Sound precision: acoustic resonance sets the tone for wind sensing

Daniel Reid, Head of Wind Energy Sales at FT Technologies, shares how the company's proprietary acoustic resonance technology is setting new standards in wind measurement, delivering high-performance sensing for offshore wind and unlocking opportunities across maritime, aviation and autonomous systems.

PES: Thanks for taking the time to speak with us today, Daniel. Can I start by asking, with wind measurement technology being a competitive space, what differentiates FT Technologies' sensors from other ultrasonic wind measurement solutions on the market?

Daniel Reid: FT Wind Sensors are exclusively powered by Acoustic Resonance (ACU-RES®) Technology, the proprietary invention of FT Technologies. This acoustic resonance measurement method differs significantly from the Time-of-Flight (ToF) principle used in other ultrasonic wind measurement solutions on the market.

The ToF principle works by measuring the transit time of ultrasonic pulses between transducers; one transmitting the pulse and the other receiving it. The system calculates the difference between the transit times with and against the wind to determine airflow characteristics.

In contrast, the acoustic resonance method uses a resonant cavity where sound waves oscillate back and forth. As the wind passes through the cavity, we measure the phase shift of the standing waves. This ensures improved data integrity within a compact and robust design, providing high and exceptional resistance to vibration and external interference, making it ideal for harsh environments.

PES: In a crowded field of wind measurement technology, what sets your unique acoustic resonance sensors apart in the ultrasonic space?

DR: Our acoustic resonance technology operates inside a small cavity, amplifying the usable signal while significantly reducing external acoustic noise interference. Other systems, ToF for example, can require extensive signal processing, averaging or filtering to manage noise in variable weather conditions. Performance often degrades over distance or is disrupted by adverse conditions such as heavy rain, snow, or pollution.

A critical performance metric distinguishing Acu-Res® is the Signal-to-Noise Ratio (SNR). To clarify, the signal refers to the usable ultrasonic wave for measurement, the noise is any unwanted disturbance, acoustic, electrical or environmental, that interferes with the signal.

A high SNR ensures clear signals, resulting in accurate and stable measurements. Conversely, a low SNR can lead to noisy data, errors and dropouts in storms. This makes SNR a decisive factor in selecting wind sensors, especially for demanding environments or key applications.

PES: FT Technologies has been the go-to for wind turbine OEMs and retrofits for nearly 25 years. Please can you share some main points of that journey and what's helped you stay ahead in such a rapidly evolving industry?

DR: A pivotal moment was the decision to collaborate closely with the OEMs during the earliest development stages of the wind sensors as we know them today. This gave us a strong appreciation of their challenges and allowed us to optimise the design from a physical, electrical and software standpoint to deliver the best sensor for the job.

This close partnership and continuous knowledge sharing remain integral to our product development approach.

PES: Offshore wind is scaling fast, bringing increased technical demands. What's changing in your development approach as you meet the expectations of next-generation projects?

Daniel Reid

DR: Offshore wind installations can be some of the toughest environments for any sensor to operate in. They also pose significant challenges to operators trying to carry out any maintenance and service work. Being able to rely on a component that has an extremely low failure rate whilst operating at a high level of performance is essential to keep the turbine operational.

We are constantly refining our products, from subtle enhancements in software processing to full-scale geometry redesigns, all with the goal of maximising performance and extending product longevity.

In regions prone to typhoons, hurricanes, icy conditions, or offshore thunderstorms, the latest FT7 series provides a vital capability to measure wind speeds of up to 90 m/s (201 mph / 175 knots) without the need for periodic maintenance.

PES: Floating offshore wind presents unique challenges, particularly in motion-induced turbulence. How do you ensure your sensors remain accurate and reliable in these dynamic conditions?

DR: We fully adopted the APQP4Wind framework across the entire business in our product development and technology for wind turbine control applications in 2019. With over 30 independent external tests and certifications, our wind sensors meet the industry's toughest standards.

This is where FT wind sensors' robust Environmental Protection System (EPS: heaters, ingress protection, hard-anodised aluminium body, and EMC protection) and Acu-Res® technology work in tandem, particularly in motion-induced turbulence. Each wind sensor undergoes our world-class wind tunnel calibration process and requires no further calibration by the customer.

The acoustic cavity is designed to behave predictably even with inclined airflow, a performance verified at a MEASNET-accredited wind tunnel.

PES: Sustainability has become a non-negotiable across the supply chain. Tell us about the steps you are taking to align with that shift, from materials to manufacturing.

DR: Sustainability is what we do. We embrace lean manufacturing principles, prioritising the reduction of material waste across our processes. Imagine holding the average FT742-FF hard-anodised wind sensor in your hand; it weighs only 320 g and 16 cm in length, uses minimal materials to manufacture, low energy to deliver and is easily transported to the top of a wind turbine nacelle.

Our ultra-compact sensor design is also low-powered, whilst still capable of highly effective heating for anti-icing performance. These benefits translate into savings for customers, as well as environmental gains.

PES: How is sustainability represented within FT's sensor in the field?

DR: The long-lasting, durable design and construction decrease the need for frequent replacements, thus reducing e-waste. Rather than replacing numerous anemometers that break and fail, customers are supporting sustainability when choosing FT wind sensors. A key feature is the sensor's compact size and low weight, decreasing the need for excess packaging and lowering the shipping CO_2 emissions.

PES: Given FT Technologies' expertise in wind sensing, are there opportunities for your technology to be applied beyond wind energy, such as in aviation, maritime or autonomous systems?

DR: Though we are predominantly known for wind turbine control systems, we crossover to a myriad of applications, including maritime use for ship navigation, yacht racing, aviation, unmanned systems, scientific research, safety warning systems, powerline monitoring and more.

Acu-Res® comes into its own in dynamic applications where traditional technologies struggle to provide consistent output under such harsh conditions. Our application engineers are on hand for any new integration to support the testing and any unique installation challenges.

PES: While wind remains at the core, what's driving that crossover into other markets and where is it heading?

DR: The need to accurately and reliably measure wind speed and direction is critical far beyond the wind energy sector. Our FT sensors, being small, tough and based on acoustic resonance, survive extreme conditions while providing consistent data. This means whether you are sailing through a storm or relying on the wind data for safe operating conditions, the FT sensor can be trusted to always deliver accurate data.

PES: With the increasing use of AI and machine learning in wind farm operations, do you foresee a future where wind sensors play a more predictive role in turbine performance optimisation?

DR: As AI and machine learning become central to wind farm optimisation, the quality of input data is more crucial than ever. Predictive models are only as good as the data they rely on; therefore, having accurate and reliable wind measurements is indispensable. That's where our sensors, built for reliability, can make the difference, producing accurate real-time data that can be readily used for control operations.

PES: As analytics become more prevalent in wind energy, how do you support seamless integration with SCADA systems and predictive maintenance solutions?

DR: FT wind sensors feature an array of user configurable settings and we work closely with our customers to facilitate seamless integration into their SCADA systems.

We offer both a digital RS485 interface and an analogue 4–20 mA current loop option. FT sensor's real-time accurate data and new features like Advanced Sensor Diagnostics, support AI-driven systems in tasks like power curve monitoring, identifying performance issues or enabling proactive maintenance that helps reduce downtime.

PES: Extreme weather conditions, such as ice, salt, and dust, can impact wind turbine operations. How do you ensure your sensors maintain accuracy and durability in these conditions?

DR: Product certification is important to us and our customers. FT wind sensors have passed over 30 external independent tests. This includes environmental certification and EMC tests for extreme weather conditions that not only impact wind turbines but other industrial uses. We also have our own onsite environmental test lab, meaning we can test any innovations or changes rapidly, furthering our development to ensure the sensor is as tough as it can be.

To ensure the highest level of accuracy, all of our sensors are calibrated using our in-house bespoke wind tunnel. Additionally, FT wind sensors are routinely sampled from production and their calibration is verified in a MEASNET-accredited wind tunnel. This rigorous process guarantees the precision and reliability of our wind sensors.

PES: Looking ahead, with turbines growing in size and complexity and projects moving ever further from shore, what role do you see FT Technologies playing in the offshore wind story over the next decade?

DR: We expect the FT sensor to remain a critical and dependable component for the next generation of turbines. Whether serving as a principal safety element on larger turbines or providing reliable performance on remote offshore projects, every unique challenge fuels our development pipeline. We are proud of our legacy in the wind industry and we are focused on building on it for the next 25 years and beyond.

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