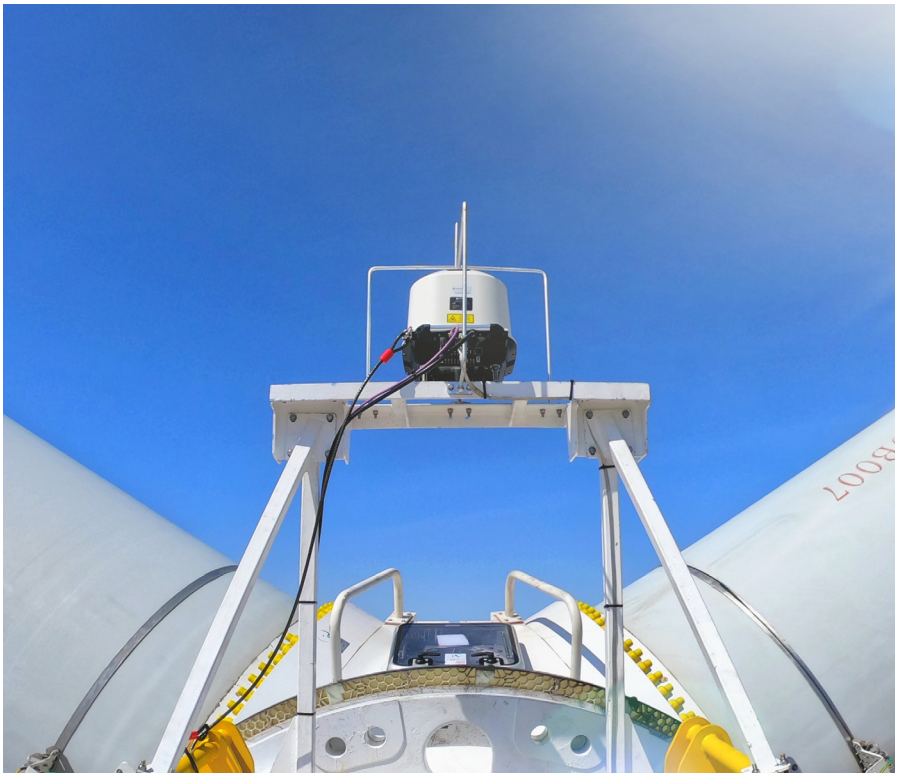
VAISALA

Product Spotlight

windcubelidar.com

WindCube Nacelle Turbine Control

Feedforward turbine control for reducing costs and improving efficiency



WindCube® Nacelle makes Lidar-Assisted Control (LAC) a reality, reducing Levelized Cost of Energy (LCOE) and creating numerous other benefits for wind energy.

By fully characterizing the incoming wind field, the system enables anticipatory control optimizations for changing conditions. This can result in significantly extended wind turbine design limits, reduced loads and costs, improved safety and resilience to extreme events, and increased energy capture.

Key Benefits

Trustworthy, superior metrology

Proactive control for improved efficiency and lower LCOE — WindCube Nacelle accurately anticipates (several seconds in advance) the wind data hundreds of meters in front of the rotor plane, allowing developers and operators to quickly respond — thereby reducing turbine loads, reducing costs, and improving energy production.

Innovation in an increasingly challenging turbine market — Reduced fatigue and extreme loads allow the use of longer blades and/or higher towers for a given class, or upgrading the wind class of a given turbine platform. This enables significant energy production increases while maintaining a streamlined portfolio of turbine products.

Innovative lidars from a one-stop shop

Seamless integration using proven designs and practices — Turbine control is an extension of existing WindCube Nacelle lidar technology, and it has been shown to integrate seamlessly with turbine manufacturers' projects. This simplicity of integration extends to wind developers and operators as well, further enhancing the manufacturer's value proposition.

Easy, reliable global solution

The simplicity and reliability of the industry leader — WindCube Nacelle is already the industry standard for LAC, operating in large fleets in China and increasing locations around the globe.

More detail:

WindBox advanced wind reconstruction algorithm

Developed in partnership with IFP Energies nouvelles

WindBox brings significant data improvements that enhance the return on investment of LAC, making it financially appealing and workable for wind farms around the world. It leverages the proven advantages of WindCube Nacelle Turbine Control lidar, resulting in an unrivaled, integrated solution.

The algorithm is the result of a unique, multi-year collaboration between Vaisala and IFP Energies nouvelles (IFPEN), a major research and training player in the fields of energy and the environment.

With this new embedded algorithm, WindCube Nacelle Turbine Control leverages the most advanced signal processing and wind field reconstruction to deliver reliable, highly valuable wind data.

WindBox helps obtain maximum reduction of fatigue and extreme loads, reliably enable turbine cost reduction, and increase energy production.

WindBox key benefits:

- Consistently improves data availability by 10%, and can improve it up to even 30% in tough atmospheric conditions
- Provides the highest achievable measurement accuracy thanks to the strong relaxation of blade-masking effect and flow homogeneity assumptions
- Provides full measurement of wind conditions, including RAWS, yaw misalignment, shears, and turbulence intensities
- Includes wind preview of 0s, 1s, 2s, and 5s ahead of time for timely, effective control actions (optional feature)

How Windbox leverages existing WindCube advantages

Existing WindCube Nacelle TC advantages

- 4 laser beams
- Simultaneous measurement at 10 distances, 4Hz sampling
- Range from 50 to 200m
- High data availability, accuracy, and reliable data check
- Complete wind reconstruction

+

WindBox advanced reconstruction

- Integrates spatial and temporal wind coherence based on multi-beam, multi-distance measurement
- Resolves complex flows for unambiguous wind speed, direction, shear, and turbulence data
- Enhances wind data outputs by compensating outliers and blade passing effects
- Provides wind preview at rotor plane, accounting for wind evolution and turbine induction effect

=

Enhanced TC capabilities

- Get the most complete incoming wind field data
- Improved data accuracy and availability

Testimonials

GOLDWIND

Goldwind, one of the world's leading turbine technology providers, chose WindCube Nacelle for its turbine control initiative, validating the suitability and reliability of Vaisala technology to this promising application.

Since 2015, Vaisala has delivered more than 180 systems to Goldwind for this purpose.

"Since deployment, we have been successfully operating our Vaisala technology with great benefit to our project. Vaisala has enabled us to innovate, create new value for our customers, and help push the wind industry forward."

CSIC 中国海装

"We have tested and evaluated several lidar reconstruction algorithms to improve our wind turbine control strategy and performance. WindCube Nacelle TC equipped with WindBox has reached our expectations and has proven to be the suitable solution for our wind turbine Lidar Assisted Control (LAC) in the current stage."

CSIC/CSSC (China State Shipbuilding Corporation)

中国中车 CRRC

"The wind previews provided by WindBox have proven to be very stable and to fit well with the estimated wind speed based on turbine production. Overall, WindCube Nacelle TC equipped with WindBox is a very promising product and an advanced technology for Lidar-Assisted Control (LAC). We believe this technology will improve our LAC, reduce turbine loads and improve the profitability of our wind farm project significantly."

CRRC Wind Power (ShanDong)

WindCube Nacelle at a glance

Applications

- Fatigue and extreme load reduction
- Production increase
- Reliability and turbine availability increase
- Continuous wind monitoring and turbine performance testing
- Building a base of historic data for failures diagnosis or performance improvements

Key features

WindBox advanced reconstruction algorithm integrating spatial and temporal wind coherence, resolving complex flows, accounting for wind evolution and turbine effects, and more

Comprehensive measurement of all essential incoming wind conditions, including rotor average wind speed, wind direction, shear, and turbulence at multiple distances before it reaches the turbine rotor

Sophisticated, high-frequency information processing allowing for quick, confident turbine control decisions

Constant accuracy from 50 to 200m with 10 configurable measurement distances

Straightforward adoption with lightweight, efficiently designed system components and proven engineering

Why Vaisala for renewable energy?

We are innovators, scientists, and discoverers who are helping fundamentally change how the world is powered. Vaisala elevates wind and solar customers around the globe so they can meet the greatest energy challenges of our time.

Our weather and environmental monitoring solutions for renewable energy are guided by several key priorities:

- Thoughtful evolution in a time of change
- Making renewable energy smarter at every stage
- Extending our legacy of leadership

Vaisala is the only company to offer 360-degree renewable energy solutions — from sensors and systems to digital services and actionable intelligence — nearly anywhere on the planet (and even on Mars). Every Vaisala solution benefits from our 85+ years of experience, pioneering deployments in 170+ countries, and unrivaled thought leadership.

Our innovation story, like the renewable energy story, continues.

VAISALA

windcubelidar.com

Scan the code for more information