PO.066

Comparison of two Nacelle Mounted LiDAR technologies for a wind turbine yaw misalignment analysis

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Abstract

Static yaw misalignment is a frequent cause of turbine underperformance during the operation of a wind turbine as it can cause production losses and undesired loads.

The detection and measurement of such a misalignment is not easily possible with the use of the data recorded by the nacelle anemometry. The accurate detection of a static yaw misalignment is performed using specific devices such as nacelle mounted LiDARs.

Nacelle Mounted LiDARs are aligned with the rotor and they can measure the relative wind direction before the wind reaches the turbine.

Two different LiDAR technologies were installed on the top of a wind turbine in France and measured the wind during the same one month period. An AVENT Wind Iris LiDAR, which measures at ten different distances and already has a long track record on many turbine models, is compared with a more recent LiDAR product, the EPSILINE YawAdvisor which measures 10 m ahead.

The goal was:

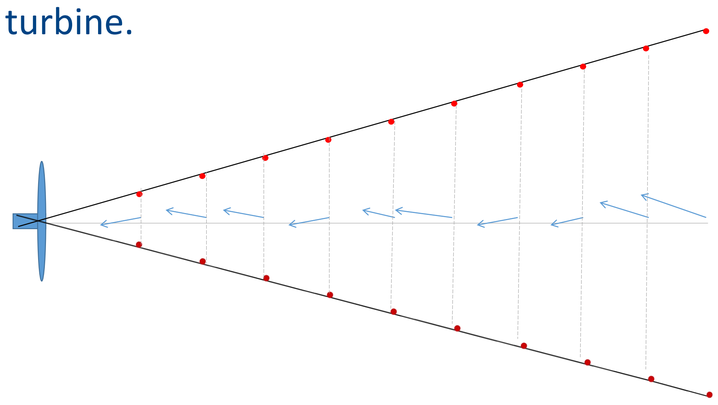
- to check the wind turbine misalignment
- To compare the behavior of both devices.

Yaw Advisor measuring at 10 m distance

Wind Iris measuring from 80 to 400 m distance

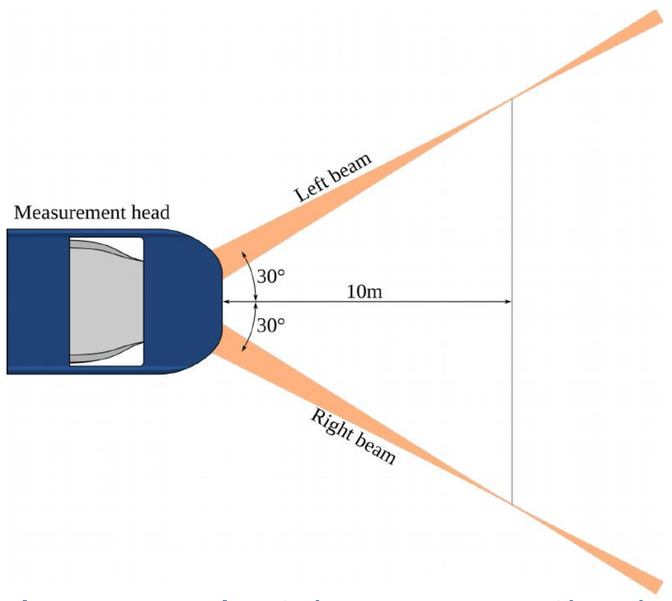
Methods

The Avent Wind Iris LiDAR (two beams) measures the horizontal wind speed and direction from 80m to 400m upwind of the turbine.



After applying specific filters to the data, the wind directions of the five first distances were averaged to calculate the yaw misalignment angle for each 10-min periods.

The EPSILINE YawAdvisor also enables wind direction measurement but immediately in front of the wind turbine (at 10 m ahead of the LiDAR) and therefore provides information regarding the angle between the actual wind flow and the nacelle centerline.

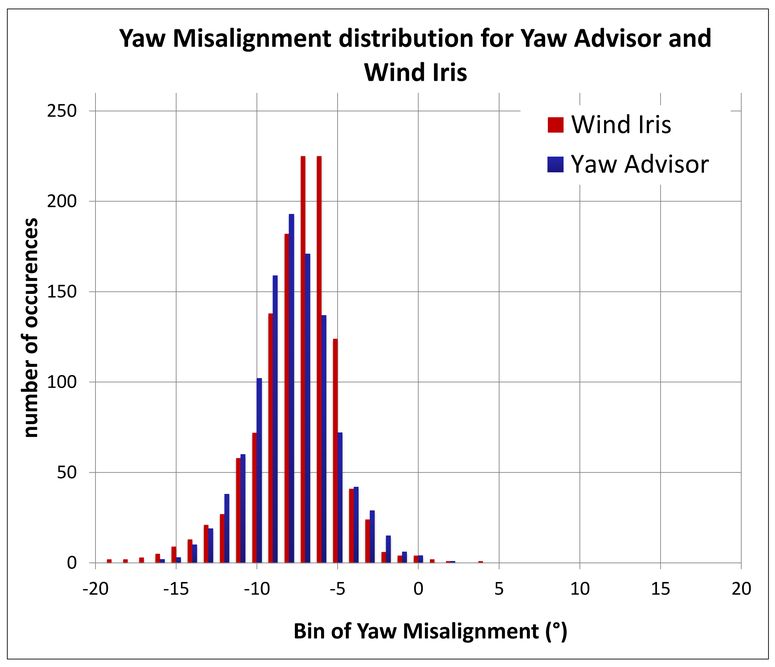


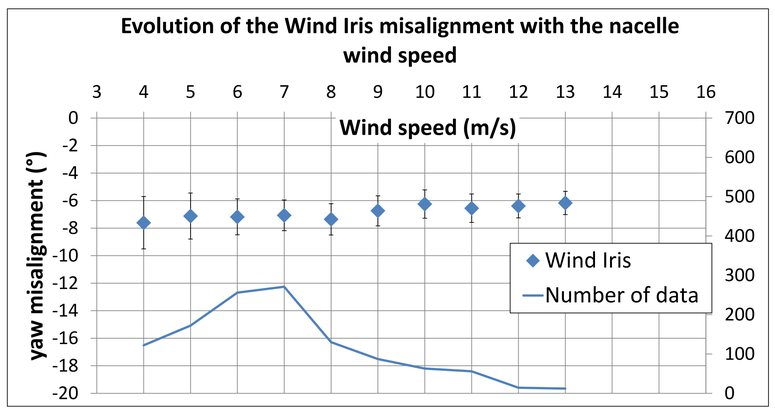
During approximately one month, both Nacelle Mounted LiDARs were measuring simultaneously on a GE2.5 xl wind turbine part of the French wind farm Laucourt, owned by VALOREM and operated by VALEMO. UL DEWI and VALEMO performed the calculation of the Yaw Misalignment with the Avent WindIris LiDAR and the EPSILINE YawAdvisor LiDAR data. Both LiDARs were accurately aligned with the rotor thanks to a specific procedure using a laser device that was aligned with the main shaft.

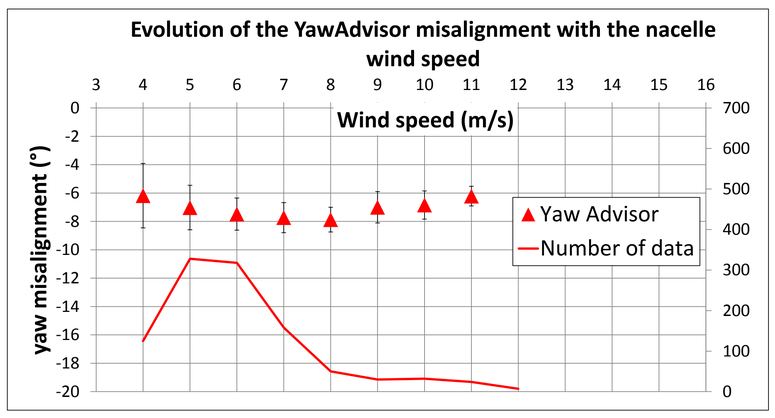
At the end of the campaign, it has been possible to check that the wind turbine was not correctly aligned with the wind. The measurements of both LiDARs were also consistent in term of static yaw misalignment and dynamic yaw misalignment.

Results

Equipment	Misalignment average value	Standard deviation
Yaw Advisor	-7,3°	2,5°
Wind Iris	-7,1°	2,7°







The data gathered by both devices are consistent and it has been concluded that the studied wind turbine was misaligned by approximately -7°

These results are encouraging as they show that the relative wind direction measured 10m ahead of the wind turbine is comparable to the relative direction measured at longer distances.

The results are based on one case study, they should be reproduced to get stronger conclusions.

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