HUTCHINSON®

Self Powered Bat Echo Jammer

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Project Outline

- Ultrasound deterrents have been proven effective for many bat species in wind turbine application.

- State-of-the-art solutions are placed either on towers or nacelles.

- Our idea is to utilize the piezoelectric actuators for ultrasound generation positioned directly on the blades.
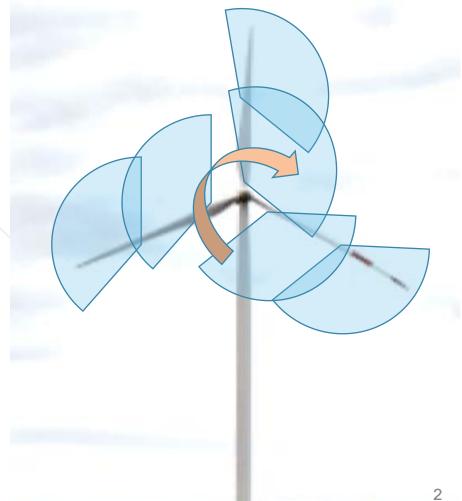
Benefits to blade mounting:
Put a sensor with range that is limited by physics (i.e. ultrasound dissipates quickly) as close to the point at which collision takes place (i.e. blade)

It might be necessary to have multiple devices along the blades to ensure universal field strength.
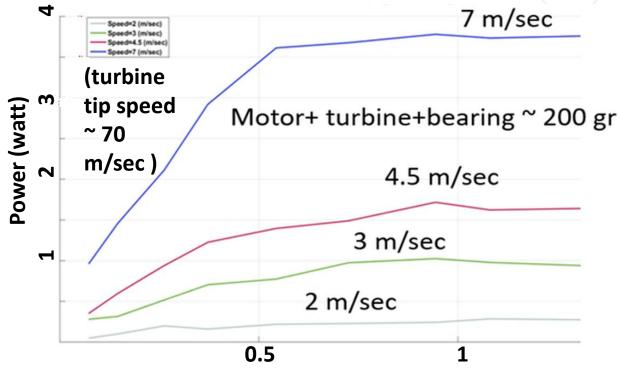
Challenges:
How do we secure the device to the turbine?
How do we power these devices?
Are these devices robust enough?
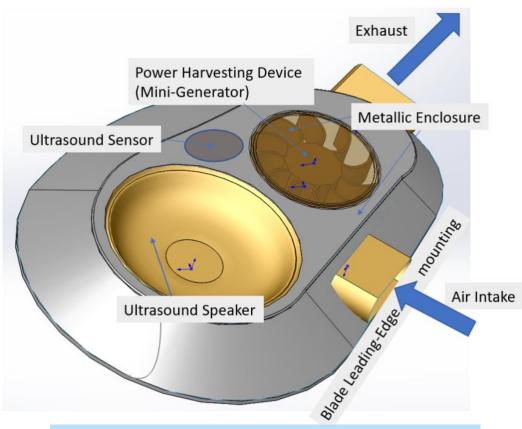
Self Powered Ultrasound Generator

- **The device we envision is self powered and mounted on the blades**
- **It is composed of mainly two parts:**

1) The power harvesting system   **2) The ultrasound generator**

(turbine tip speed ~ 70 m/sec)

Motor+ turbine+bearing ~ 200 gr

7 m/sec

4.5 m/sec

3 m/sec

2 m/sec

Power (watt)

Load (normalized to matching impedance)

Power Harvesting Device (Mini-Generator)

Exhaust

Metallic Enclosure

Ultrasound Sensor

Ultrasound Speaker

Blade Leading-Edge mounting

Air Intake

- **Projected device performances based on preliminary results show that we are able to produce the required energy.**

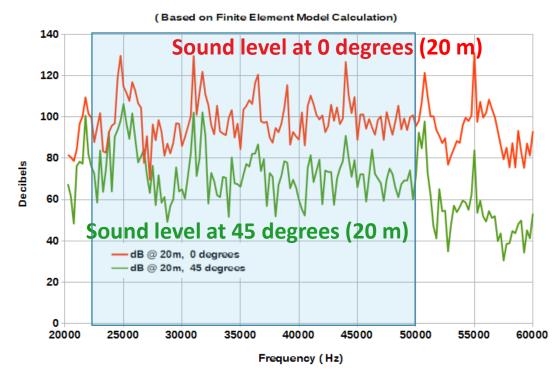**It is a very challenging project- no doubt!**

The Ultrasound in more detail

- The ultrasound generator is a stainless-steel cone driven by a piezoelectric actuator
- Our simulations show
    - 80 dB at 20 m distance (at 0 degrees)
    - Requires less than 10 W in dry air

Calculated Decibel Level at 20 meter Range for Single Low Profile Ultrasound Source
(Based on Finite Element Model Calculation)

Sound level at 0 degrees (20 m)

Sound level at 45 degrees (20 m)

- dB @ 20m, 0 degrees
- dB @ 20m, 45 degrees
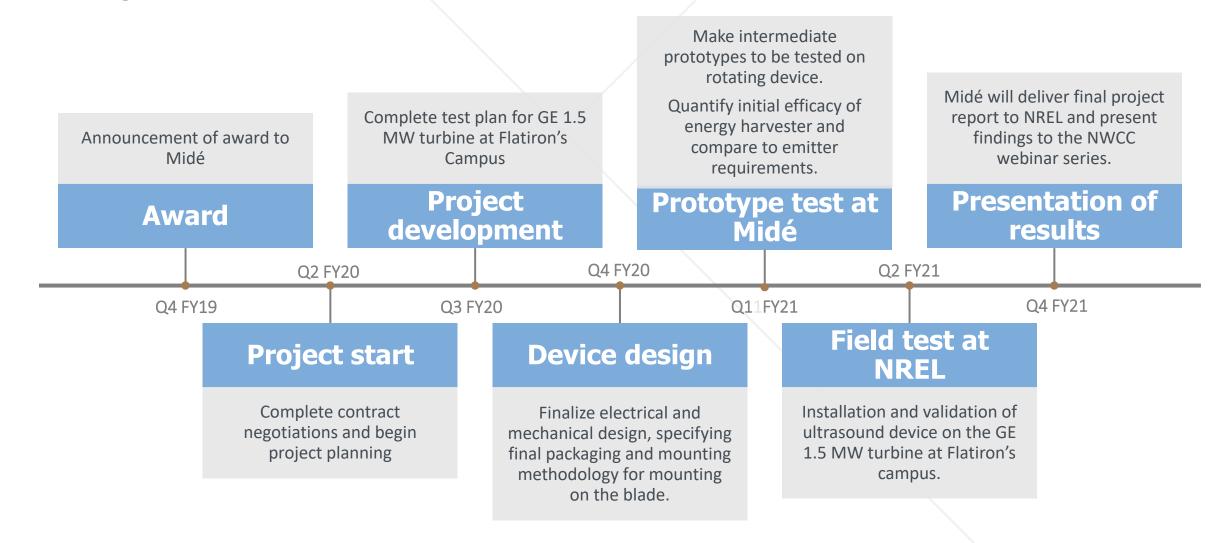
Decibels

Frequency (Hz)

- Data reported in literature show that the range of the most common bat species ranges between 20 and 50 kHz.
- The idea of this deterrent is that an ultrasound source would jam bat echolocation, and, as a result, the bat would avoid that area.
- This approach has been validated in some studies, although exceptions are reported.

There are many different questions that will remain after Phase I of this project, including, how far and what level of sound is necessary for deterrence. However, in this phase, we will concentrate on producing the target sound level (which is in line with other solutions). The final product will be a TRL1 to 3 (prototype)

Project timeline

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Announcement of award to Midé

Award

Complete test plan for GE 1.5 MW turbine at Flatiron's Campus

Project development

Make intermediate prototypes to be tested on rotating device.

Quantify initial efficacy of energy harvester and compare to emitter requirements.

Prototype test at Midé

Midé will deliver final project report to NREL and present findings to the NWCC webinar series.

Presentation of results

Q2 FY20 — Q4 FY20 — Q2 FY21

Q4 FY19 — Q3 FY20 — Q1 FY21 — Q4 FY21

Project start

Complete contract negotiations and begin project planning

Device design

Finalize electrical and mechanical design, specifying final packaging and mounting methodology for mounting on the blade.

Field test at NREL

Installation and validation of ultrasound device on the GE 1.5 MW turbine at Flatiron's campus.

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Summary of Project Outcomes

- Quantification of efficacy of mounting methodology on blade (both from ground tests and on a rotating rotor).

- We will have quantitative results from a rotating frame on how much energy is available to power this device.

- This will be the first in-field deployment of a Midé device on a MW-scale turbine. We will get significant feedback as a result as to the robustness of the device.

- Conducting this field experiment will give more insight into the challenges associated with mounting a device like this on a wind turbine blade.

- Operational validation of energy harvesting and ultrasonic emitter performance.

Midé Technology, a Hutchinson Company