Smart fibres

SmartBlade

Optical Blade Loads Monitoring and Control System for Wind Turbines

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Key Applications:

- Independent Blade Pitch Control
- Blade condition monitoring
- Blade residual fatigue life assessment
- Ice Detection

SmartBlade Optical Loads Monitoring System

SmartBlade System Overview

Wind energy production is rapidly increasing to help satisfy growing global energy demands. In a push to increase wind energy production efficiency and reduce costs, turbines are becoming larger with rotor diameters ever increasing. High reliability and low maintenance is critical for these large turbines, however, the difference in wind speed at the top and bottom of such large rotors (wind shear) is greater. This leads to rotor imbalances which lower conversion efficiency and reduce the fatigue life of the drivetrain components. Individual pitch control (IPC) of the blades solves this issue by minimising rotor imbalance, so increasing efficiency, extending life and reducing maintenance costs.

IPC algorithms require real-time loads data for each blade to be available at high speed. Measuring these loads with electronic sensors is impossible due to the frequency of lightning strikes to the blades. Blade load monitoring systems using optical fiber Bragg grating sensors have broad industry acceptance due to the technology's insensitivity to lighting strike

Smart Fibres' optical blade loads monitoring system benefits from highly robust aerospace qualified instrumentation, a long and successful deployment history and a price point that meets industry needs.

The Smart Fibres system also outputs blade bending moments that can be used for condition monitoring. Rainflow counting of these data shows remaining blade fatigue life and allows blades to be serviced or exchanged at the most appropriate intervals.

With suitable processing, data from Smart Fibres' system can also be used to detect blade ice formation and melting. This knowledge helps operators maximise the availability of turbines in cold regions, whilst reducing the danger of ice shedding.

Key System Features

- Highly robust instrumentation, proven in military jet flight trials 0
- Uses 25 year Telcordia qualified optics
- All optical sensing technology, no susceptibility to EMI, and no conducting cables in the blades
 - High sampling rate, sensor count and resolution, automatic gain control to counter unexpected attenuation
 - Stable long-term measurements, no drift and no recalibration required
 - Uses 100 % COTS components, giving supply certainty and low cost
 - Simple, proven installation technique allows complete rotor instrumentation in 1 day

SmartBlade Components

- 1 SmartPatch FBG sensors
- 2 Ruggedized optical cable
- 3 Blade connection box
- 4 Cable to interrogator



Blade equipment – x_3



SmartScan Dynamic FBG Interrogator

SmartScan is Smart Fibres' in-house tuneable laser interrogator for FBG sensors. Its high resolution, broad temperature range and low power consumption makes it the ideal instrument for a turbine blade loads monitoring system. SmartScan communicates with the turbine PLC or SCADA system via Ethernet or CAN bus. Further details at www.smartfibres.com/products/smartscan

SmartBlade System Specifications:

Number of sensors		24 (4 strain & 4 temperature * 3 blades)
Measurement range		Up to +/- 5,000 µstrain
Wavelength repeatability		< 1 pm
Wavelength stability over temperature range		< 5 pm
Measurement rate	Ethernet	2,500 Hz
	CAN bus	250 Hz typically due to bus capacity
Interrogator mass		1 kg
Sensor dimensions		100 × 15 × 1 mm
Interrogator dimensions		140 x 110 x 70 mm
Sensor connection box dimensions		130 x 130 x 60 mm
Sensor operating temperature range		-40 to +60 °C
Interrogator operating temperature range		-20 to +60 °C
Communication interfaces		Ethernet, CANopen
Interrogator input voltage		+9 to +36 VDC
Interrogator power consumption		typ 7.5 W, max 10 W