X4edge

cutting edge analytics

Smart turbine control

to increase AEP

SITUATION

- YIELD LOSS DUE TO STANDSTILL
- MANUAL INSPECTION / RESTART
- PREVALENT SAFETY RISK
- OVERLY CONSERVATIVE DESIGNS
- POOR ENERGY-TO-LOAD RATIO
- UNKNOWN LIFETIME LOADS
- STRUCTURAL DAMAGE
- SLOW DEGRADATION
- MAINTENANCE WORK

SOLUTION

RIC — Rotor Ice Control

Stops a wind turbine with ice-buildup and restarts automatically after melting.

TLC — Turbine Load Control

Avoids detrimental loads, helps optimize blade design, and enables turbine lifetime extension.

TIC — Turbine Integrity Control

Identifies different types of degradation and damage based on analytical and empirical tools.

FEATURES

EFFICIENT OPERATION
Stopping as late as necessary and restarting as early as possible increases the energy yield.

AUTOMATIC STOP/START
Automatic restart without visual inspection even in low wind significantly increases yield.

RELIABLE DETECTION
Reliable and certified detection of ice mass on the rotor increases safety to people, assets and property.

KNOWLEDGE OF LOADS
Using a load control system allows lighter and cheaper blades, as safety reserves can be optimized.

ACTIVE LOAD REDUCTION
Active load reduction and avoidance of overloads allows the use of longer blades.

LIFETIME EXTENSION
Knowledge of cumulative loads can determine the virtual age and form the basis for lifetime extension.

DAMAGE DETECTION
The impact of sudden damage can be quantified, trigger fail-safe operation and avoid costly fatal accidents.

DEGRADATION MONITORING
Turbine wear is tracked over time and alert levels are set for early damage detection and to avoid fatal loss.

OPTIMIZED MAINTENANCE
Improved predictive maintenance and repair planning increases turbine uptime and annual energy production.

IMPACT

4% AEP
12,000 EUR
per year for a 3 MW turbine – assuming a price of 5 cents/kWh.

8% AEP
24,000 EUR
per year for a 3 MW turbine – assuming a price of 5 cents/kWh.

Early detection of fatal damage can save at least
10,000 EUR/Case
through less production downtime and less costly replacement.

SITUATION

- TURBINE UNDERPERFORMANCE
- COMPLEX WIND FIELDS
- SECTOR CURTAILMENT
- LIMITED SITE SELECTION
- INCREASED PRODUCT COST
- NOISE CURTAILMENT
- POWER LOSS DUE TO WAKES
- TURBINE FATIGUE
- POWER OUTPUT INSTABILITY

SOLUTION

TEC

Turbine Efficiency Control

Improves sector curtailment and power curve over the entire range of wind speeds and terrains.

BNC

Blade Noise Control

Manages noise curtailment to increase overall energy output or even enable a specific site at all.

WFC

Wind Farm Control

Supports the optimization of the entire wind park, for example by balancing wake effects.

FEATURES

OPTIMAL OPERATION
Sensor data helps to optimize the energy yield for high turbulence, wind shear, and non-horizontal inflow.

IMBALANCE CORRECTION
Correcting yaw-misalignment, pitch error, aerodynamic rotor imbalance, and anemometer calibration errors.

SECTOR MANAGEMENT
With empirical knowledge of flow conditions and loads, operating restrictions are reduced and yield increased.

PASSIVE NOISE REDUCTION
Identifying the sources of noise leads to better wind turbine and blade designs.

ACTIVE NOISE REDUCTION
Dynamically maximized energy-to-noise ratio optimizes the possible energy yield.

CURTAILMENT MANAGEMENT
With actual and ongoing noise measurements, operating restrictions can be reduced and yield increased.

CUSTOM CONTROL STRATEGIES
Sectorial wake-steering or power-derating control strategies reduce the wake effects within the wind farm.

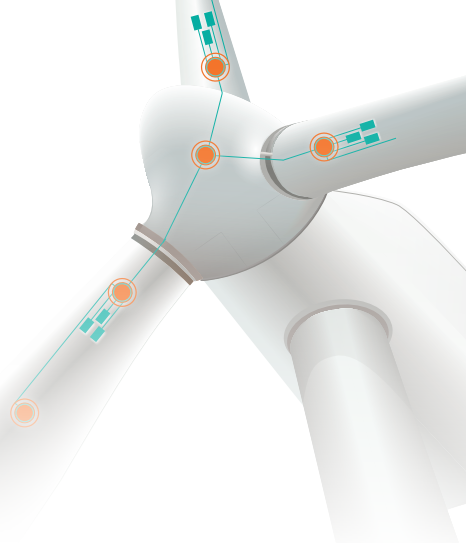
POWER SYSTEM INTEGRATION
Dynamic wind farm control algorithms assist in the power system and energy market integration of wind farms.

PARK-WIDE INSIGHTS
Turbine sensor data provides valuable insights on design, operation and planning of wind farms.

IMPACT

2% AEP	3% AEP	4% AEP
6,000 EUR	9,000 EUR	12,000 EUR

per year for a 3 MW turbine – assuming a price of 5 cents/kWh.



SENSOR PLATFORM

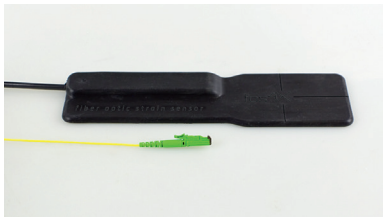
WE PROVIDE SENSORS AND SOLUTIONS TO DRIVE SMART WIND ENERGY.

Under the umbrella brand **“X4edge”** we bundle our portfolio of digital products for the optimization of wind turbine performance. Some of these products are based on our modular sensor platform **“fos4Blade”**.

At the core of the fos4X rotor blade sensor platform fos4Blade is our unique and reliable fiber-optic measurement technology, which is immune to lightning and electromagnetic interference. fos4Blade can be individually and cost-efficiency adapted to your requirements due to its modular design, consisting of a configurable set of strain and vibration sensors and a central measuring device.

The software solutions (or apps) based on the sensor platform close the gap between the fundamental measurement of blade properties and real customer value. With our industry expertise and cutting edge model-based analytics, machine-learning and AI techniques, we convert sensor data from the edge into relevant, actionable insights that you can access from wherever you are.

MISSION



The levers of classical mechanical engineering and turbine construction are well-developed. Consolidation and production shifting are certainly suited to further lower cost of energy.

We are, however, convinced that close collaboration between turbine manufacturers and suppliers, consistent recording of smart data, open interfaces and software for performance optimization are the better solutions for the industry.

With this conviction, a lot of domain knowledge, fantastic measurement technology and modern data analysis methodology, we help the wind industry into the digital age.

ABOUT

Founded in Munich in 2010, fos4X GmbH specializes in innovative fiber optic measurement technology and sensor technology – primarily in rotor blades for wind turbines – and develops intelligent solutions for the optimization of wind energy.

The fiber optic sensors and solutions are also used in the fields of electric mobility and railways, thereby supporting the efficiency and further development of these industries focused on renewable energies.

fos4X
rotor blade sensing

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