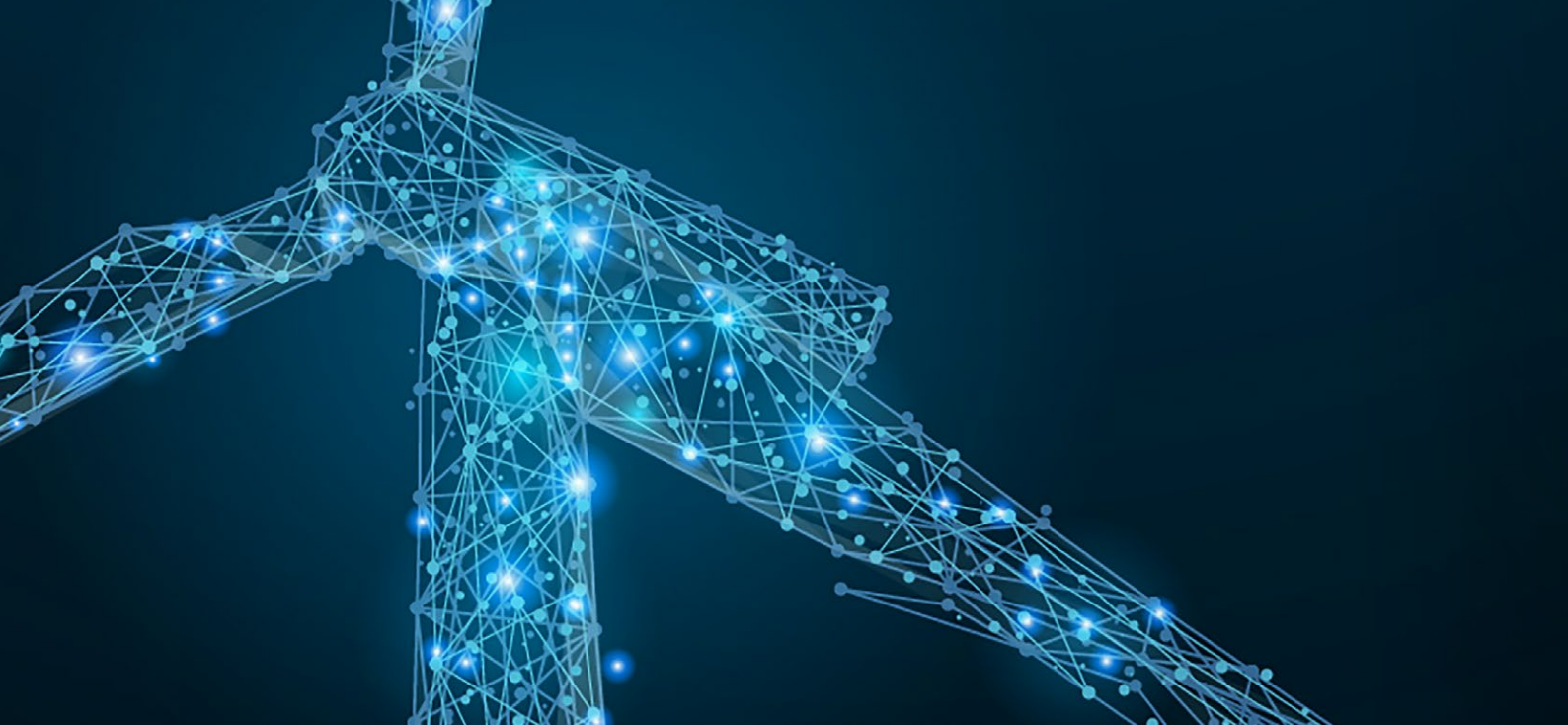




How do our blades give you a cutting-edge?

SHM.Blade® – Intelligent and cost-effective system for the condition monitoring of rotor blades



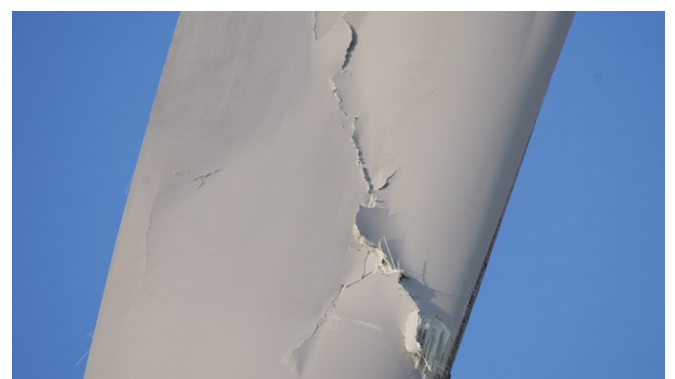


On the Safe and Cost-Effective Side

Rotor blades of wind turbine generators (WTGs) are exposed to extreme environmental conditions and strong dynamic demands. At the same time, however, they determine the energy yield and thus decisively influence the economic efficiency of a WTG. Damage must be detected as early as possible and distinguished from normal influences from the environment and day-to-day operation. More serious damage can be prevented by the relatively inexpensive repair measures available at this early stage. Downtimes as a result of damage not detected or detected too late are avoidable, the energy yield can be increased. Periodically recurring tests are not sufficient for early detection. Permanent monitoring with SHM.Blade guarantees a higher level of safety.

SHM.Blade for the Detection of Structural Damages

If the stiffness of the rotor blade decreases due to damage, it is reflected in the natural oscillations. Therefore, SHM.Blade uses sensors to record and interpret the global vibration behavior allowing for structural damage to be detected early on. For this purpose, a reference state is used, which is determined fully automatically for each individual rotor blade subsequently to the commissioning of SHM.Blade. Such a blade-specific learning phase ensures high damage sensitivity despite production-related mass and stiffness tolerances. After completion of the learning phase, condition indicators are continuously calculated, which provide information about the current blade condition at any time. This increases safety and makes maintenance



Damage to the rotor blade

work easier to plan. Thanks to a two-stage warning and alarm concept, the plant control system can react immediately in urgent cases – consequential damage or even an expensive replacement of the rotor blades can be avoided.

¹ Source: Dr. C. Heilmann et. al.: Balancing of WTG Rotors, Economic Advantages and Technical Implementation (Auswuchten von WEA-Rotoren, Wirtschaftliche Vorteile und technische Umsetzung), WID White Paper, o.O. 2015

² Source: T. Jung et al.: Economic Feasibility Study of Ice Detection Systems on Wind Turbines, (Wirtschaftlichkeitsstudie von Eiserkennungssystemen an Windenergieanlagen) Weilburg, Germany 2015



SHM.Blade for the Detection of Aerodynamic Imbalances

Almost 50 percent of all wind turbines have inadequately balanced rotors. In at least 30 percent of all cases, it is due to aerodynamic imbalance. This results in stronger vibrations, which lead to higher loads and thus to increased lifetime consumption of the drive train, rotor blades, tower and foundation. The aerodynamic efficiency and thus the generated electrical power of the wind turbine can be reduced. In addition, increased noise emissions can occur.

With the help of the unbalance indicator calculated by SHM.Blade, aerodynamic imbalances can be detected early and precisely. This ensures a vibration-optimized and component-protecting operation. A reduction in performance is avoided and the risk of a stoppage is reduced. The integrated pitch angle monitoring also extends the service life of the drive train components and support structures.

IDD.Blade® for the Detection of Ice with Automatic Restart Function

Authorities demand that a wind turbine be stopped when the rotor blades are iced over, to protect the surroundings from ice shedding. In addition, increased loads caused by ice build-up have an influence on the service life of the wind

turbines, which should not be underestimated. The assessment based on meteorological data or visual inspections is often very time-consuming and imprecise, especially since icing can be to varying degrees within a wind farm. The measurement of the vibration behavior has proven to be a safe and efficient method in recent years: If the mass of a rotor blade changes due to ice build-up, the vibration behavior also changes. Thus, vibrations provide us with information about the current degree of icing.

With the IDD.Blade option, the actual icing condition of each rotor blade is recorded individually and precisely. If the system detects critical ice build-up, the plant is automatically stopped. The sensitivity can be configured specific to the location. This way, the energy yield is optimized depending on whether personal safety or the protection of the WTG is the primary concern. If the rotor blades are free of ice again, the plant will restart automatically – Ice detection also works below the switch-on wind speed of the WTG. When using systems without such a function, the WTG has been proven to stand still unnecessarily for more than 50 percent of the time. IDD.Blade reduces the downtimes to the times of actual icing and guarantees continuous power generation under non-critical conditions. Loss of yield can be avoided.

The system can also be used as a stand-alone module without SHM.Blade.

Monitoring Intelligence Center MIC.Blade: Turning Data into Knowledge

The data collected by SHM.Blade is evaluated together with the current operational and EOC data directly in the Monitoring Intelligence Center MIC.Blade. From this flood of data, all important indicators are extracted and made available to the user in a clearly arranged form at any time. They can see at a glance whether limit values are being adhered to, whether and where a problem is occurring, what the cause may be and what measures need to be taken to rectify the error or prevent the damage from progressing.

Event-controlled notifications and alarms can be configured individually. You do not receive standard reports, but a dashboard tailored to your requirements. In addition, automated reporting (optionally with expert assessment) can be provided, which also meets regulatory requirements.

The security of sensitive measurement data is always in the foreground. A data center in Germany, a secure Internet connection and protected access data ensure that only authorized persons can view results and data. If a data connection is still not desired or not possible, all monitoring and data backup functions can also be outsourced to a central wind farm server.

Holistic Approach: From the Bottom to the Tower to the Top

Regardless of location, a sustainable reduction of operating costs while simultaneously increasing yields is becoming increasingly important. In order to fully develop the potential of a wind farm and to ensure long-term efficiency, it is therefore advisable to monitor the turbines holistically. Contact us for more information about our global Structural Health Monitoring concept and our products for condition monitoring of foundations and towers.





The Benefits of SHM.Blade at a Glance



A two-stage alarm concept allows for an immediate reaction to problems. Long downtimes due to damage that is not detected or is detected too late are avoided as well as cost-intensive consequential damage, should it occur.



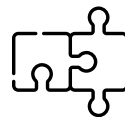
The early detection of damage makes it possible to plan service interventions. This increases safety and reduces costs for repairs and maintenance work.



With the IDD.Blade option, downtimes can be reduced to the times of actual icing. When there is no ice, the system restarts automatically.



The system is protected against damage caused by power surges and lightning strikes in accordance with the requirements of IEC 61400-24.



The system is individually configurable and can also be easily retrofitted to existing systems.



The damage detection with SHM.Blade and the ice detection with IDD.Blade are certified by DNVGL according to the applicable guidelines.



SHM.Blade and IDD.Blade have proven themselves in practice. Several hundred systems have been successfully used in the field for several years.



What moves Wölfel?

Vibrations, structural mechanics and acoustics – this is the Wölfel world. Here we are experts, this world is our home. More than 120 employees daily do their best for complete satisfaction of our customers. For more than four decades we support our customers with engineering services and products for the analysis, prognosis and solution of tasks in the fields of vibrations and noise.

Are vibrations really everywhere? Yes! That's why we need a wide variety of solutions! Whether it is engineering services, products or software – there is a specific Wölfel solution to every vibration or noise problem, for example

- simulation-based seismic design of plants and power stations
- measurement of acoustic emissions of wind turbines
- universal measuring systems for sound and vibrations
- expert reports on noise immission control and air pollution forecasts
- dynamic occupant simulations for the automotive and aviation industry
- and many other industry-specific Wölfel solutions ...



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