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APPLICATION OF SPINNER ANEMOMETRY IN YAW ALIGNMENT CONTROL

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Spinner anemometry is a new wind measurement concept, in which the flow over the spinner of a wind turbine is used to detect free wind speed, yaw error and flow inclination angle. It was introduced at EWEC2007, and first measurement results on a full size wind turbine were presented at EWEC2008. Further experience has been gained. In an ongoing project the use of spinner anemometer to control yaw alignment is investigated. First on a single turbine, later on a row of turbines in a wind farm. The results from the experience gained on the single turbine will be presented.

Approach

Alignment of wind turbines in the wind is investigated on a single turbine in order to determine yaw error statistics with a spinner anemometer. Then the spinner anemometer is connected to the control system to align the turbine in the wind. Systematic offsetting the alignment is then carried out to investigate performance reduction as function of yaw error. The results will show whether the theoretical cos2 relationship of performance reduction is verified. Performance increase of a whole row of wind turbines in a wind farm will afterwards be verified.

Relevance

Anyone can experience problems of yaw alignment of wind turbines by visual study of individual wind turbines in wind farms and wind turbine clusters. It is easily seen that turbine alignment deviates up to 20°. Yaw misalignment may reduce energy output by 1-5%, but this is difficult to verify, because an accurate yaw error measurement has not been possible in the past. Meanwhile, a spinner anemometer performs accurate yaw error measurements. The working principle avoids an offset in the yaw error due to rotation. All mounting and geometry errors are canceled out by rotation. The gain factor determining the inflow angle to the rotor axis, can easily be field calibrated. The concept may lead to significant improvement of yaw alignment, and thus 1-5% increase of turbine performance.

Innovation

The state of the art in yaw error measurement is the nacelle based wind vanes or 2D sonic sensors. Meanwhile, investigations show that nacelle anemometry is extremely complex. Adjustments are made but it is difficult to include all relevant operation situations. Service practice is another uncertainty where errors are introduced. Positioning the yaw error sensor in front of the rotor is innovation that reduces cost of electricity.

Results

The paper describe experience gained from connecting a spinner anemometer to the control system of a wind turbine to investigate yaw alignment and performance improvements. Other improvements on the concept will also be presented.

Conclusions

Visual study of wind turbines confirms misalignment problems. The spinner anemometer concept is an ideal sensor for yaw alignment control. The sensor may improve energy output by 1-5%. Experiments on a single turbine are used to verify assumptions, and results will be presented at the conference.