TOPIC 6 INDUSTRY AND ADVANCED MANUFACTURING

Impact of Electric Charge Compensation on Wind Energy Production: A Statistical Quantile Regression Analysis

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INTRODUCTION

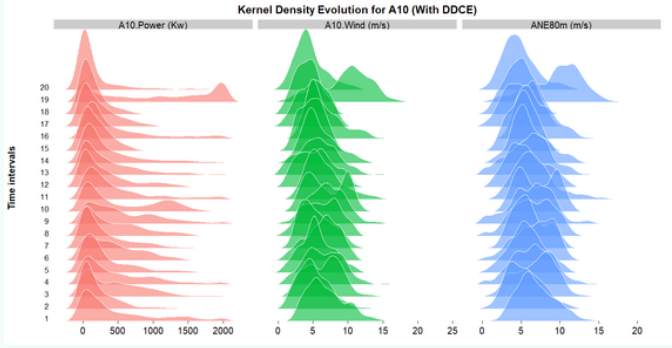
The energy production behavior of wind turbines is generally controlled and regulated by the analysis of the generated energy versus wind speed. The wind speed is referred to as the measurements taken by an anemometer placed in the gondola, after the main plane of each wind turbine. Wind turbines are large in size, with mechanical, electrical, and electronic components, and their cost, installation, and maintenance are high.

For these reasons, and due to the environment in which they operate, they require electrical protections, similar to other important installations such as telecommunications towers, airport radars, transmission lines, and substations, among others.

The **Electronic Charge Compensation Devices (ECCD and dineol)** [1] [2] are passive devices that carry electrical currents to the electrical Earth, preventing lightning impacts and derivative electrical current pulses, reducing radiofrequency disturbances in the protected area, and attenuating the corona effect as well.

RESULTS

Data collected over more than a year of operation of several wind turbines installed at different locations are analyzed. We compare the **energy produced versus wind speed** in turbines with and without ECCD and Dineol installed, in order to assess the changes in their behavior. Our preliminary work shows a r**elevant increase in energy production (about 9% +/- 5% in the Annual Energy Production** – AEP – for the different analogous wind turbines) due to the **use of ECCD and Dineol**. Additionally, better maintenance and longer operational life can be expected for turbines with ECCDs installed.



This work was partially developed during the 1ENG08 WindEFCY Project of the EMPIR/EURAMET Program and has continued with the support of the Dinnteco group of enterprises.

CONCLUSIONS

From the work done evaluating the wind turbine energy with different statistical analyses and mathematical fitting programs, it has been proved that **statistical analyses are typically based on histograms** of data where dynamic ranges or sampling intervals are assumed to fit a Gaussian distribution. However, the data derived from the wind turbines we considered do not follow a normal Gaussian distribution. The introduction of a new parameter or variation due to the use of **ECCD and Dineol** in the wind turbines results in significant **changes** in the **histogram distributions**. In particular, there are notable changes in the asymmetry index of the generated energy and wind speed statistical distributions [3].

Symmetries are strongly assimetrical. It cannot be justified to continue using average values when these are less significant than 30%.

We use a **Kernel density estimator** [4] to show the density asymmetry presence in all experimental results on energy production, wind speed (in gondola and meteorological stations).

The **use of ECCD and Dineol gives better significant value using statistical Quantile Regression** [5] than conventional statistical methods. The conventional statistical methods are considered by us as obsolete, because they aren´t representative: means, variance and correlations aren´t supported by Gaussians or normal statistical distributions.

It is necessary to develop a **new standard** that includes representative, reliable statistical methods, such as Quartile Regression.

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