



Reliable Anemometers to Improve Small Wind Turbine Performance

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FT Technologies Background



- Formed in 1983 in London, UK.
- Manufacturer of wind sensors, specifically designed for wind turbine control.
 - Inventor of Acoustic Resonance technology which results in a small physical size and high measurement qualities
- >120,000 sensors installed worldwide
 - >99.9% reliability
- Used by the world's leading wind turbine OEMs
- Used by several major wind turbine OEM's.
- Certified to 28 International environmental standards in addition to UL/CSA 61010.

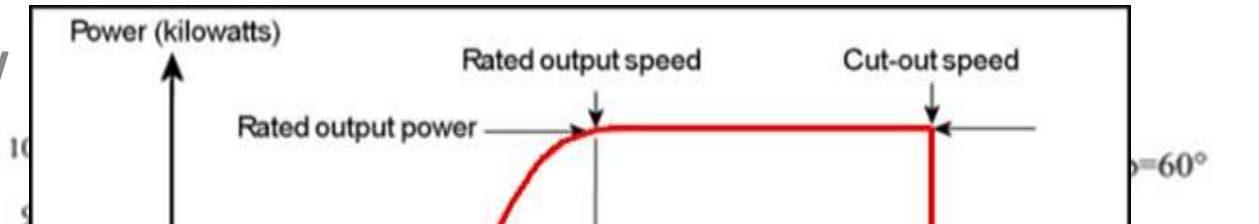


Role of wind sensors in turbine control

- Control of cut-in/cut out

- Yaw

- In



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$$\text{POWER IN THE WIND} = d \times D^2 \times V^3 \times C$$

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Many designs and technologies available

Mechanical sensors –
cup (speed) and
vane (direction)



Ultrasonic sensors –
speed and direction
in one unit



Frequently encountered problems

- Sensors stop working completely due to ice or snow, causing the turbine to shut down



- Damage caused by lightning
- Bearing damage due to ice penetration



Birds find the sensors tasty!

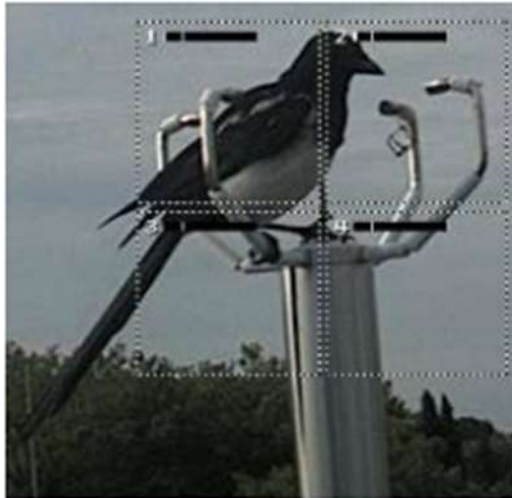


Figure 1: destroyed membrane

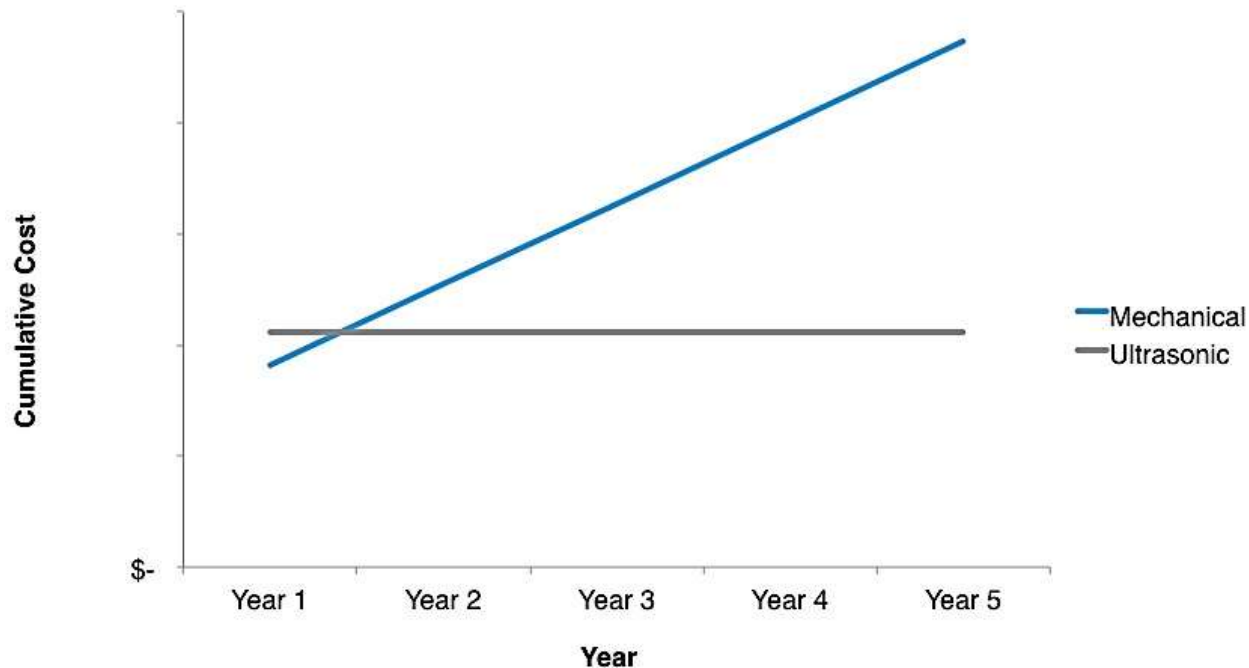


Figure 2: sonotrode ripped out

Ultrasonic CoO better than mechanical



5 Year Wind Sensor Cumulative Costs



Many ultrasonics require no periodic calibration or maintenance, unlike mechanicals

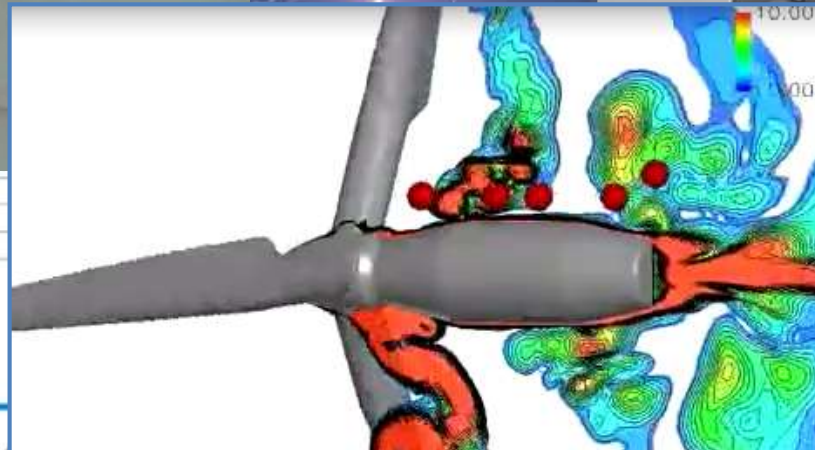
Challenges of small wind

Smaller scale creates issues for wind sensors:

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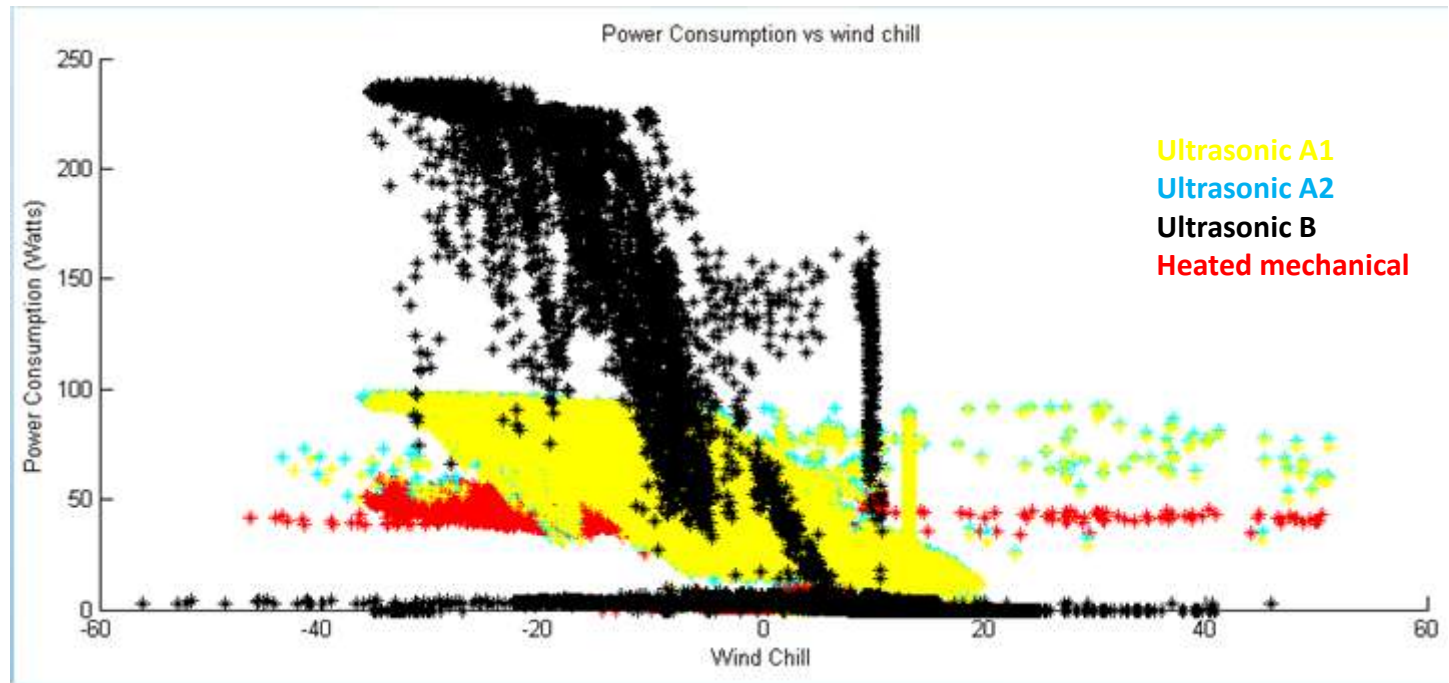


Year of installation
Capacity (kW)
MWh/year



55

Power Consumption vs wind chill



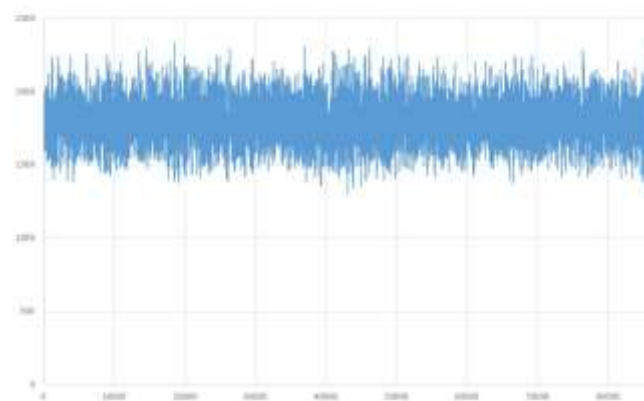
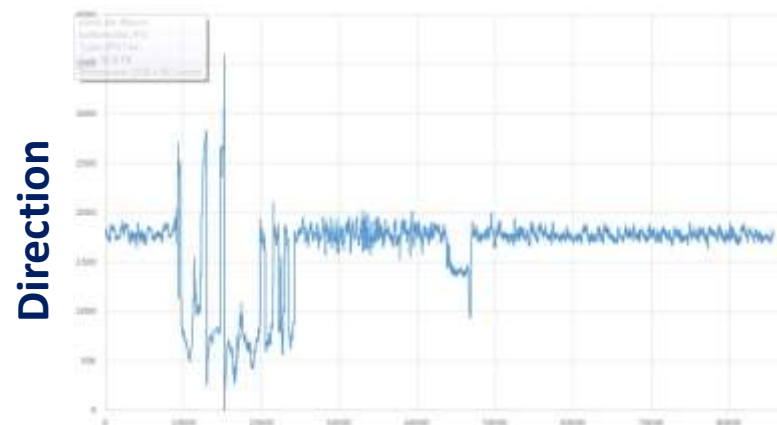
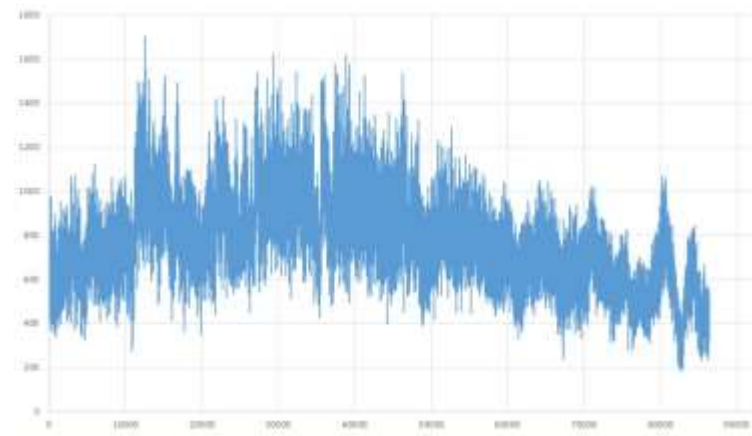
$$\text{Wind Chill } (^{\circ}\text{F}) = 35.74 + 0.6215T - 35.75V^{0.16} + 0.4275TV^{0.16}$$

where

T = Air Temperature ($^{\circ}\text{F}$)

V = Wind Speed (mph)

Noise performance



Ultrasonic A

Ultrasonic C

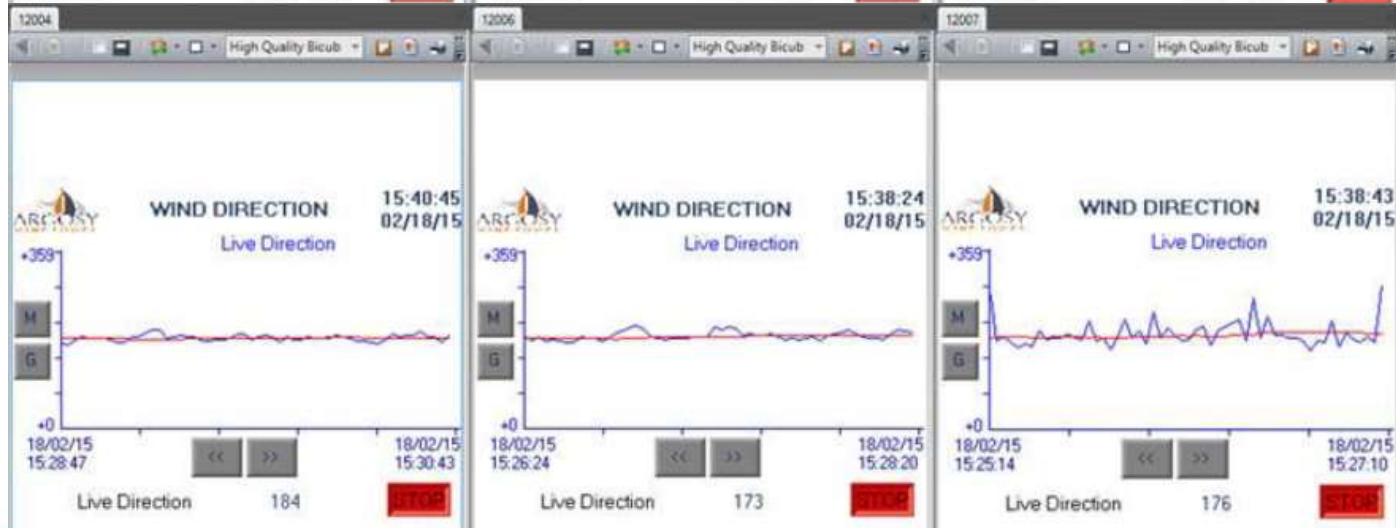
Comparative performance of wind sensors (4)

Noise performance

Wind speed



Direction



Ultrasonic A

Ultrasonic C1

Ultrasonic C2

Conclusions



- The choice of wind sensor can have a direct effect on the uptime, and power production output of your turbine.
- Wind sensor technologies are available commercially which offer:
 - Very high levels of reliability,
 - Very high levels of data availability,
 - Excellent icing performance with low power consumption,
 - High signal/noise measurement quality with high EMI immunity,
 - Low CoO (compared to mechanicals),
 - Long lifetimes.

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End of Presentation

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