



HPSYSTEM.IT

Wind Farms Monitoring

 opto
sensing

Continuous & real-time monitoring of the status of wind farms has a huge and strategic importance with respect to **cost containment** and **environmental protection**.

Due to large scale, high cost and extreme environments their health monitoring and maintenance are big and fundamental challenges.

Especially when a wind farm is located in difficult environments it is the target of multiple hazards such as:

- **natural phenomena** (as earthquakes, ice, soil subsidence or landslides);
- third-party accidental or intentional **damages**;
- **structural failure** due to aging or lack of maintenance;
- **erosion and breaking due to sea action** for offshore wind farms.

HPSYSTEM.IT and Optosensing are able to provide a **complete continuous and real-time monitoring system** of overall wind farm:



from **preliminary wind and site assessment campaigns...**



...to the permanent monitoring
during its whole life time.

The design of wind farms is closely subject to a **complete knowledge of the project site** and its wind characteristics.

Therefore, a precise wind assessment campaign is the necessary first step, for the whole project (i.e. for dimensioning and turbine selection).

HPSYSTEM.IT, together with Optosensing, offers the **measuring equipment** to perform a wind assessment campaign supplying the necessary environmental parameters sensors, data acquisition & transmission units and related services.



Gonio-Anemometers,
wind characterization



Data Acquisition & Transmission Units



Inclinometers & Extensometers,
soil monitoring



Thermometers & Barometers,
air characterization











Landsense,
terrain characterization



Laser Scanner and Distance Meters

The development of faults in the tower or blades can cause **serious damages to the whole wind turbine** system if prompt repair action is not taken and can lead to huge failures, catastrophic for the system revenue and the surrounding environment.

Several damages can occur due to a lot of factors:

-  perpetual variation of **aerodynamic forces**;
-  **gravitational loads**;
-  **lightning** strikes;
-  weather conditions (i.e. **ice** on blades);
-  **sea action** for offshore wind farms;
-  **transport**;
-  natural phenomena;
-  and so on...

So, blades and the whole system could experience leading and trailing edge splits, cracks, holes or bends.



The capability to predict critical turbine faults and **identify potential problems or defects at an early stage**, implements an highly performing early warning system, performing an **instantaneous and cost effective diagnosis** of the farm thus allowing timely maintenance interventions.



EARLY WARNING



COSTS REDUCTION

RISKS REDUCTION



SYSTEM LIFE TIME EXTENSION



OPTIMIZED GENERATION



Traditional methods mainly rely on:

- the periodic control of system integrity by **direct inspection** techniques;
- **airborne survey** by visual observation;
- **single or multi-sensors** approaches.



NOT COMPLETE EARLY WARNING!

they are not able to detect or anticipate some specific disturbances or failure (included slow ground deformations);



NO CONTINUITY!

they are not able to perform a continuous monitoring .

DISTRIBUTED OPTICAL FIBER SENSING SYSTEM + NANOTECHNOLOGY

Combining both HPSYSTEM.IT and Optosensing's technologies, we are able to offer a highly performing system **able to predict failures** providing a continuous monitoring of static and dynamic parameters.

In particular, an optical fiber deployed along **the entire length of system (on blades and on the tower)** allows to obtain:



accurate strain and temperature profiles of the system;



the prevention and detection of **damages and failure.**

If at any time a turbine starts to degrade from a preestablished baseline the system can send an alert to the customer before there's a failure.

Such a technology offers several advantages which enables to:



perform a **continuous and real-time survey** of the operating conditions of the farm;



verify, point by point, the structural integrity from the time of installation to its **entire life-time**;

with the further advantage of being:



Low invasive;



Immune to electromagnetic interferences and to chemical and atmospheric agents (rain, lightning, high temperature, etc ...).







DAMAGE IDENTIFICATION

Due to large scale and the constant fatigue loading from rotation and wind gusts, blades and the whole wind turbine **shell be subject to cracks** induced by huge strain and stress overloads.

Distributed optical fiber sensors constitutes a cutting-edge solution thanks to their capabilities for detecting damage, determining damage location and assessing the nature of damage.

A single optical fiber can be **displaced all along the structure** of the wind turbine allowing accurate strain and temperature profiles.

By placing the same optical cable near the foundation, the sensor can reveal stress overloads interesting it.





ICE DETECTION

Especially in some remote environments, **ice can easily form on turbine blades**, adding hundreds of kilograms, thus degrading performances (sometimes inducing to shutdowns) and **reducing the working life**.

The optical fiber disposed all along blades, acting as a **distributed temperature and strain sensor**, offers a performing solution to the problem of blade icing.

By measuring the temperature, the system can identify hazardous icing conditions and activate the proper control system avoiding damages and allowing **continuous turbine operation**.

Furthermore, the distributed sensor **continuously measures the bending moment of the blade** as it rotates thus detecting changes in amplitude as ice builds on the blade.



MODAL ANALYSIS

Vibrations of a wind turbine have a negative impact on its performance.

Revealing and mitigating the vibrations of a wind turbine can potentially prevent and/or reduce failures, improve system efficiency, extend its life time and reduce maintenance costs.

Combining both nanotechnology and fiber optics technology, customer can have a performing vibration monitoring system for **the study of the dynamic behaviour** of the whole turbine both for design validation and during operations.



The knowledge of the soil has a huge importance both in **preliminary assessment campaign** and during the **operating life time** of the wind farm.

Our innovative system - combining the advantages of both nanotechnology and optical fiber technology - greatly increases performances on soils monitoring allowing continuous monitoring to **reconstruct both the 3D deformation and temperature profiles** of the soil on which it is installed.

The linking optical cable between each of **hybrid tech inclinometers** could be itself part of an hybrid tech inclinometer, disposed alongside the ground level.

This way, we offer a system including measures of displacements and deformations **in the horizontal plane too.**



Using our monitoring system, companies can:



identify damages, deformations and anomalies at an **early stage**;
reduce delays due to maintenance and repair;



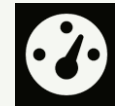
save money in the maintenance and management;



precisely **locate damages**;



prevent disasters;



optimize generation.



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