Scaling up rotor blade inspections

Join SkyVisor for a look at the transformative impact of in-housing rotor blade inspections with automatic drone flights and AI-driven defect detection solutions. Discover how to gain greater control over your assets, learn about the latest drone regulations, pricing, and technology, plus explore how deep learning is revolutionizing blade health monitoring.

The changing role of operators

For wind turbine operators, the increasing demand for renewable energy and rising labor and equipment costs highlight the shortcomings of the traditional full scope operation & maintenance (O&M) strategies.

The statistics are alarming: 65% [1] of O&M costs are unexpected, disrupting schedules and supply chains. Rotor blade maintenance alone consumes 22% [2] of turbine costs, and blade and drivetrain failures account for 80% [3] of these unplanned expenses.

These figures underscore the failure of traditional full scope O&M strategies to address the industry's evolving needs. However, innovative AI solutions for composite blade defect detection are emerging, leveraging cutting edge technology to aid in the digital transformation of O&M practices.

SkyVisor, a French company established in 2018 operating in 30 markets worldwide, offers an all in one software suite for renewable energy asset management, featuring an automatic drone flight app and an AI-powered asset management platform.

As the industry evolved, the company noticed a significant shift: operators, who previously focused on developing as many projects as possible, started with the drop in energy guarantee price to focus on the turbine performance, thus investing more in the operation and maintenance of their assets.

With six years of experience and 10 GW of inspected assets, it has become a trusted industry leader to support and supply operators with dedicated O&M software, endorsed by clients such as EDF, RES, and RWE.

Today, the company is revolutionizing inspections with a deep learning approach developed by its expert engineers. This innovative method significantly improves defect detection accuracy and efficiency, allowing operators to analyze inspections independently.

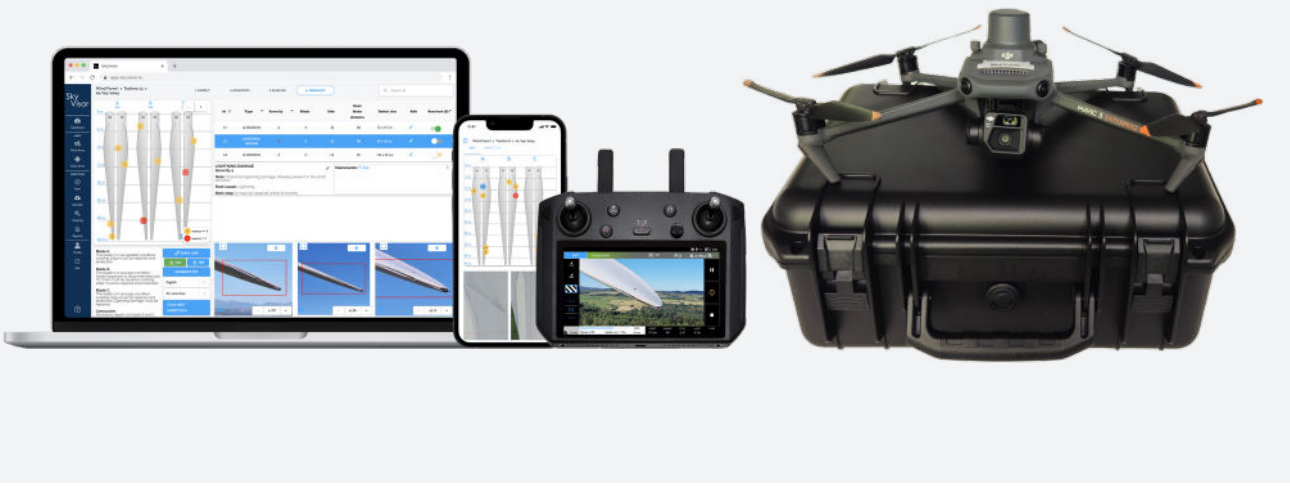
Take charge with in-house inspections

Gone are the days when original equipment manufacturers (OEMs) handled all maintenance. Today, operators are increasingly taking charge of asset management, using portable drones for in-house inspections and focusing on production beyond installation.

Traditionally, blade health assessments were carried out by resource intensive, contact inspections every 7 to 10 years. Nevertheless, those inspections were not meeting the real need; being able to adjust inspection frequency depending on real turbine conditions. Now, autonomous drones with SkyVisor's software enable inspections to be done whenever it's required, providing detailed and cheaper insights for condition assessment and predictive maintenance.

By conducting frequent in-house drone inspections, issues are addressed before they impact performance. For instance, defects requiring close monitoring can be inspected monthly with SkyVisor's unlimited inspection model, whereas new turbines in a low erosion region can be inspected at a lower frequency.

With over 8,000 inspections conducted, the company's wind solution makes inspections easy. Automatic drone flight software inspects turbine blades and towers in just 18 minutes per turbine, all while complying with local regulations. Their approach focuses on high quality, standardized data; flexible inspection scheduling; plus time and cost efficiency.



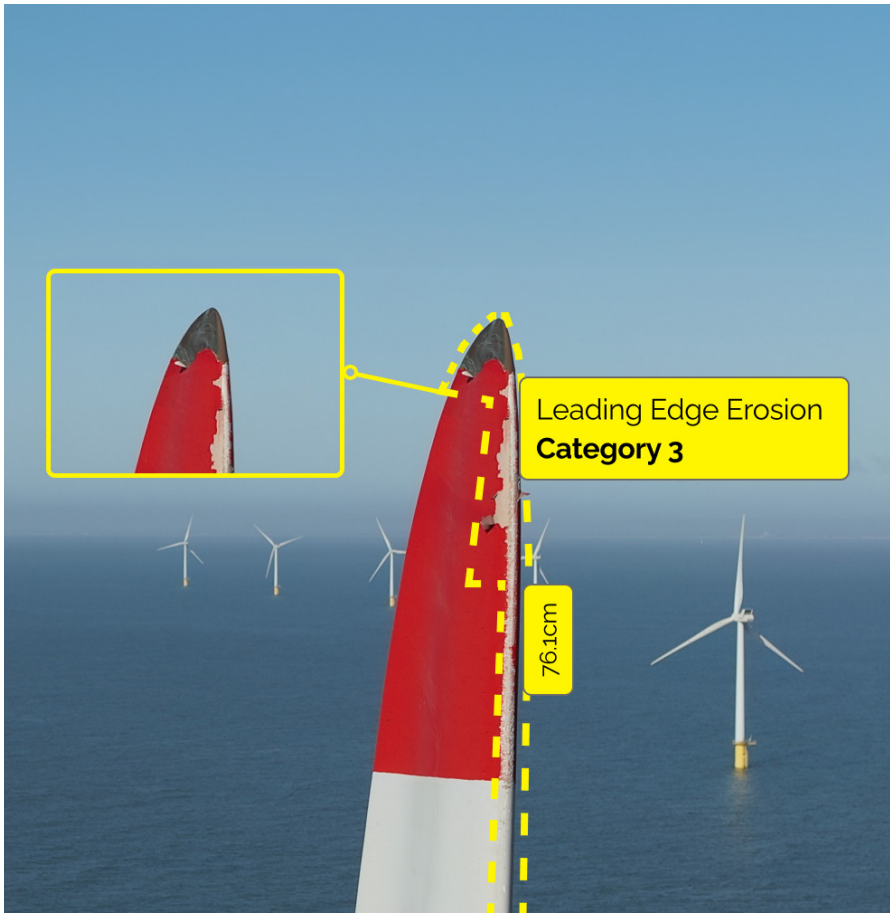
Its blade inspection app guides 100% autonomous drones to gather precise, high quality data throughout the turbine's lifecycle, enabling operators to monitor defects with the same accuracy as doctors tracking changes in a birthmark.

How drone industry advancements support in-housing

Recent legal and industrial advancements have turned drones from complex to fly machines into everyday tools. Four main drivers explain these changes: smaller and cheaper drones, a clearer legal framework, and powerful automation software.

First of all, drones benefited from the breakthrough evolution of the smartphone industry. Indeed, modern drones now share the same internal components, such as GPS chips, and accelerometers, benefiting both from smartphone innovations and scale induced drop in price. Previously, high quality images required large, custom drones weighing around 6 kg (13 lbs) for a 20,000€ acquisition cost, whereas today, models like the DJI Mavic 3 Enterprise, weighing just 900 grams (2 lbs) for only 5,000 €, deliver the same image quality when equipped with the automatic flight software from SkyVisor, that allows it to fly automatically at a distance of only five meters from the blade.

Lastly, the recent updates to European drone regulations, effective January 1, 2024, keep simplifying drone use and placing them in everyone's toolbox. The EASA[4] regulations allow drone flights outside populated areas, thus for most wind farms, even the ones next to airports with a minimal license, the Online OPEN Category exam.



So what to do to start inspecting turbine blades yourself? Just subscribe to SkyVisor's all-in-one package offer, which covers software, hardware, insurance, and training. You will then start inspecting straight after your one day training, which can be completed either on-site or comfortably online through their eLearning platform.

The training program guarantees the safe and compliant use of the solution. Support during your subscription, including free consultation and operational assistance, ensures that SkyVisor becomes your personal drone department throughout your in-housing journey

Once this powerful tool is set up and part of your daily routine for close blade monitoring, the next step is ensuring the data collected is valuable for both today's needs and tomorrow's innovations.

It all starts with data

With wind turbines expected to operate for 25+ years, effective data management is crucial, especially given fast technology changes and turnover. The financial instability of OEMs and the collapses of some of them like Senvion [5] highlight the risks of losing valuable asset data. To safeguard against these risks, operators must take control of their data.

High quality, proprietary data enables better defect detection, supports the creation of digital twins, and enhances predictive maintenance strategies, ensuring long term availability and reliability of data. This also reinforces predictive maintenance strategies by improving data quality and ownership.

The company excels in standardized data collection, ensuring that your data belongs to you. When you own your data, you have full control over who can access it and how it's used. This ensures that even if external partnerships change or end, your data remains secure and accessible.

SkyVisor Wind's automated flight captures images following uniform guidelines, ensuring defects are recorded the same way over your entire asset lifecycle. The drone will take about 120 images per blade, providing a detailed dataset of the 12 blade sides. Additional parameters are also logged, such as the defect position or size based on proprietary algorithms, providing crucial context for defect classification and decision making.

AI and deep learning in blade defect detection

Artificial Intelligence (AI) is revolutionizing the industry's ability to process vast amounts of data. Deep Learning (DL), a subset of AI, is particularly influential in providing fast and precise defect detection that makes predictive maintenance more accessible for every operator.

The new deep learning solution has already significantly benefited operators. A great example is the feedback from Boralex, a top tier French IPP which saw a 61% reduction in time spent on defect detection and a 50% increase in identifying defects.[6]

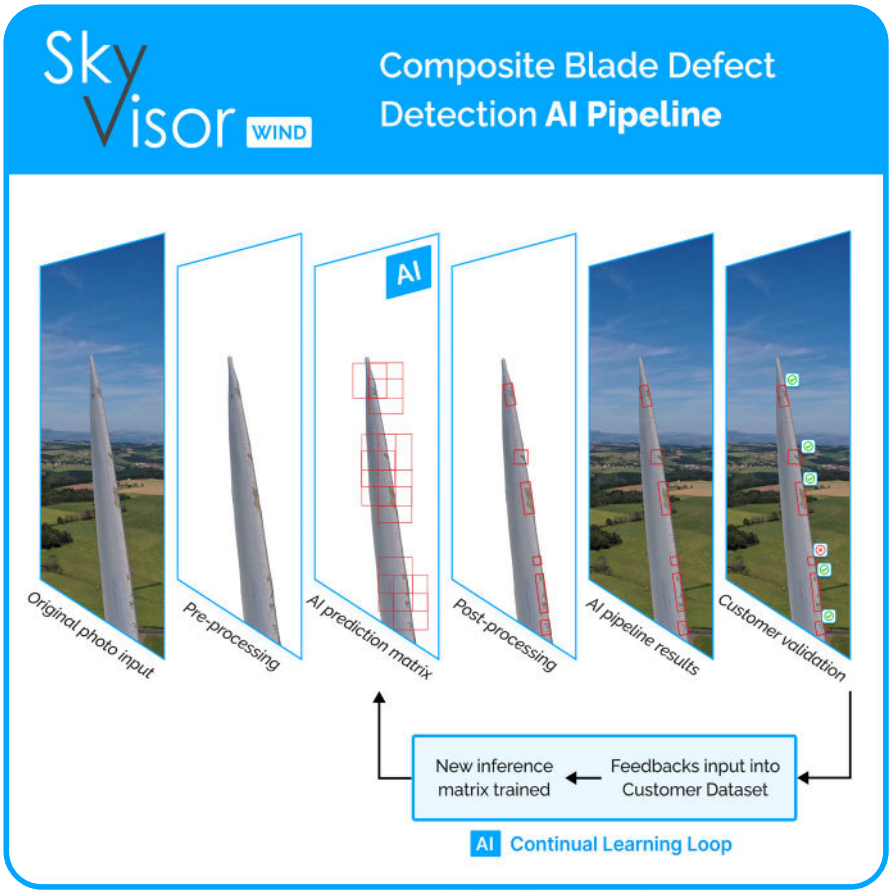
Their approach leverages deep learning models, which use artificial neural networks with multiple hidden layers to make accurate predictions from data.

In wind turbine inspections, two primary applications of deep learning are classification and segmentation. Classification algorithms categorize images into predefined types like blade erosion, delamination, or cracks. Segmentation models take this a step further by localizing specific defects within an image.

The defect detection process begins with an AI pipeline which includes preprocessing steps to prepare the data for analysis. Ensuring datasets are clean, qualified, and properly classified is crucial for effective utilization.

Convolutional neural networks (CNNs) are then applied to this preprocessed data, processing images through multiple neural layers to identify defects accurately. By applying CNNs to high quality datasets of blade images, operators can quickly and accurately identify defects from simple lines to complex patterns, similar to human visual processing.

The final outputs classify and localize defects within the images. SkyVisor's technology has identified over 100,000 blade composite defects, highlighting its effectiveness.



Key features of their asset management platform include:

- Defect localization: Automatically detects and localizes defects in blade inspection photos, eliminating the need for manual review.
- Automatic type and severity suggestion: Provides immediate assessments of defect type and severity, allowing operators to prioritize maintenance efficiently.

Evolving with every blade

SkyVisor AI's superpower lies in the company's commitment to continuous learning. Its AI models evolve to stay abreast of the latest developments in blade composite aging and wind energy sector knowledge. With hundreds of drones inspecting diverse turbine models, the company ensures uniform standards, reliable defect detection, and effective result comparisons.

High quality data enables AI algorithms to train and test on consistent datasets, significantly enhancing detection accuracy. The company integrates client data and real world observations into a rigorous feedback loop using continual learning, refining model performance to stay ahead of technological and environmental changes. It ensures the technology remains at the forefront, effectively recognizing and classifying new and emerging blade defects.

By embracing in-house inspections and AI based defect detection, operators can enhance safety, reduce costs, and ensure the reliable operation of their wind farms for years to come.

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To see our AI solution live and take your first steps for in-housing, visit us at WindEnergy Hamburg at stand A1.100 or contact us at sales@skyvisor.eu

Resources

[1] Renewable Energy World, 2023
[2] Wood Mackenzie – Global Wind O&M Trends, 2020
[3] Reliability of wind turbine subassemblies, 2009
[4] https://www.easa.europa.eu/en, 2024
[5] Renewables Now, 2015
[6] SkyVisor internal study for Boralex SA, 2024