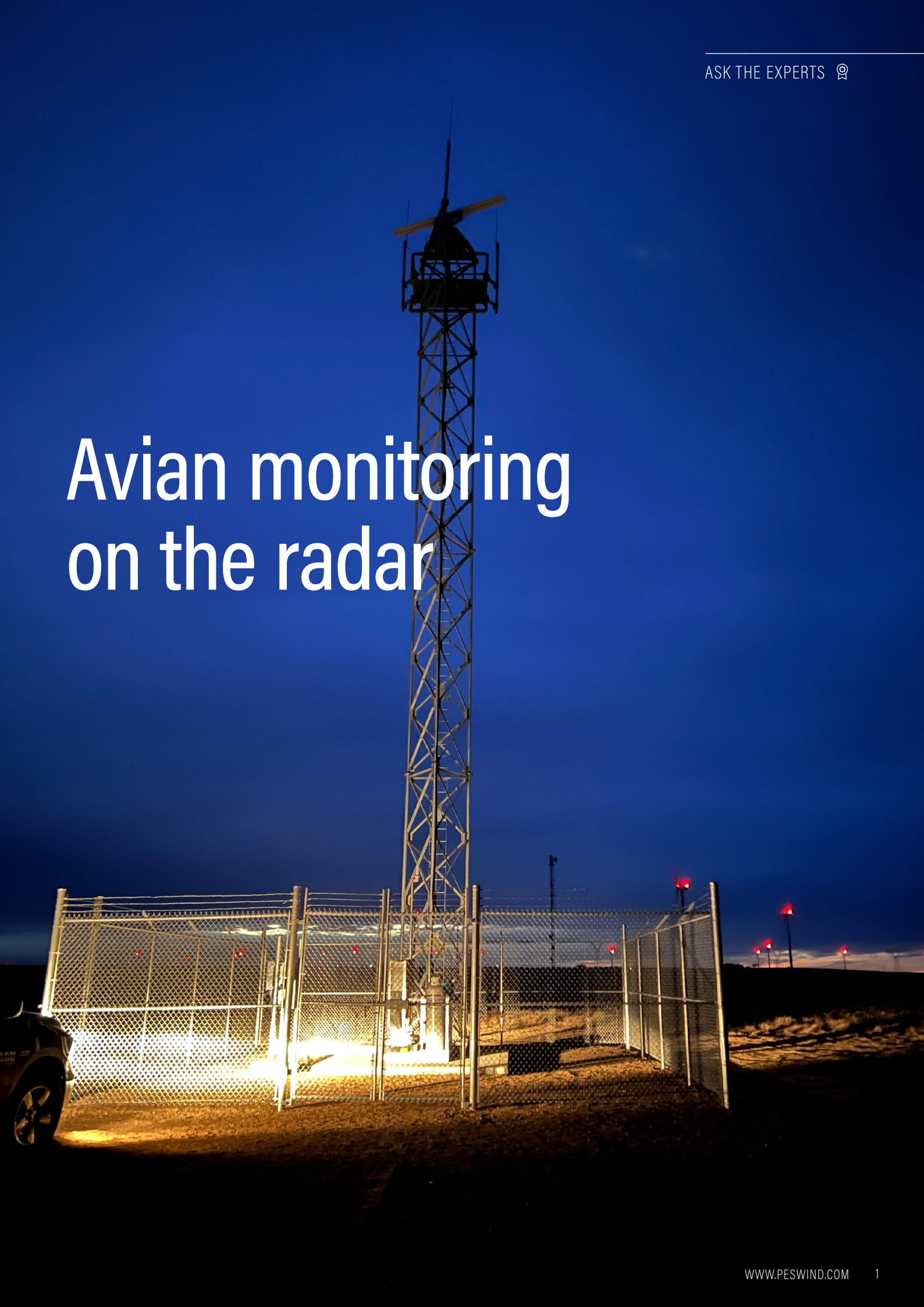
Avian monitoring on the radar



Originally developed for the US Air Force and NASA as a precision bird detection radar system, DeTect's Avian Radar technology can provide continuous monitoring of bird and bat activity at ranges of three to eight miles around wind farm sites. The company's Senior Biologist, Jenny Davenport, explains more to PES.

PES: Firstly, I'm really pleased to welcome you to PES Wind and look forward to learning more about DeTect. Perhaps a good place to start would be for you to give us a little background on the company and where you fit in the wind sector?

Jenny Davenport: DeTect was founded in 2003 and just celebrated its 20th anniversary on June 11th. We specialise in advanced 2D andTrue3D™ radar and other sensor technologies for aviation, security, and environmental applications. We got our start back in 2003 when we were working closely with the US Air Force to develop radar systems to detect and track birds to prevent costly bird strikes to aircraft.

Our first system, the MERLIN Aircraft Birdstrike Avoidance Radar, is still a core part of our business. We also found opportunities in the wind energy space and, in 2004, delivered our first bird radar system for a pre-construction survey at a proposed offshore wind farm off the coast of the Netherlands. These early systems are still operating today, nearly 20 years later.

Since then, wind energy bird radars have been one of our top products. In 2012, we developed an Aircraft Detection Lighting System (ADLS) that activates wind turbine obstruction lights only when aircraft are near a wind farm to reduce night-time light pollution. All these developments allow us to provide comprehensive bird and bat monitoring and mitigation, as well as lighting control, for both land-based and offshore wind farms.

PES: Can you tell us more about your relationship with the US Air Force and NASA?

JD: NASA got our attention in July 2005 when the space shuttle on the STS-114 mission was struck by a Turkey Vulture during launch. It was concluded to pose significant damage risk to the heat shield tiles on the space shuttle. DeTect understood immediately how our radar systems could manage this potentially fatal safety gap and we were given the opportunity to monitor the next launch on July 4th, 2006. The successful launch was the first time an avian radar system had been used in the decision process of launching a rocket system. DeTect's MERLIN system subsequently was used by NASA to support 22 launches of the space shuttle, until the program ended in 2011.

PES: You've delivered quite a number of radar systems since the business was founded 20 years ago, haven't you?

JD: Yes, we have delivered over 400 bird radar radars around the world, plus more than 140 ADLS and over 200 airspace, marine and counter-drone systems around the world to date.

PES: You operate worldwide, but which regions are your primary focus?

Jenny Davenport

JD: We are based in Panama City, Florida, USA, and most of our early work was primarily in the US. Today we have delivered our specialised radar systems to Canada, the UK, Europe, Africa, the Middle East, and Asia. We will deliver our first system to Australia in late 2023. Today we are definitely a global organisation with global offices and staff.

PES: One of your focuses is around bird monitoring and mitigation, isn't it? Can you give us a bit of background to the systems and services you provide here?

JD: Wind farm developers and stakeholders are concerned about bird and bat movements in and around a prospective wind farm site, so they contact us to carry out a pre-site radar survey of the area. In some cases, they are concerned with seasonal migrations, while others may have worries about an individual protected species.

We typically install the MERLIN system at the site and do continuous monitoring for at least a season, and sometimes up to a year or more to give a complete picture of bird and bat movements at the site. The length of the survey period depends on the site and the potential for bird and bat mortality.

The technology is highly automated providing unattended 24-7 collection of high-quality data on bird activity around the site that can be used to develop detailed pre-construction mortality risk projections and for operational mitigation. Once the wind farm is operational, the radars are often used

to provide continuous monitoring of bird and bat activity at the wind farm.

Additionally, the radar can be integrated with the operating wind farm to detect high risk bird or bat activity as an early warning system, providing advance detection of bird and bat activity that presents mortality risk and automatically engaging mitigation actions up to and including idling of turbines until the risk passes.

PES: What are the benefits of this, compared to conventional visual and manual radar ornithology avian survey techniques?

JD: Our radar systems are fully automated, consistently scanning 24 hours a day, seven days a week, 365 days a year and can see at greater distances and in most weather conditions. A biologist, for example, cannot reliably 'see' bird and bat movement at night, which is when migration is most prevalent, or at a distance beyond one kilometer, even in daylight.

Traditional biologist surveys also depend on limited sampling periods collecting data from only parts of a night and a season, potentially missing important or unknown bird activity, and observer surveys are even more difficult and expensive offshore.

The MERLIN bird radar on the other hand processes the radar signal in real-time, providing live displays of bird activity location, flight paths, altitudes, size, and other information with all data stored to an internal SQL data system that can be post processed to provide a very detailed analysis of bird and bat activity at the site with virtually no data gaps.

The radar system in this case acts as a pair of 'electronic binoculars' for the project biologists to help them gain a better understanding of biological activity at the site, providing a more quantitative assessment of bird and bat mortality risk.

PES: As wind farms shift further and further offshore the challenges increase, don't they? What are some of the main challenges you come across?

JD: The two greatest challenges continue to be limited access for surveys and harsh environmental conditions. One particular challenge is that radar systems need a stable platform to operate correctly and oftentimes there are no existing platforms where an offshore wind farm is being developed from which a radar survey could be conducted. To address this, DeTect is now developing a lightweight, stabilized True 3D bird radar that can operate on a research buoy or floating platform. DeTect is undertaking 'first article' trials offshore in the US and Europe and plans to have this new system commercially available by early 2024.

PES: What lessons have been learned from these?

JD: Everything must be controlled, diagnosed, and fixed remotely, to the greatest extent possible. Testing before deployment is critical. Equipment hardiness is also critical, as every part must be able to withstand and survive the harsh environmental conditions: sun, temperature extremes, water from waves and condensation, humidity, salt, and cyclone-level winds.

None of these factors are compatible with electronics to begin with, but the equipment must be able to withstand them to an even greater degree offshore. Fortunately, our experience in developing hardened radar systems for the military has provided us with the expertise and resources to address these requirements.

PES: How can DeTect help?

JD: With over 600 successful projects to date, we have the global expertise, staff and experience to deliver effective solutions.

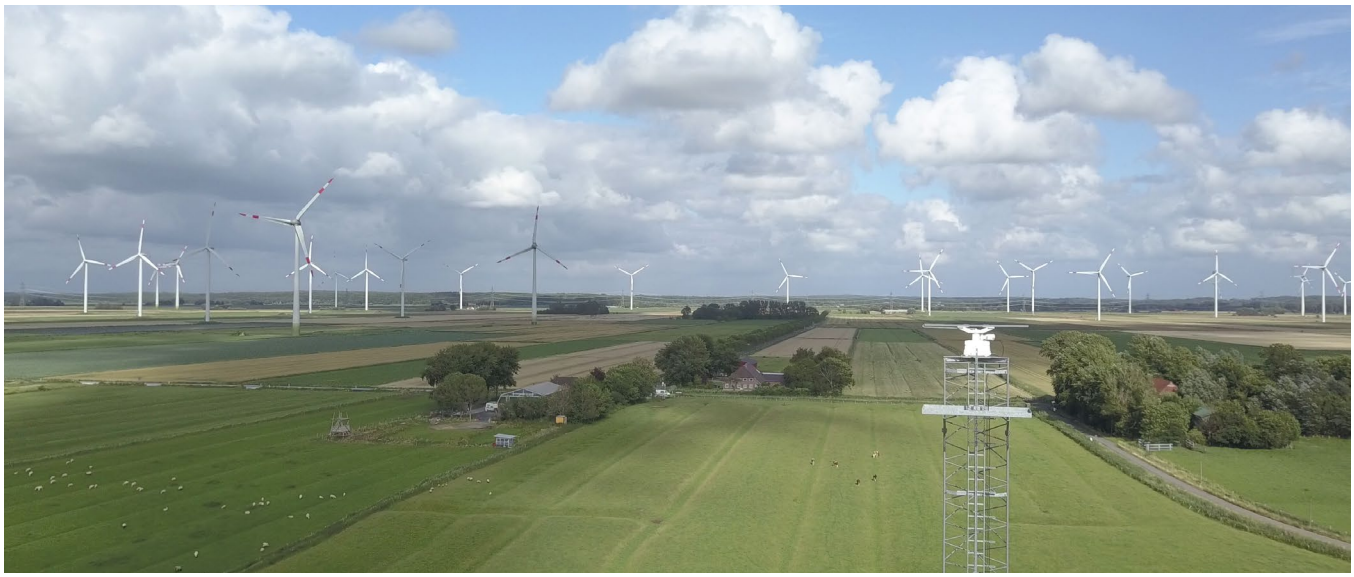
Our professional staff includes experienced multilingual engineers, programmers, scientists, aviation safety professionals, security specialists, and technicians that are the top experts in remote sensing, radar engineering, system integration, security, operation, and environmental management.

We also have over 40,000 square feet of company-owned office, laboratory, and manufacturing space in the US, Canada, and Poland to support design, development, assembly, and testing of advanced radar systems. In-house manufacturing expertise includes fabrication, mechanical assembly, electronics design and fabrication and seamless integration of third-party components such as cameras, video and infrared sensors, and deterrent devices into our products.

DeTect systems are in use at facilities and projects worldwide with a proven record of exceptional performance and reliability, and over five million hours of successful operating experience since 2003. With us, customers get more than a system. Each system is supported by a team who have extensive background and experience in systems design, manufacture, siting and, most importantly, integration and use of the technology in the real-world environment, with effective user interfaces to meet each customer's specific business operational requirements.

PES: What kind of range does the technology have?

JD: The radar sensors for 2D and True 3D™ typically have a range of three to eight miles with the shorter ranges used when smaller targets are the focus. But as always, radars are line-of-sight, so project design is very important to ensure full coverage of the airspace around the project site. Other sensors used in conjunction with the radar sensor also have their own limitations. Acoustic monitoring, for example, is often



used for determining species presence of bats, but also some bird species.

Acoustics, however, are greatly affected by call frequency and atmospheric conditions. For bats the average detection range is 25 to 30 meters, but ranges from 10 to 100 meters depending on the species. The range for acoustic bird monitoring is somewhat greater. Visual monitoring, with camera or video, is also affected by the target size and environmental conditions, with daylight cameras detecting up to one to two miles and thermal cameras detecting up to 2,000 meters at night.

PES: Presumably the system can be used both to assess risk during the setting up of wind farm sites and provide important information for those already operating?

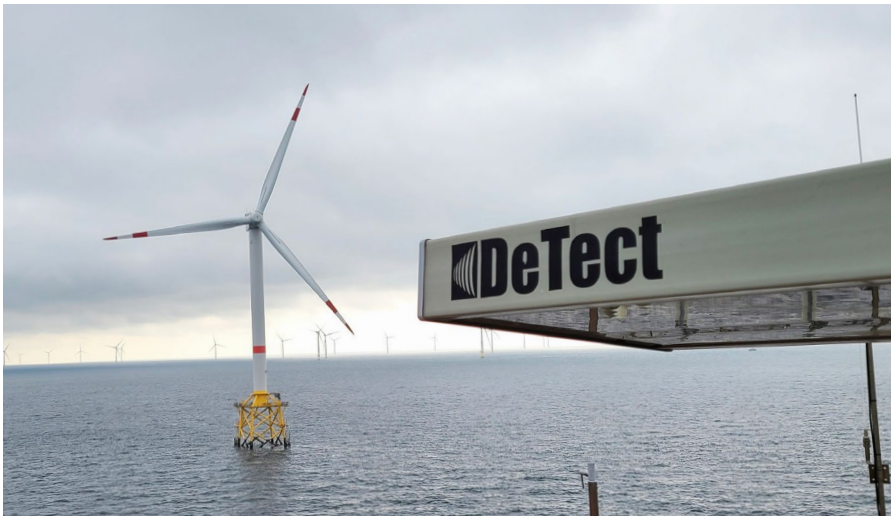
JD: Yes. DeTect specialises in both pre-operational monitoring and post-operational monitoring and mitigation. Our BMS is used to assess a site prior to development but is more often used as a first step for BMMS, which evaluates activity and movement patterns at a site, followed by analysis of that data, and finally development and implementation of mitigation strategies using the initial data collected.

The BMMS technology today, with our advanced True 3D radar technology and integrated Artificial Intelligence software, can now not only detect and track birds and bats, but can also identify targets down to the species level. DeTect's BMMS is also adaptive, continually evaluating results and adjusting risk thresholds and strategies as needed to minimise bird mortality while maximising clean energy production.

PES: What kind of data does the technology provide and how is it delivered?

JD: The data provided depends on the type of system and auxiliary sensors deployed. Primarily radar data is provided, but also input from other sensors including acoustics, cameras, and weather data. The radar data are essentially counts of targets but are delivered as standardised target passage rates and can be filtered by target size and / or targets flying through a particular zone. The radar data along with data collected simultaneously from other sensors, provides clients with a rich dataset of bird activity onsite, ways to categorise that activity, and associated environmental conditions. This in turn, allows the discovery and modelling of risk criteria, and the development of mitigation strategies based on sound, reliable data.

Data comes in the form of generalised data reports for a week, month, or season, or can be customised to only present specific data such as whether risk criteria were met and when or if mitigation occurred. Data can be delivered automatically as a daily email or sent as a report for longer time periods, with options for customised manual reports also available. Computer displays showing the radar and other



sensor data in real-time, alongside any risk or mitigation thresholds, are also very useful for wind farm biologists and operators.

PES: Can you give us a real-life example of how MERLIN is being used already by your customers?

JD: Most of our projects are under confidentiality agreements, however there are various published articles and sources online. For example, in 2008, we worked with Pattern Energy to develop the first radar-based systems for monitoring and mitigating bird fall-out risk (www.theguardian.com/environment/2009/may/01/wind-farm-bird-radar). The US Fish and Wildlife Service and other regulators around the world have also used MERLIN technology to assess and map bird risk at proposed wind farm sites (www.fws.gov/project/avian-radar-project-and-great-lakes-airspace-map-decision-support-tool).

PES: As well as birds, you focus on aircraft too don't you? How has this area of your business grown as a result of the Dark Sky initiative to reduce light pollution and customer demand?

JD: Our business has grown significantly over the past few years as a result of the Dark Skies initiative. In 2012 DeTect commissioned its first HARRIER ADLS. In early 2023 we delivered our 100th system and the company currently has over 35 systems on order, to be delivered in 2023 and 2024.

ADLS enables wind farm operators to keep the turbine aviation lights off until the radar detects a plane entering a designated zone around the wind farm, at which point, the radar allows lights to turn on. The lights then return to off once the radar system detects that the plane has left the zone. In some instances, DeTect's ADLS has enabled a wind farm to be permitted as it has been able to demonstrate that the lights will be off most, if not all, of the night.

The ADLS is a win-win solution for both the neighbours and the wind farm operators, keeping the skies dark 97% on average. Multiple US states have now mandated ADLS for all new wind farms, requiring retrofitting of most older wind farms. DeTect has even trademarked the slogan 'Be a good neighbour, Keep the lights off'!

PES: Are you working on any new technologies to help further as the sector grows?

JD: Interestingly, I was reading your last publication and there was an article about drones being used at wind farms for turbine inspections and other tasks. Currently an operator cannot fly a drone farther than they can see it as the drone cannot see-and-avoid other objects like aircraft in the airspace.

We have another product, the HARRIER Beyond Visual Line-of-Sight (BVLOS) radar that was the first to be approved by the US FAA for use as a mobile airspace radar to extend drone operating ranges out to 16+ miles allowing operators to conduct their inspections offshore or on land from a single location. More importantly, the architecture of DeTect's radars is such that a bird or ADLS radar can also function as a BVLOS radar making it a muti-functional system, for birds, aircraft, drones, all from a single radar sensor.

PES: What do you think the future holds for the use of radar, are there even more possibilities to be discovered?

JD: We certainly think so. Our radar technology is already being used in multiple industries for a variety of applications. Other developing applications for our radar systems include BVLOS, security and surveillance, and drones. We have learned that there will always be a need for innovative detection technology, and there is no lack of questions pushing that technology development forward. And that is where DeTect has thrived, creating accessible radar technology for variable monitoring and mitigation needs under continually developing challenges.

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