



Peak inspection records



Tom Brady

SkySpecs CTO, Tom Brady, dropped in to catch us up with the latest developments in the use of drones for inspections. It has been quite a year for them, with record breaking numbers of inspections in the fastest time. This company is wowing the industry.

PES: Welcome back to PES Wind magazine. Thanks for talking with us. For our new readers would you like to begin by explaining a little about the background of SkySpecs and how you currently serve the wind industry?

Tom Brady: Thank you to PES for taking the time to speak with us! SkySpecs is an automated diagnostics and maintenance provider for smart grid applications. We're a team of engineers obsessed with applying our robotics expertise to

problems faced by owners and operators of energy infrastructure.

Today, we serve the wind industry with a drone-based blade inspection solution. Our drones are completely automated, requiring only the push of a single button to collect photos of all four sides of each of the three blades of a wind turbine in 20 minutes or less. We've conducted over 3,000 inspections this year, saved our customers thousands of hours of downtime, and identified tens of



The second thing driving drone adoption is a globally improved understanding of what drones can and can't do. At the end of the day, drones are just tools, and although drones allow us to act in the third dimension, they still aren't magic. This mindset has shifted somewhat from a couple years ago, when the hype around drones was so intense that it was challenging to filter the signal from the noise. Highly funded startups were preaching the gospel of drones, stating that drones could and would do absolutely anything. In that sense, the drone industry has matured since we last spoke with PES in that we're seeing a lot more focus. The industry has taken note of and awarded that focus. Whereas in 2015 and 2016 we saw generic drone 'platforms', we now see much more funding pouring into -and customer traction with - drone technology companies focused on solving the unique problems faced by specific industries. This is how SkySpecs is tackling the challenges of the energy sector - bit by bit we understand a challenge faced by a customer, and we build a tailored solution around that problem, which can then be deployed at scale.

PES: We are in a period of innovation in regards to technology and imagine that this applies to drones, could you bring us up to date on any new developments?

TB: I think the 2010s will come to be identified as a modern renaissance in artificial intelligence and automation technologies. These advances are driven largely by the availability of data, cheaper sensors in more viable form factors, and the ability to process that data with more powerful computers that take up less space.

From a macro view, driverless vehicles have had a huge impact on drone technology, as they've pushed the market toward economies of scale that could never have been afforded to drones on their own. Consider, for example, the laser range-finder that SkySpecs uses for its navigation system, which is also used by many driverless vehicle manufacturers and researchers. A comparable system in 2000-2010 would have been five times the size and over 10 times the price.

Beyond humanity's ability to pack more transistors into a square inch on an integrated circuit, we've also become much better at dealing with data. It's no coincidence, for example, that we get Siri and driverless cars in the same decade. These two technologies are both built on a foundation of interpreting and acting on data.

In the case of driverless cars, it's understanding contextual information -- is that a pedestrian or a fire hydrant? What does that road sign mean? Where in the world am I?

In the case of Siri, there are more human factors -- How should I answer that question based on every other question I've

answered in the past and the feedback I've gotten from people like you?

Drones, particularly in the workplace, face similar challenges and have benefitted greatly from broader developments in the artificial intelligence arena.

PES: We see that in the spring you were breaking records on wind turbine inspections, please tell us about this.

TB: In May we announced that we had completed over 400 inspections in a 30 day period. Since that time, we've shattered our own records several times over, with single day totals of over 30 inspections for a single drone.

We're looking to next year for even more impressive volumes as the wind industry turns collectively toward a more proactive approach to blade maintenance, and blade inspections continue to be a priority.

The key differentiator for SkySpecs, which allows us to carry out inspections so efficiently, is our automation technology. Our process for doing inspections requires only a push of a single button.

The turbine is stopped once, the drone operator presses 'go', and the drone does all the work while the operator stands by and observes. The blades don't need to be rotated and pitched multiple times, as is common for ground-based and most other drone-based inspection methods.

PES: We were wondering why SkySpecs decided to focus on wind turbine inspection with the UAVs?

TB: It's a funny story, so I'm glad you asked. When we founded SkySpecs, we fell victim to what I like to call 'product hubris.' We thought we could build a single drone that could do absolutely anything -- from bridge inspections to power line inspections to sewer inspections and surveillance.

We lacked focus, so it ended up taking quite a while before gaining a deep understanding of the challenges faced by any subset of our potential customer base.

The event that pointed us wholly toward the wind industry was back in 2013. We were wrapping up our masters degrees at the University of Michigan at the time, and there was a business competition for students called the Clean Energy Venture Challenge. Our pitch deck then focused on bridge inspection, which is not clean energy related, so it took a few wise words from an advisor to get us to apply.

'Just change all the pictures in your pitch deck from bridges to wind turbines and submit an application.' He was right - the challenges faced in conducting inspections are similar across industry verticals.

We applied to the competition and ended up winning, which landed us some prize

thousands of instances of damage that owners can use to make better decisions about repair.

PES: We know that the use of drones is rapidly growing, what has changed since we last spoke?

TB: It's encouraging to see drones delivering real business value across a variety of sectors.

In my opinion, there are two reasons that drone use has become pervasive across industries. First, off-the-shelf GPS waypoint-following technology has substantially lowered the training and experience barrier for drone operators readily solving the data collection problem in several industry sectors; agriculture and construction are two examples. What used to take hundreds of hours of piloting experience can now be done with just the click of a few buttons.



money and a sponsored trip to the American Wind Energy Association show in Chicago in 2013.

At AWEA, we found many wind owners and O&M companies that were investigating drones, or had actually tried and struggled to deploy them, as part of new blade inspection procedures. They immediately saw the value of automation. Since AWEA 2013, wind turbine inspection has been at the core of our business.

PES: Do automated inspections have an impact on efficiency/ROI? If so can you explain how?

TB: Wind turbine owners can save money simply by getting inspections done quickly. For every single inspection SkySpecs conducts, we're saving our customers 30 minutes to 3 hours of downtime when compared to traditional or more manual inspection methods.

This translates to \$20 - \$100 of additional energy production per inspection on a 2MW turbine, which adds up quickly when you consider major wind owners with 10,000 wind assets or more in their fleet. Downtime savings, though, is only scratching the surface in terms of how owners will save money with automated

inspection technology.

Imagine if asset managers could understand precisely how damage would grow over the course of the next year, or if they knew how much a certain type of erosion was affecting their top line.

These are the types of benefits that excite us, and that we're confident automation will someday offer. With an autonomous inspection platform, we capture the same pictures, year after year, allowing damage and repair data to be tracked and measured more accurately than it's ever been.

PES: Could you tell us about any current or future projects?

TB: Over the past year, we've amassed an enormous, machine-readable database of blade damage. Hundreds of thousands of photos of blades span dozens of turbine makes and models across the entire globe. When this data is used in the aggregate, and correlated against a variety of different inputs, such as weather patterns, geography, and the turbine's year of installation, we'll be able to develop models that can predict which turbines are at high risk for certain types of blade damage.

Taking that one step further, we're working

with strategic partners that own wind turbines to see whether correlations can be drawn between blade damage and losses in production.

For example, we know that leading edge erosion can have an adverse effect on a turbine's performance -- in some studies, shown to yield 5 - 8% losses. Quantifying the impact of blade damage on how much energy a turbine can produce and how much it costs to produce that energy will allow owners to calculate the expected return on investment for conducting a repair.

When thinking how maintenance is currently viewed across the energy sector, this new data-driven approach is very exciting. Rather than maintenance decisions being made at the discretion of an expert, economic analysis powered by machine learning and artificial intelligence will be able to tell us precisely the right time to conduct a repair, and how much it should cost.

Someday, predictive and preventative maintenance technologies will pay for themselves in improvements on energy producers' top line.

That's the world we're trying to create, and where you can expect to see some major

developments from SkySpecs in the years to come.

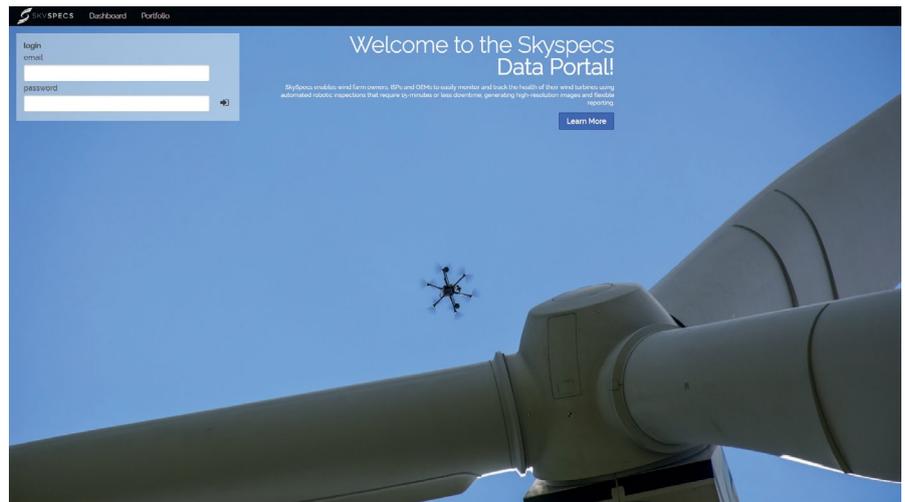
PES: We note that there are more and more UAV operators. How are you finding this and what do you think makes SkySpecs stand out from the competition?

TB: This increase is a testament to drone manufacturers and the incredible advances they've made in off-the-shelf drone technology. Extremely versatile commercial drone platforms are now available for only hundreds or a few thousand dollars. Many come with advanced safety features that make piloting minimal.

For industrial use cases, though, the ease of use of off-the-shelf drones can turn out to be a bit of a trap. What we've found throughout the wind industry is that drone operators, and, in many cases wind turbine owners with internal research groups focused on drone technology, have succeeded at large in proof of concept or demo blade inspections conducted by a manual drone pilot.

In fact they are so encouraged and excited by their initial tests, or after an initial demo, that they end up committing the resources to deploy the technology at scale.

In attempting to replicate the inspection across hundreds or even thousands of turbines, manual pilots tend to come up



short. Taking pictures of wind turbine blades is one thing, but taking the same pictures across an entire fleet year after year is quite another.

Scalability and reliability are where SkySpecs has excelled above its competition. When we return to these same turbines, we'll collect the exact same data, allowing our customers to precisely track and compare blade damage over time. This is something that no manual drone operation can currently guarantee.

We've also found that managing and

making sense of all the data that drones are able to collect is no small task, especially for manual drone companies operating in a dozen or more different industry applications. SkySpecs' web portal enables owners of wind turbines to prioritize repairs and filter damages in a variety of ways. We've removed our customers from the complex task of data organization and management, and are allowing them to focus on what they do best -- produce energy!

www.skyspecs.com

