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Case Study

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Expanding and improving offshore wind research:

How Centrale Nantes uses WindCube Scan lidar to research and optimize floating wind turbines offshore

The challenge: Improve and expand the laboratory's offshore research capability with scanning lidar

Centrale Nantes is a French engineering school, founded in 1919. Known for its innovation in renewable energy, the Research Laboratory in Hydrodynamics, Energetics and Atmospheric Environment (LHEEA) has 1 km^2 of designated maritime zone: the SEM-REV. This zone is dedicated to measuring metocean conditions and hosting marine renewable energy prototypes, among which is Floatgen — the first floating offshore wind turbine (FOWT) in France.

As the lab continues to expand its offshore wind energy research, LHEEA sought lidar equipment to support two important projects: FLOATEOLE and WAKEFUL. FLOATEOLE is focused on optimizing floating wind turbine operation: By studying how the wavewind-structure coupling affects the performance and durability of wind energy converters, researchers will uncover more efficient ways to operate them. The purpose of WAKEFUL is to focus on FOWT wake unsteadiness.

The greatest challenge of the FLOATEOLE and WAKEFUL projects will be to put a scanning lidar on the floating platform of the Floatgen wind turbine, where it will analyze the wind resource and the wind turbine wake.

The solution: A flexible, reliable scanning lidar that can support multiple projects

LHEEA purchased WindCube® Scan 100s for its offshore wind energy, urban atmosphere, and air quality applications. The laboratory selected WindCube Scan based on its high performance, reliability, and remote access.

The capabilities of WindCube Scan make it a leading instrument for wind analysis. Its versatility offers operational possibilities across research themes in the LHEEA laboratory, such as developing Marine Renewable Energies and increasing knowledge of the atmospheric environment.

WindCube Scan 100s has an articulated head to control the viewing angle in azimuth (360°) and in elevation (+/- 110° from zenith) plus a 3km range. Researchers can program a series of shots at different angles to reconstruct the vertical profile of the wind vector with a period of about 3 seconds. Other types of scanning are used to map a vertical slice of the atmosphere (variable elevation and fixed azimuth) or a horizontal slice (elevation zero and variable azimuth).

These scans help the lab to study atmospheric phenomena spatially, such as atmospheric boundary layer, wind turbine wakes, aerosol dispersion, and largescale turbulence.

"It is well adapted for research — you can set up scanning scenarios, which is an exceptional advantage," says Sandrine Aubrun, professor at LHEEA.

WindCube Scan will be installed on a stabilizing platform. The stabilizing platform mitigates the altitude motions in order to control the exact areas of measurement for the lidar.

Based on the Centrale Nantes campus, the DAUC, EMO, and SEM-REV research groups in the LHEEA laboratory will also use WindCube Scan to respond to societal and environmental issues directly related to energy transition. The lidar will be a decisive tool to support the development of onshore and offshore wind turbines including:

- Analyzing offshore wind resources
- Understanding complex coastal atmospheric phenomena
- Improving the characterization of wind resources
- Verifying technology performance
- Quantifying wake interactions between wind turbines
- Improving assessments of environmental and economic impact

The benefit: Greater insight, thorough research, and increasing capability by attracting more programs

After a quick and easy setup process, the LHEEA has been impressed with WindCube Scan's robustness, very high data availability, remote access, and real-time data and measurement displays.

Researchers can conveniently see real-time results and adapt all measurement specifications remotely. Boris Conan, assistant professor at LHEEA, says, "If tomorrow you have suitable weather conditions, you can adapt all the parameters remotely [to conduct tests]."

The availability of WindCube Scan is also quickly advancing the laboratory as a major national player. It is an important lever in establishing collaborative research programs and has already led to the submission and launch of several national and international research collaborations.

"Lidar is an added value for the laboratory, and it helps us to be more attractive and get more research projects," adds Aubrun.

Funded projects include WEAMEC FLOATEOLE (2018) and WAKEFUL (2019), ANR MOMENTA (2019), ADEME ePARADISE (2019), and VAMOS (German funding). The acquisition of the scanning lidar was cofinanced by the Pays de la Loire region, the ERDF (2017 call for laboratory equipment), and the Investments for the Future program via PIA SEM-REV.

"I am convinced that having a lidar [in your project] opens a lot of doors for fullscale experiments. It is the best instrument to measure the atmospheric flow in the wind farm environment by providing space resolution."

Sandrine Aubrun
Professor at ECN/LHEEA

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