, PCB, and programming work.

# International Small Wind Turbine Contest (ISWTC)

# International Small Wind Turbine Competition

- Annual contest in which university student teams from around the world compete in building a Small Wind Turbine
- First organized by NHL University of Applied Sciences in 2013
- Currently organized by the Hanze University of Applied Sciences
- Goal: To build the most efficient & sustainable wind turbine with the highest energy yield
- Lasts for 1 week in June/July



**Hanzehogeschool Groningen**  
University of Applied Sciences

# International Small Wind Turbine Competition

Deliverables:

- Design Report
  - Technical design choices
  - Research
  - Outline of turbine construction
- Sustainability Report
  - How feasible is the construction of the turbine in developing regions (ex. Sub-Saharan Africa)
  - Life cycle assessment
  - Embeddedness
  - Maintainability
  - Materials
- Turbine
  - Electronics/mechanical safety
  - Tested in Open Jet Tunnel at Technical University of Delft (best power production) (2-3 hrs)

# International Small Wind Turbine Competition

Presentation:

- Present turbine & poster to other teams, general audience, and jury of wind energy experts

# Weight Breakdown

- 60% Energy Output
- 20% Sustainability
- 20% Report & Presentation



# Example Turbines



a. Wind tunnel




b. UofT



c. Lodz University of Technology

# Progress

# Timeline



F24: Recruitment, sponsorships/funding, and advisory professor. Designs for each sub-team completed and manufacturing plans set.

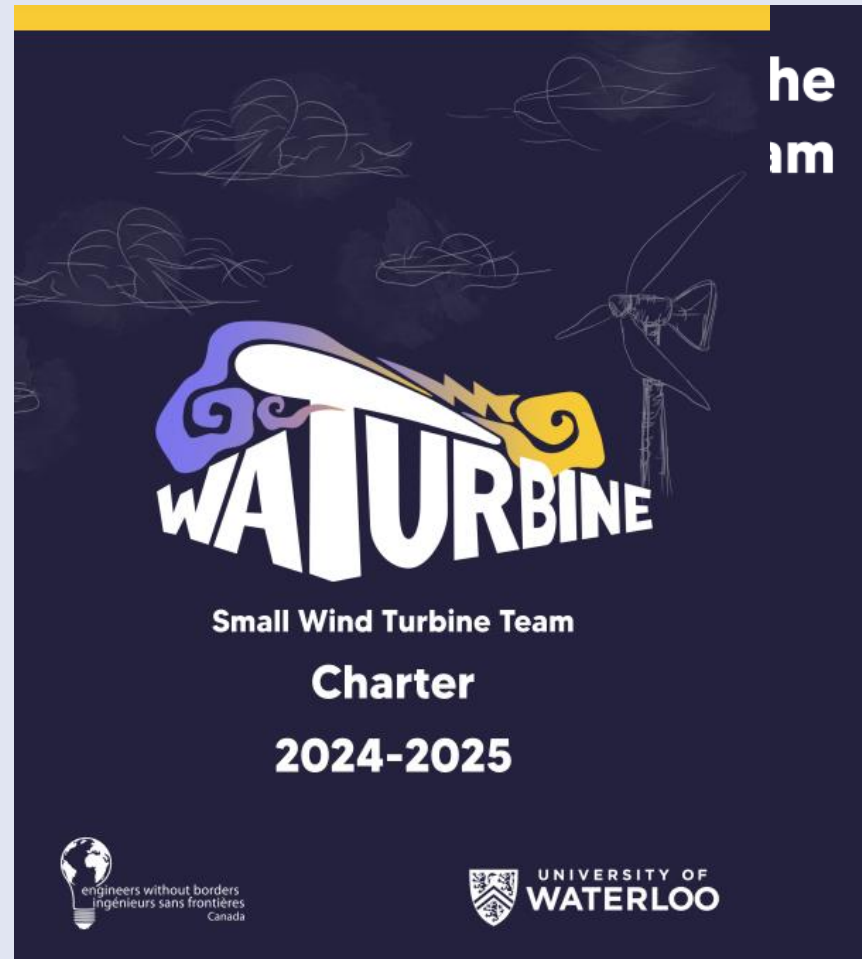
December 2024: Registration opens for the ISWTC. 500 euro fee paid.

W25: Manufacturing, construction, and testing of the turbine takes place in tandem with the research/writing for all reports and presentations.

S25: Competition occurs.

# Team Charter

- Linked on our Notion!
- Mission
- Sub-teams and leadership
- Structure
- Tools
- Onboarding process



# Sponsors

- Package completed
- Start reaching out this week-next

**WATurbine**  
Small Wind Turbine Team  
Sponsorship Package  
2024-2025

## WATurbine

WATurbine is a team of ambitious engineering students from the University of Waterloo, dedicated to driving innovation in the fields of renewable energy and sustainable technology. Our goal is to design and manufacture a highly efficient and sustainable small wind turbine that is being researched for use in sub-Saharan Africa. The team aims to showcase the wind turbine at the International Small Wind Turbine Competition held annually in the Netherlands.

WATurbine is a subsidiary of the University of Waterloo's Engineers Without Borders Chapter, and WATurbine aims to embody the non-profit's mission through wind power advancement.

## Engineers Without Borders (EWB)

Engineers Without Borders Canada is a non-profit organization whose vision is to create an equitable and sustainable future for all globalized people and the planet, through the engineering community and technological innovation to improve the quality of life and important global issues both within Canada and beyond. WATurbine is a part of the University of Waterloo's Engineers Without Borders Chapter, which was the first in the world to have a long history of providing sustainable engineering

## About the Team

### Small Wind Turbines

While large commercial wind turbines are used to power the electric grid, small wind turbines are smaller both in size and output. Small wind turbines can be used in urban and rural settings on tall building rooftops or to power off-grid communities.

### International Small Wind Turbine Contest (ISWTC)

## Impact

### Wind Energy

Wind is a completely renewable source of energy and is one of the fastest growing forms of energy globally, with a **50% year-on-year growth** in total installations from 2022 to 2023 [1]. In 2023, 7.3% of global electricity was generated by wind power [2]. If the wind industry triples its annual growth by 2030, we will be globally on track to meet the UN's COP28 climate change goals [1]. The advancement of wind power technology is therefore crucial to contributing to the clean energy transition and the fight against climate change.

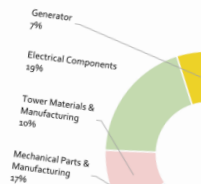
While wind energy is a critical form of renewable energy, there are important improvements that must be made within the wind turbine industry. Wind turbines have large footprints and last around 20 years, requiring land for transportation and manufacturing.

### Sustainability of Wind Turbines

### Power of Goals

The ISWTC calls for the use of the Sub-Saharan Africa region, where there is immense need for power. Only 1% of the population has access to electricity.

With a total initial budget of \$11,257, WATurbine is currently manufacturing the turbine, and transporting to Sub-Saharan Africa. With your help, we can build a wind turbine that provides clean energy materials, while achieving optimal efficiency.



## Small Wind, Big Hearts

As a team of driven students with a vision, we would not be able to accomplish our goals without sponsors like you. We are determined to engineer a wind turbine that pushes the boundaries of sustainability and power, while proudly representing the University of Waterloo's reputation for innovation and Engineers Without Borders' mandate for socioenvironmental development.

Your contribution, whether monetary or in-kind, will play a crucial role in our team's success and will help advance the skills and knowledge of future renewable energy engineers. Our sponsors will be proudly displayed on our turbine, team apparel and website. We appreciate your consideration of supporting WATurbine, and hope that you will cheer us on as we embark on this new and exciting challenge of engineering a greener future for all.

	Platinum \$5000+	Gold \$3000+	Silver \$1000+	Bronze <\$1000
Logo on Turbine	XL Choice of Location	L	M	S
Logo on Team Apparel	XL	L	M	S
Logo on Website + Social Media	XL	L	M	S
Certificate of Appreciation	●	●	●	●
Logo on PCBs	●	●	●	●
Mini-Turbine Model Gift	●	●	●	●

our team and ... a f  
ed energy!

# Aerodynamics

# Aerodynamic Leads



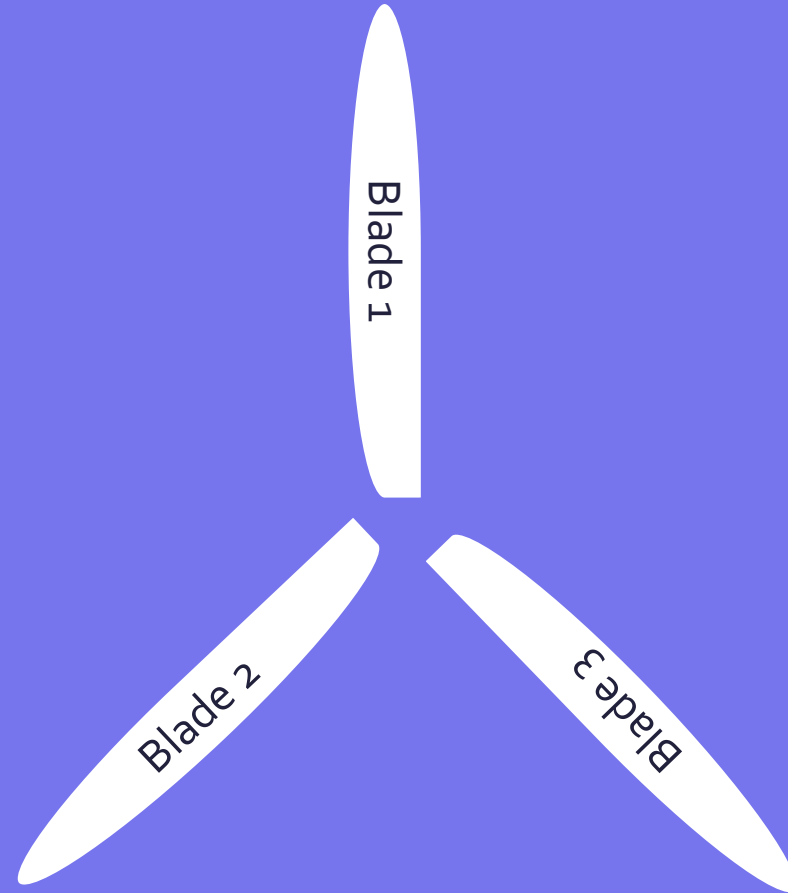
**Alan Hu**  
Aerodynamics Lead



**Violet Hu**  
Aerodynamics Lead



**Katherine Liu**  
Aerodynamics Lead



# Overview

- We are the blades!
- Join us to explore and learn all about the theories and functionality of airfoils and aerodynamics
- Weekly Meetings: **Wednesdays @8-9pm**
  - CPH 3678
  - Discord VC: Staer(e)o



# Projects

## F24

- Airfoil selection and blade design
  - QBlade
- Wind speed and pitch table for controls team (variable pitch)
- Finalize manufacturing plans and timeline
  - Research on manufacturing method for blades
  - Material selection for blades
  - Refine cost estimations

## W25

- Blade manufacturing
- Testing and Integration with other subteams (mainly mechanical and controls)

# Onboarding

- QBlade fundamentals
  - Blade design and wind turbine simulation
  - Read over documentation in our OneNote

The logo for QBlade Community Edition. It features the word "QBlade" in a large, bold, black sans-serif font. A thick, black horizontal line is positioned below the "QBlade" text, extending across its width. Below this line, the words "Community Edition" are written in a smaller, black sans-serif font.

**QBlade**  
Community Edition

# Controls

# Controls Leads



**Steven Armstrong**  
Embedded Systems Director



**Xander Hayhoe**  
Controls Lead

# Overview

- Develop PID algorithm for optimizing Pitch
- Measure real-world precision of servo motors
- High level system design
- Work hand-in-hand with Power team
  
- First team meeting Sunday Oct. 6, 6:30pm
  
- Join this team to work with Teensy, STM32, C/C++, Python, and CAN

# Projects

## F24

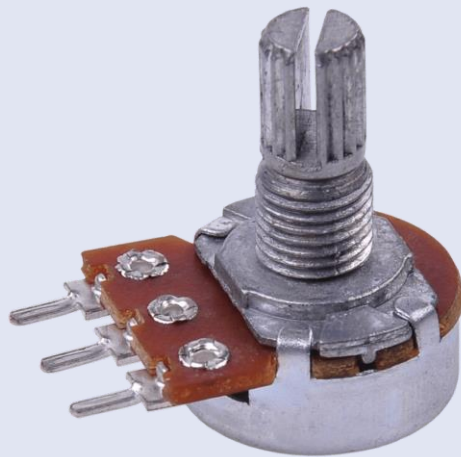
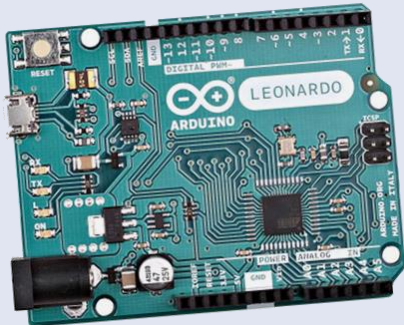
- Onboarding Challenges
- Part sourcing
- Microcontroller research
- Start work on initial PID Algorithm

## W25

- Part collection
- Build relevant circuits
  - Design and print PCBs if time allows
- Fine tune initial algorithm
- Work with Aero and Mech teams to assemble rotor

# Onboarding

- Challenge: Control a servo using a potentiometer with spare Arduinos, breadboards, potentiometers, and servos.
- Tools needed: Arduino IDE for programming.
- Demo requirement: Show working code to proceed with team onboarding. Debug and retry allowed with feedback provided for troubleshooting.



**Mechanical**



# Mechanical Leads



**Evan Kwon**  
Mechanical Lead



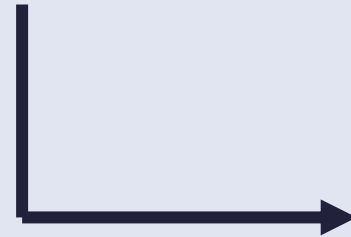
**Robert List**  
Mechanical Lead



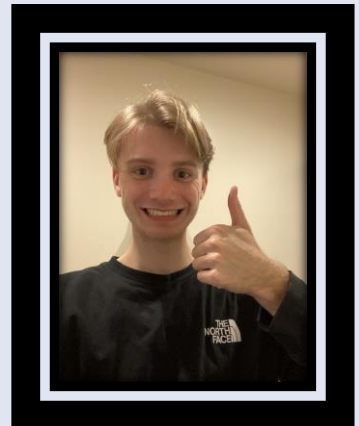
**Jun Woo Oh**  
Mechanical Lead

# Overview

- Join us if you're interested in the design and/or manufacture of dynamic mechanical system!
  - Lots of opportunities for problem solving and design
  - Since many of the sub-systems have very open-ended solutions, you'll have lots of opportunities to shape the outcome of the design
- Weekly meeting times and locations TBD
  - 2/3 members offsite, one of which is in an inconvenient time zone
  - For the time being, discussions are on discord



UTC+13:00



# Projects

## F24

- Sub-system definitions and requirements
  - Assigning constraints and design goals to each sub-system
  - Hand calcs to get a rough idea on sizing components
- Detailed CAD models for each sub-system
- Small scale prototyping

## W25

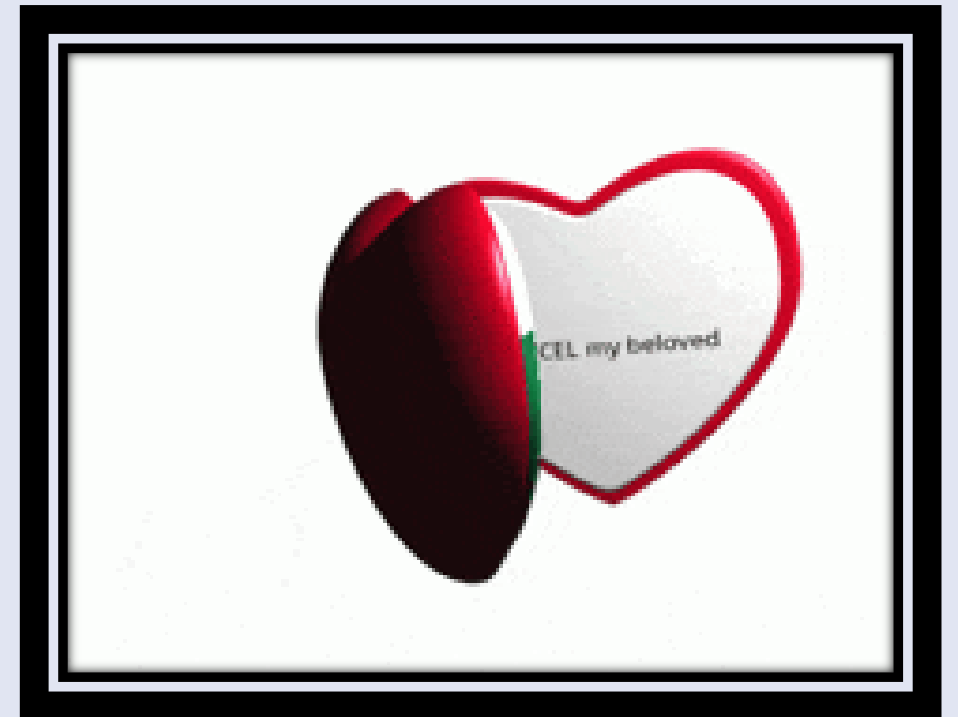
- Material sourcing and BOM management
- Manufacturing parts and assembling sub-systems
- Iterative design process when we inevitably run into issues 😊

# Onboarding

- No onboarding task required 😊
- Read through (and adhere to) the CAD design handbook (WIP)

Not required, but is a plus if you have:

- Excel skills!
- Ability to sketch ideas on paper
- Mechanical system design experience (i.e. through a robotics team)



# Power

# Power Lead



**Ben Liu**  
Power Lead

# Overview

- Designing self-startup system
- Battery system will also allow for stable power output
- Exploring options to maximize power output
- Work hand-in-hand with Controls team
  
- First team meeting Sunday Oct. 6, 6:30pm
  
- Join this team to work with circuit design, power generation, battery management, etc.

# Projects

## F24

- Research necessary electrical fundamentals for parts selection
  - Coordinate with aero team for generator selection
  - Coordinate with controls for feedback systems
- Draft initial main circuit
  - Draft required sub circuits and PCBs
    - Including safety mechanisms
- Source parts and manufacturers (if needed)

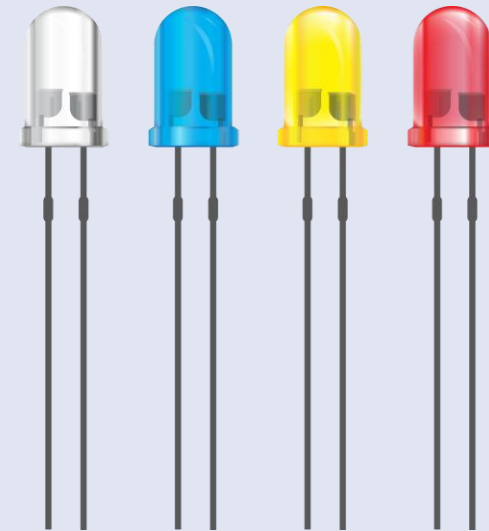
## W25

- Test all purchased electrical components
- Assemble power management boards and motor control systems
- Work with Structural team to mount generator
  - Make changes to structural team requirements as needed
- Assemble circuitry on turbine frame
  - Test circuitry and components after assembly



# Onboarding

- Electrical Safety Training – Self-Registered LEARN Course
- Onboarding Task: Demonstrate basic electrical principles using a real DC Motor
  - Really just spinning a brushed DC motor by hand
- Expected outcome: The multimeter will display a reading and potentially light up an LED



**Structural**

# Structural Leads






**Chantel LeClercq**  
Structural Lead



**Laasya Rajgopal**  
Structural Lead

# Overview

- Research 
  - Research sustainable materials for tower
  - Explore the fabrication of the nacelle
- Design work 
  - Design the nacelle and portable (potentially foldable) tower
  - Conduct FEA and CFD on the designs
  - Learn how to integrate with other sub teams
- Manufacturing 
  - Hands-on manufacturing of nacelle and tower in Student Machine Shop

# Projects

## F24

- Finish Material Selection 🦶
- Establish Material Procurement Resources / Exact Costs 💰
- Establish Manufacturing and Procurement Timeline 🕒
- Complete CAD Model of Tower and Nacelle 🏠
- System Integration (CAD 😊)

## W25

- Acquire Materials 🍷
- Make the Tower (try not to break it challenge!)
- Report Writing 📝
- System Integration (not CAD 😞)

# Onboarding

- Structural Design Considerations
- CAD (Models)
- Simulations (FEA and CFD)

 Meetings: Wed @6pm on discord! (be there or be squared)

# Recap

1. Fill out the form
2. Join the Discord and look through #resources
3. Meetings
  - General WATurbine Meetings
    - Thursdays @ 9PM in E7 1401 and on Discord (Round Table VC)
  - Aerodynamics
    - Wednesdays @ 8PM in CPH 3678 and on Discord (Staer(e)o VC)
  - Controls & Power
    - Sundays @ 6:30PM, location TBC and on Discord (Remote Control + Powerade VCs)
  - Mechanical
    - Weekly Meeting TBC
  - Structural
    - Wednesdays @ 6PM on Discord (5'6" VC)



