



Community wind farm research

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• Spr 2016: Students worked with Weaver Wind Energy to evaluate blade designs for upscaling a domestic-scale wind turbine. 3D blades printed and tested in the wind tunnel. Spr 2017: A design for turbine vibration measurements was implemented at a small wind turbine in the field

• Spr 2016: Project to evaluate feasibility to acoustically detect bird strikes with turbine blades (awarded MAE Bart Conta Prize in Energy & Environment). Spr 2017 designed a remote system used to monitor acoustic emissions at the small turbine site, to be deployed at operating wind farm

Blade design
&
aerodynamics
mechanics

Meteorology
& wind
resource,
turbine
response

Acoustic,
social &
environment
impacts

Education
&
community
interactions

• Spr 2016: Students learnt about and applied wind measurement types & field techniques. Met. station deployed. Spr 2017: Meteorological station was deployed at a local small turbine site, in addition to data analysis and modeling on the impact of wind gusts using wind farm data

• Student projects include designing educational material for the FREE center and wind turbine building and testing at Enfield Elementary School. The school students helped us by designing our new logo (both semesters)



Acknowledgements: Funding from Engaged Cornell

Community partners:

Weaver Wind Energy

Black Oak Wind Farm

Fenner Renewable Energy Education Center

Enfield Elementary School

Old Bird Inc.



Summary

A senior/graduate course (MAE4120/4121 & EAS4120 Community Wind Energy Research) was developed between 3 partners at Cornell and 4 external partners. It offers students the opportunity to develop research projects in community wind energy that are design based (senior design project with significant engineering element) and with other components such as developing and presenting educational material. Working with our local community we are collaboratively developing new research projects and educational opportunities.

MAE 4120/4120 & EAS 4120: Spring syllabus '17

Week	Topic	Assignments and grade
1	Wind farm basics (Prof Barthelmie)	Assignment 1 Wind farm (8%)
2	Projects & education project discussion	Assignment 4 Project outline (6%)
3	Wind meteorology (Prof Pryor)	Assignment 2 Wind meteorology (8%)
4	Atmospheric measurements (Prof Pryor)	Project development
5	Education project work	
6	Acoustic measurements (Dr Klinck)	Assignment 3 Acoustics (8%)
7	Acoustic measurements	Education project
8	Bill Evans, Old Bird Inc!	Assignment 6 Mid semester project progress report (10%)
9	Enfield Elementary School	Assignment 5 Education project (10%)
10	Marguerite Wells, Invenergy	
11	Project work	Feedback on projects
12	Project work in the lab	
13	Deployments in the field	Feedback on projects
14	Analysis and report writing	Draft project reports due
15	Project presentations	Assignment 7 Presentations (10%)
16	Project writing	Assignment 8 Final project reports (40%)

Lectures by Cornell partners (30%)

Lectures/visits to/from community partners (10%)

Project work with community partners (60%)

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Do students value this engaged-based learning? Yes!

Direct quotes from 2016 course evaluations

"As a graduating senior, I was surprised to find this was by far the best course I have ever taken in my entire life. It fundamentally changed my understanding of how research is conducted, made me aware of the limitations working professionals have in the STEM fields, and showed me that with a little work, one can actually make a difference in the world."

"I learned how to improve my thinking process. Instead of simply working on a problem in isolation, I was able to bring everything we learned throughout the course and not only apply it to my research, but have it shape my research in a direction that would be most suitable to people in the field."

"Great class! I really liked the project-based concept - I find I learn things much better when I need to use or present them in the context of project work."

"I think a course project allows us to apply engineering knowledge to a real-world problem. This idea is often talked about in the engineering curriculum but is never as 'real' as it was in this course. I like that we contributed (in however small a way) to the local wind energy industry."

"The greatest gift this class gave me was not only an appreciation and greater interest for wind energy, clean tech, and the environment, but I actually won two (*job*) offers while taking this course."

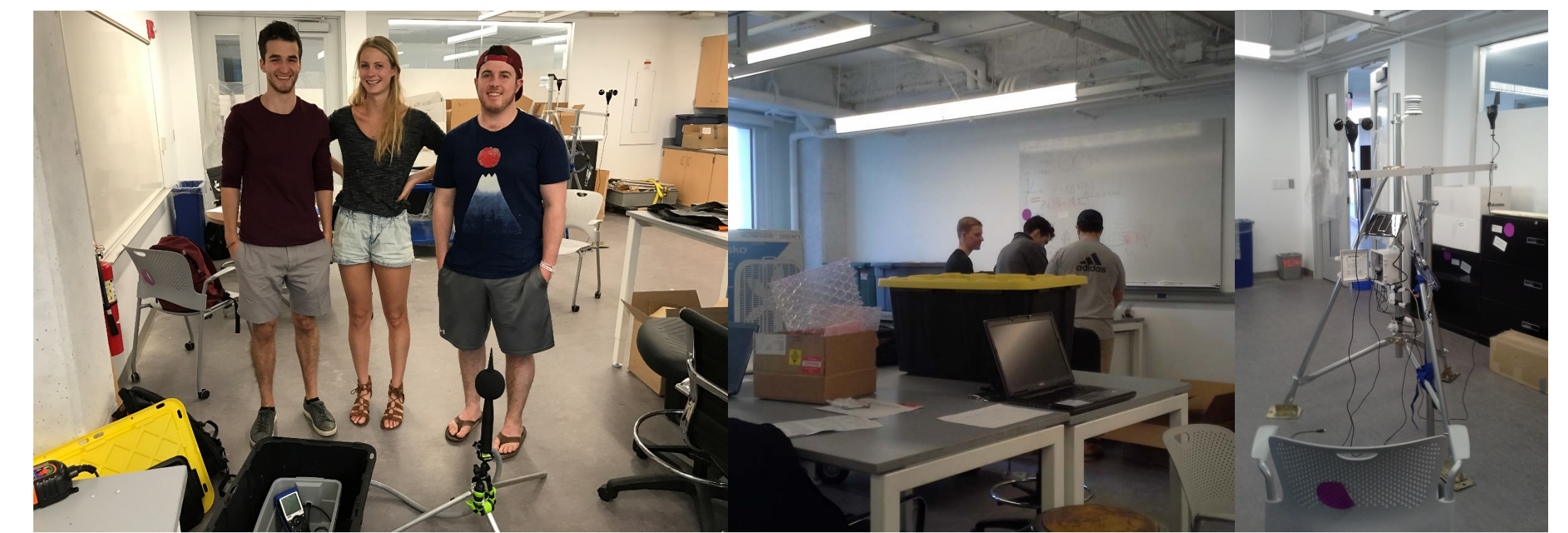
Follow up with students from 2016 spring one year on:

"I had a great time in your course; yours was one that helped to pique my interest in renewable energy. I'm an energy and sustainability consultant at **** now, and I use what I learned in your classes for wind energy feasibility assessments on a regular basis. I'd love to help out any way I can to ensure the class continues."

"The level of autonomy afforded to the students in Professor Barthelmie's class drove one to think like a researcher. Guidance and resources were always available, but students were encouraged to select and design their own study. This was both engaging and exciting, and differed in structure from the vast majority of other classes available. This was the first class I took where I had an active role in choosing the work in which I was involved, which more closely mimics a true research environment. This course was inspiring, and helped to plant a desire to seek out additional research opportunities at my current company."

"I presented on the research I did for this class during the interview for my current job; Professor Barthelmie's class directly helped me to get hired. Because I helped to develop the question I researched, I was passionate about the work I did, and that certainly showed in an interview setting. The structure of the class allowed students to demonstrate initiative and technical competence, both of which are highly valued in the workplace."

"I enjoyed the course, it felt intriguing and very different from a traditional class. As a research based elective class, I find it has high value in giving me what I needed before I headed out into the real world. The variety of professionals who came gave unique perspectives on the wind power industry. This open-mindedness helps show the opportunities out there. I personally developed my wind blade CAD modeling skills (now useful in exactly what my *** engineering job does), with the understanding of how its design and performance affects the overall turbine and external features. I'm glad to see the course has progressed and hope it continues to do well in the future."



What is needed to run this type of course?

Keys to success:

- Faculty willing to undertake this kind of experience where they have less control over the content & outcomes and to invest time way above and beyond the normal course load without additional credit
- Students with open minds and a determination to connect their traditional course work to community-based projects in exchange for an enhanced learning experience
- Administration willing to invest in real terms for project equipment, other resources and TA's and to be flexible in assigning credit to faculty participation
- Community willing to invest time and energy, sometimes for rather intangible benefits

Are there other benefits? Yes!

