FIBERSAIL

Shaping the structures of tomorrow

Turning critical structures into smart structures

EPIC

Presentation

08.07.2020

Introduction

Portuguese-Dutch Startup focused on Wind Turbine Rotor Performance

Researched at FEUP – Engineering Faculty of Porto University, Portugal

Owner of Fibersail patent pending blade shape sensing technology

Backed by Innoenergy, Portuguese and Dutch investors

Blade O&M Forum innovation winner 2017

Vision

We believe that Rotor-Load-Controlled Wind Turbines for maximized performance will pave the way for a far more competitive wind industry.

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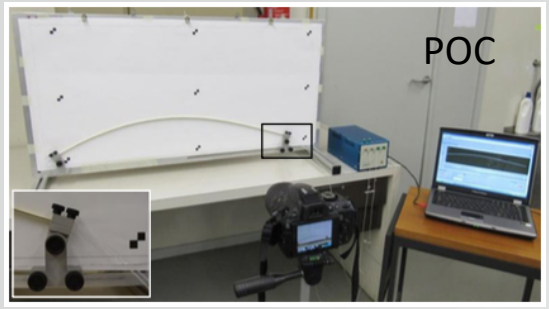
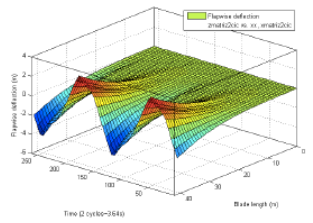
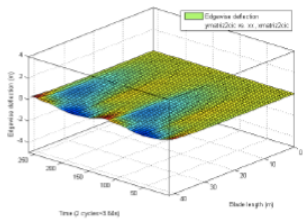
The Journey



Flapwise deflection (2cicles ~ 3.64s):

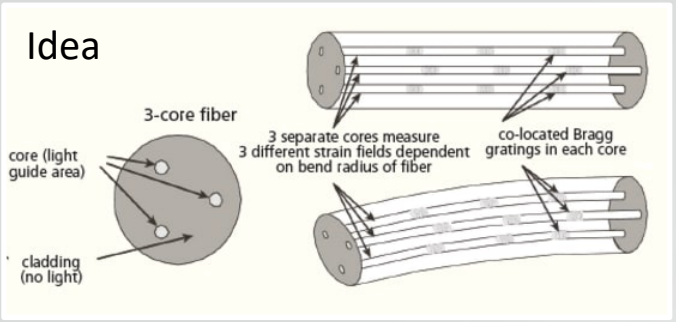


Prototype

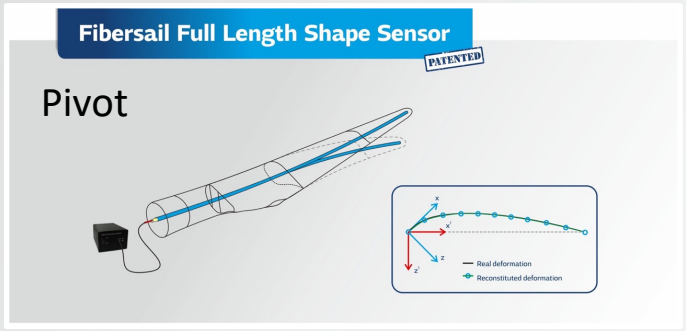


2006 — **2015** — **2016** — **2017** — **2018** — **2019**

Idea



Pivot



Accelerate

rockstart.

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Problem To Solve

Undetected rotor imbalances causes **Underperformance and Extra Loads**

Unpredicted failures increases **O&M Costs**

Lack of information makes it difficult for **Lifetime Optimization**

*"2019 Wind Turbine global unexpected costs on **repairs and corrections above 7,5B€"** (Source: Wood Mackenzie)*

*"Most Wind Farms have potential for **between 5% to 11% performance** improvements" (Source: Sgurr Energy)*

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Fibersail Solution

1 Blade Shape Sensing System

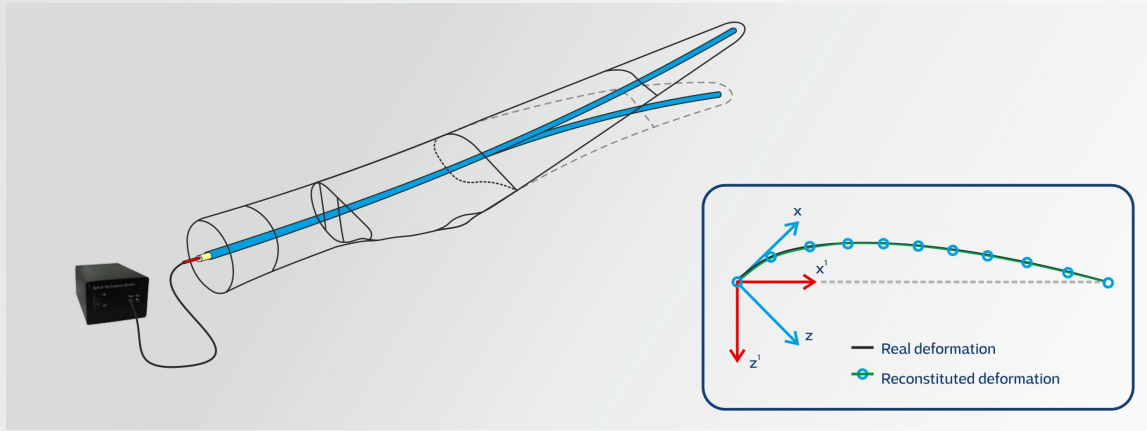
Based on fiber optic technology to measure 3D displacement
Independent from OEM blade design

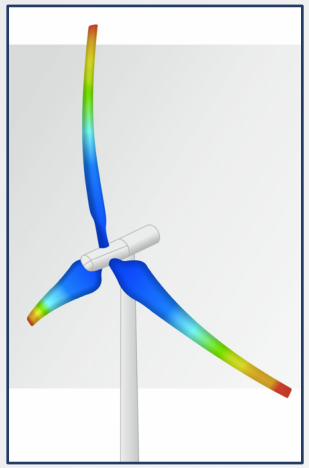
2 Structural Behavior Analysis

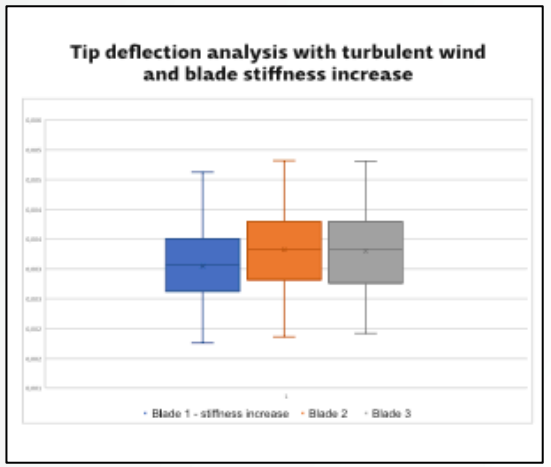
Flapwise and Edgewise displacement measurement
Convert the rotor into a giant anemometer

3 Failure and Wind Pattern Detection

By comparing and analyzing blade deflections
Launch alerts and propose corrective actions







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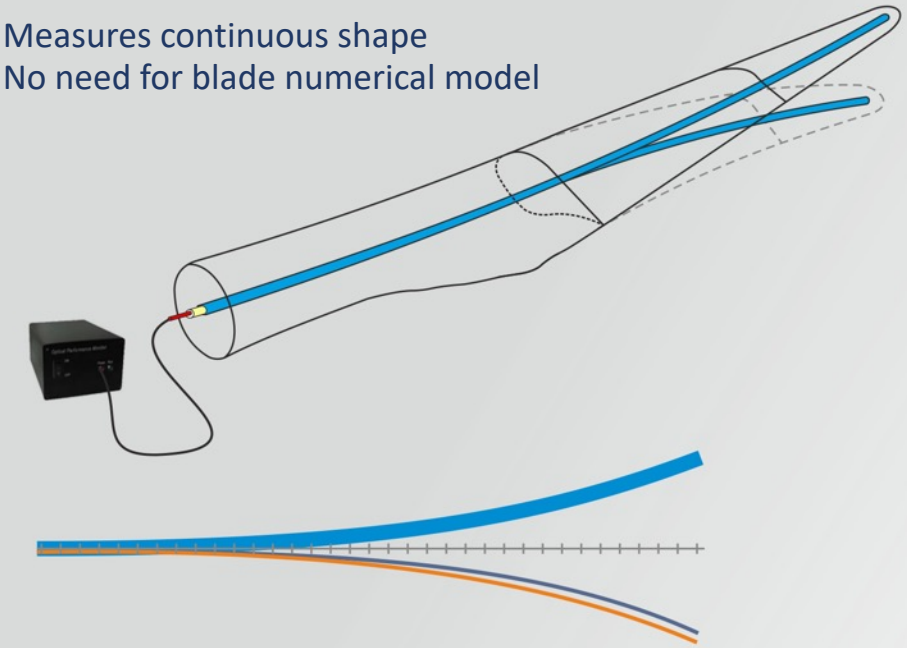
Product Differentiation

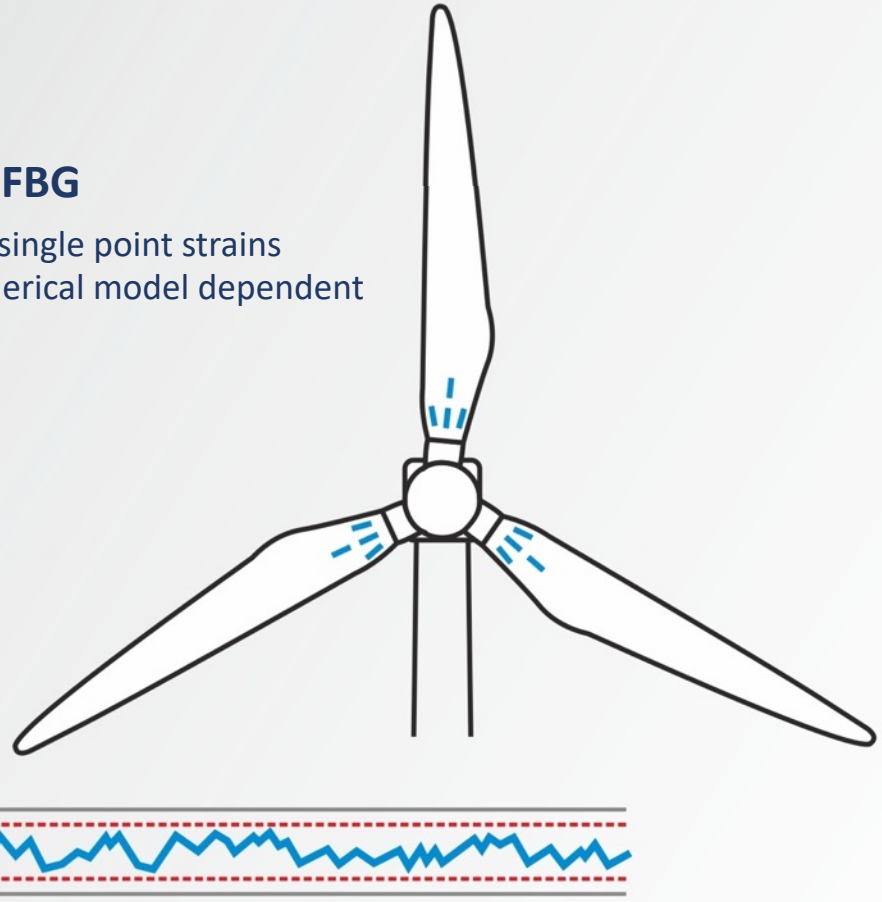
Fibersail

Measures continuous shape
No need for blade numerical model



Current FBG

Measures single point strains
Blade numerical model dependent



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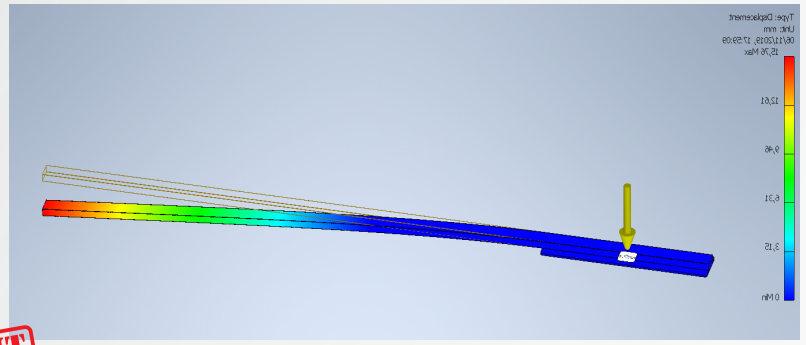
Fibersail Technology

Shape Sensing Technology

4 Single mode arrays of bend insensitive Polyimid 1250BI (length of blade)

10mm FBGs written in Femtosecond

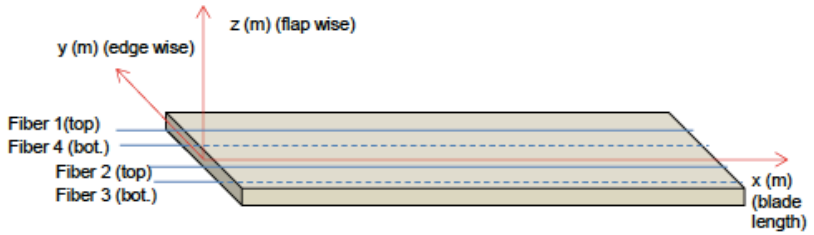


PATENT PENDING

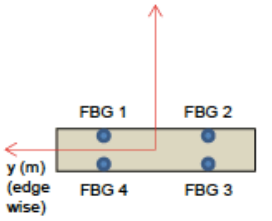
Table 1 - Datasheet of 18 meter length 3D shape sensing sensors

Characteristic			Sensor 1	Sensor 2	Sensor 3
Accuracy	Edge	R^2	1.00	0.99	0.99
		RMSE (m)	0.01	0.02	0.02
		RMSE / L* (%)	0.11%	0.18%	0.15%
Reliability	3 sensors	R^2		0.99	
		RMSE (m)		0.02	
		RMSE / L* (%)		0.15%	
Resolution *2	Edge	Tip deflection (mm)	1.17	1.17	1.17
		Tip deflection / L* (%)	0.01%	0.01%	0.01%
	Flap	Tip deflection (mm)	3.15	3.15	3.15
		Tip deflection / L* (%)	0.03%	0.03%	0.03%
Robustness	Edge	Min. curvature radius *3 (m)	2.00	2.00	2.00
	Flap	Min. curvature radius *3 (m)	0.74	0.74	0.74
Durability	Edge wise and flap wise fatigue testing	Cycles (>)	5000000	5000000	5000000
		Years (>)	20	20	20

Axis system



(a) Perspective view of axis system



(b) Instrumented cross-section

* L is the maximum distance between instrumented cross-sections

*2 Resolution evaluated at maximum tip deflection considering FBG resolution of 1 micro strain

*3 Considering the maximum allowable strain of FBG of 2500 microstrain

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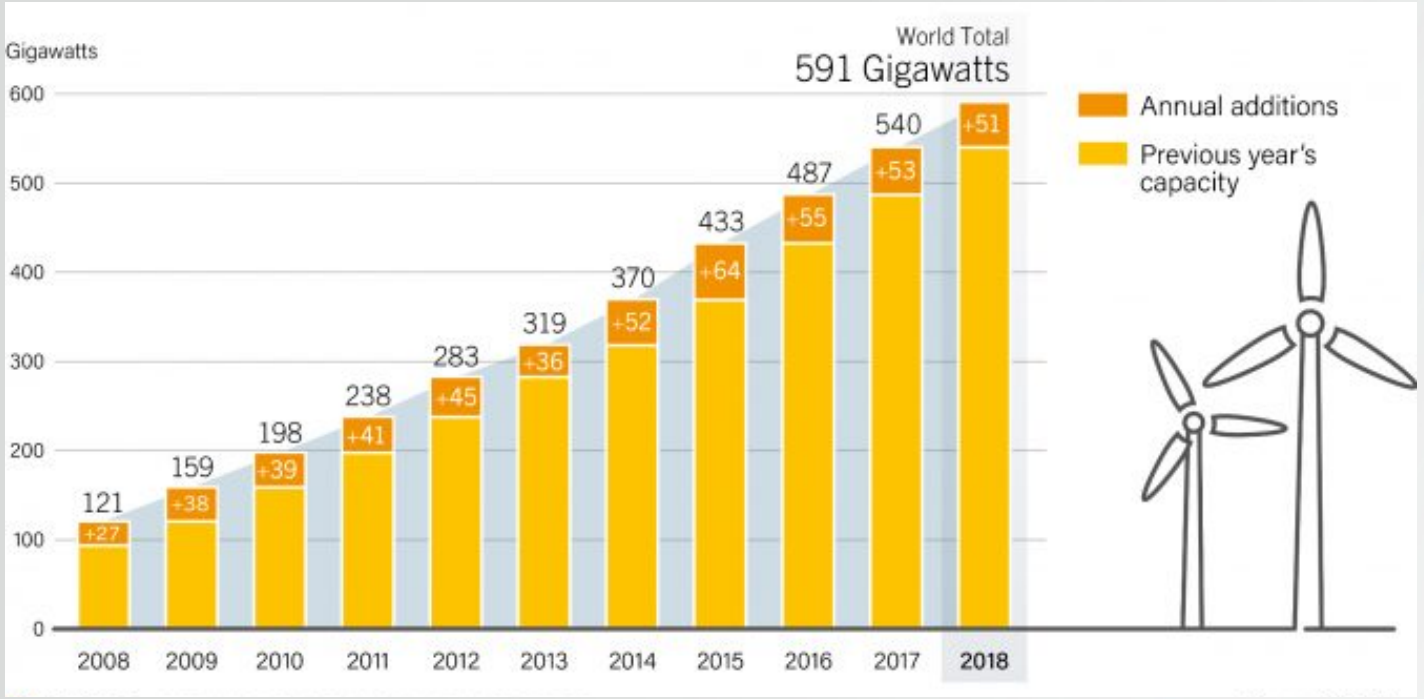
Market Demand



Wind power global capacity and annual additions, 2008-2018 (source: GWEC)

340.000 Wind turbines in operation in 2018

20.641 New Wind Turbines were installed during 2018

1.200 meters of fiber optic for a 12MW Offshore WT

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“If you cannot measure it, you cannot improve it”

William Kelvin