automation solutions

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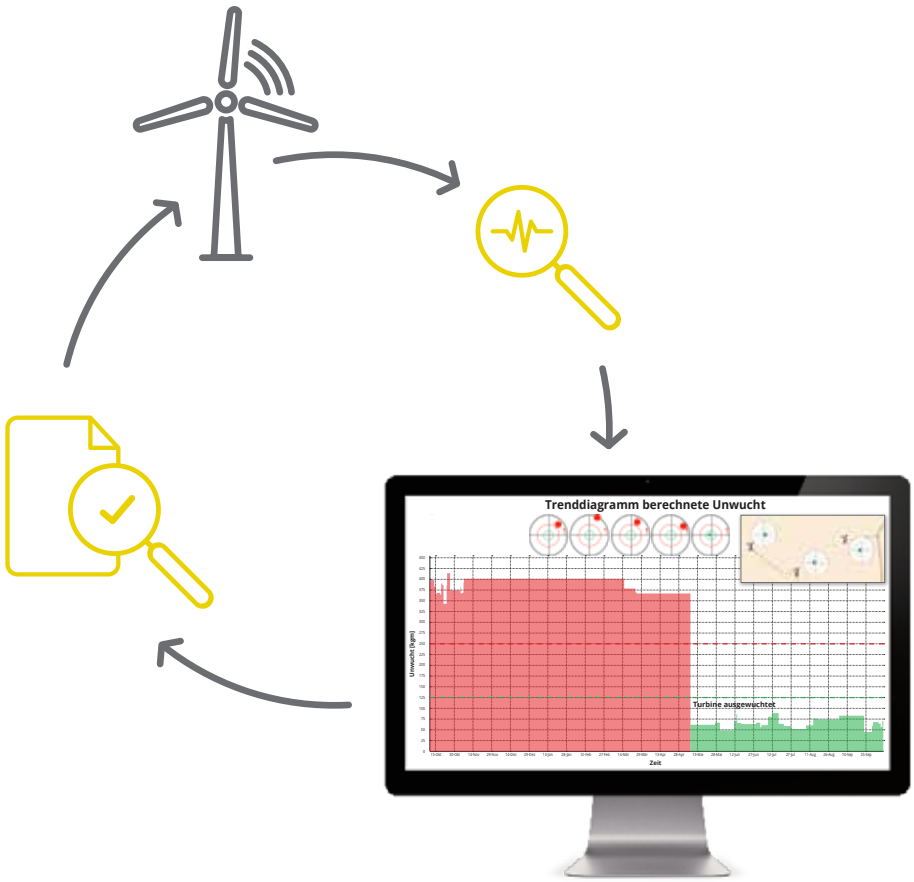
Blade Unbalance Calculator

Unbalance estimation without loss of availability.



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Unbalance estimation without loss of availability

Do you know the balance quality of your main rotor?

Mechanical unbalance of a wind turbine rotor can cause significant forces on the drivetrain and the tower. Often a much better tolerance can be achieved than is required by the manufacturers‘ specification, but this is not a requirement.

In addition, unbalance can change over time due to blade erosion/ damage, and ingression of moisture into the structure of one or more blades.

How do you find out?

The standard method for measuring mechanical unbalance has been through the addition of test weights. This provides both the information about the balance status of the blades, and the necessay correction mass and location, but the process requires access to the blades and the consequent loss of availability. Accessing the blades at least twice, with a test run of the turbine in between, means loss of availability can be considerable.

Can we do better?

Our software solution replaces this method and calculates blade unbalance with no interruption of operations. To optimise the on-site work, we identify those turbines in need of attention. Although mass unbalance provides a clear 1/rev signal, on a wind turbine this is complicated by:

- Variable speed operation
- Natural frequency of the tower
- Aerodynamic imbalance – also 1/rev but principally an axial force

Our software helps you to distinguish between mechanical unbalance and other existing sources of vibration.

Bachmann's solution

Blade Unbalance Calculator

The Unbalance plug-in to Bachmann Monitoring's CMSSTD software allows the mechanical unbalance to be calculated, giving a regular estimation of the mass unbalance of your rotor without the need to fit a trial mass. This allows you to identify those turbines which require mechanical balancing, rather than requiring you to assess the entire farm individually.

The mechanical balance is calculated by a model-based algo- rithm using basic build data. The model is built once and is valid for all similar turbines on your farm. Using real-time information from a simple 2D MEMS sensor in the centre of the nacelle, the output from the module is a measure of the actual mechanical unbalance (in kgm).

Optionally you can also add an extra position sensor on the main shaft, from which the module will also identify the angular location of the current unbalance (which is directly opposite the required correction mass).

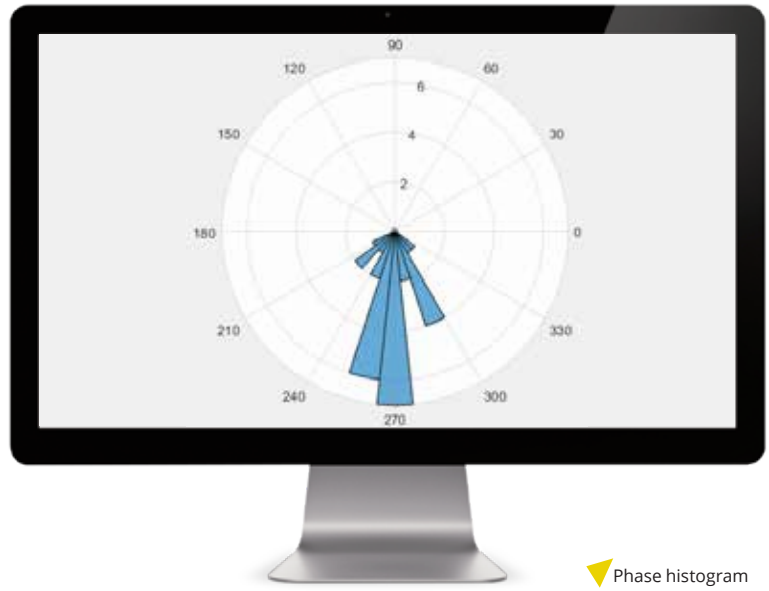
You can also identify whether a rotor 1/rev results from aero- dynamic or mechanical unbalance, thus allowing you to plan the appropriate corrective action for a time that suits you. There is also full visibility of whether a turbine balance is degrading.

With Bachmann Monitoring's 20 years of Condition Monitoring experience underpinning this software and the diagnoses it provides, you can be confident that you will have better knowledge of the state of your turbine rotor thanks to this simple plug-in.

Is this solution applicable to your turbines?

Although this is a plug-in to the Bachmann CMS, it does not require such detailed vibration measurements, so can function on any turbine with a Bachmann controller and spare input for the MEMS transducer. It is therefore immediately compatible with any Bachmann equipped turbine, whether controller, CMS or both.

If you have no Bachmann equipment on your wind turbine, then you would need to add a minimum of a processor unit and a signal input, or if you are planning installing a CMS anyway, then this is a good reason to choose the Bachmann system.



Phase histogram

Immediate success

This is not simply theory. During the testing of the system on a customer's wind turbine we were able to identify that a change in 1/rev observed on the main shaft was not as a result of unbalance, but had occurred during a service visit. Subsequent investigation found that the service had included some limited work on the pitch system that had introduced an aerodynamic imbalance.

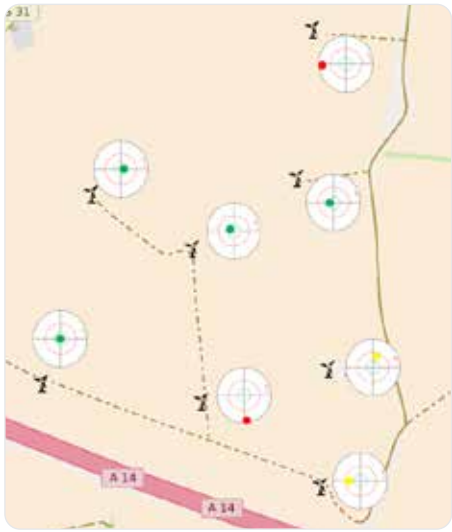
Your benefits

This simple software solution provides you with an update to the balance condition of your turbine every time the machine runs in a specific speed range.

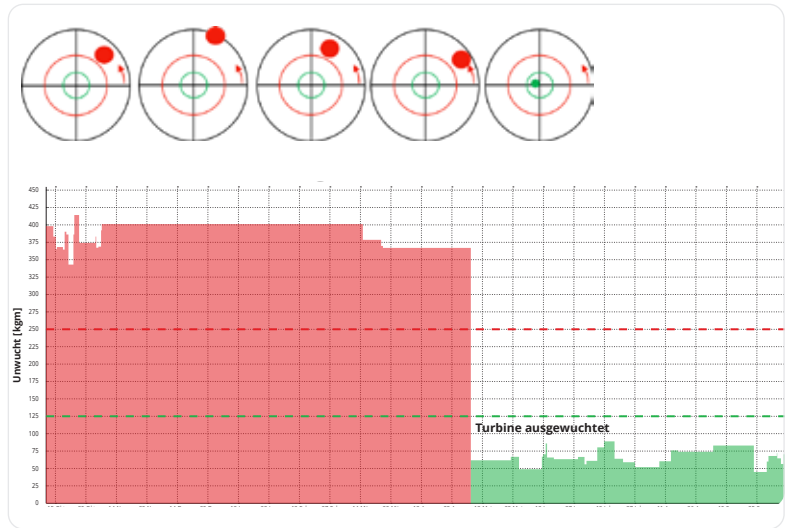
In this way you gain greater knowledge of the condition of your turbines. The requirement to carry out mechanical balance surveys is removed.Balancing need only be carried out where it is needed, and should be possible in "one shot".

Changes to the one/rev vibration on your main rotor can be reliably attributed to either mechanical or aerodynamic effects, and suitable corrective actions can be planned.

Unbalance of individual turbines displayed on a map



Trend of calculated unbalance



Note: All displayed graphs were generated from actual test data using commonly- available visualisation tools.

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