eologix
sensor technology

6D inertial sensing on the blade surface – know the moves of your blade

Winterwind 2021

Michael Moser, Theresa Loss | eologix sensor technology gmbh

Introduction

eologix wireless sensor platform

- measures also close to blade tip
- is independent from turbine location
- is independent from turbine type and age
- is independent from SCADA data

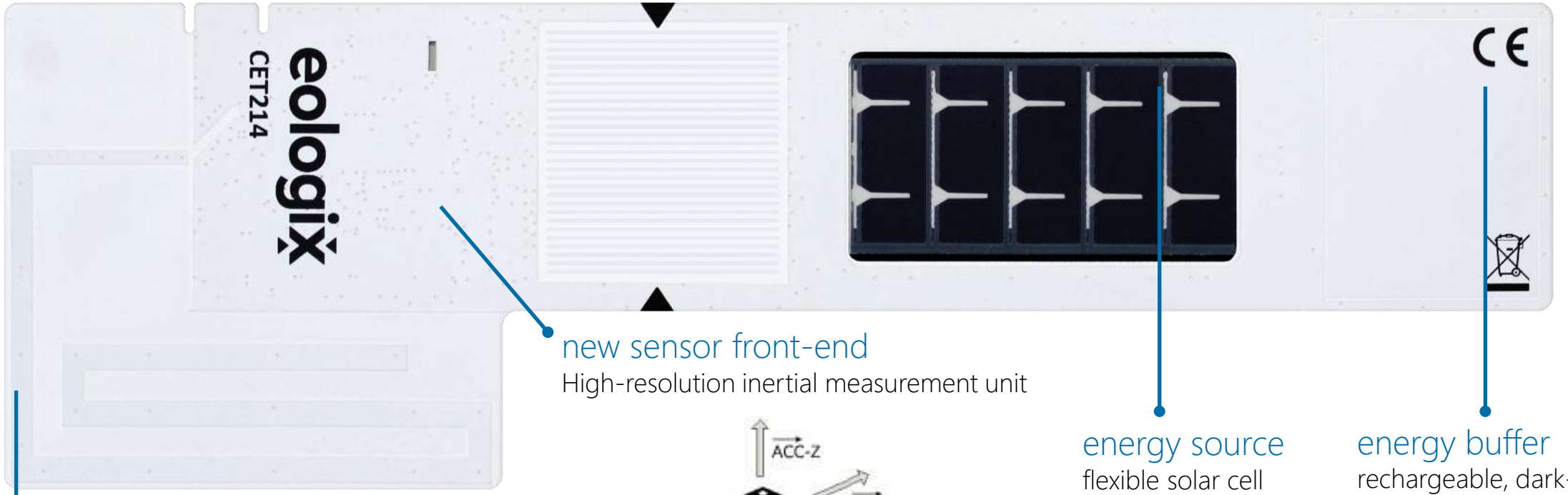
Technology

Inertial measurements sensor layout

ca. 200 mm

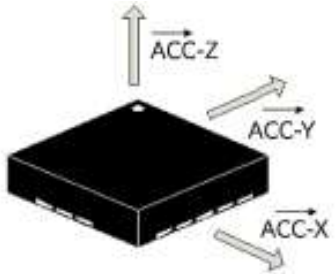
max. thickness < 2mm

ca. 65mm



wireless
no cabling in blade or hub

new sensor front-end
High-resolution inertial measurement unit



https://www.maximintegrated.com/en/design/technical-documents/app-notes/5/5830.html

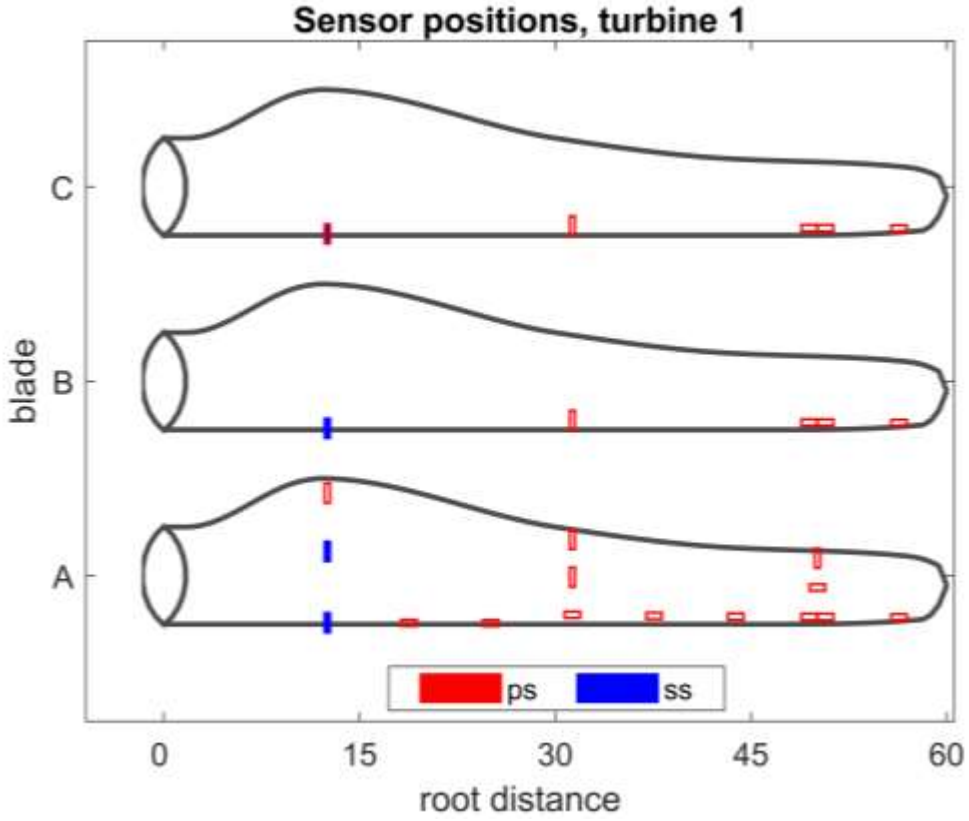
energy source
flexible solar cell
for unlimited
energy supply

energy buffer
rechargeable, dark-time
>1000h

Experiment set-up

Sensor distribution

- Sensors
  - at different radial positions
  - at different distance from trailing edge
  - on all three blades
- Aim
  - to combine data from multiple sensors to get information on local and overall behaviour
- First set of measurement campaigns
  - sampling frequency exceeding 800 Hz
  - several weeks of data



Experiment set-up

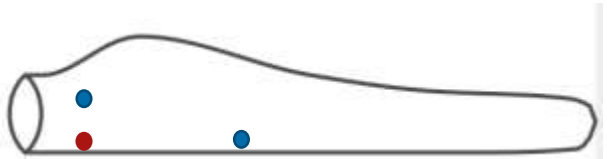
Turbine types

Turbine type	Nominal power	Location
Enercon E66	1.5 MW	AUT
Senvion MM92	2.04 MW	CAN
GE 2.75-120	2.75 MW	GER
Enercon E101	3.05 MW	AUT & GER
Vestas V117	3.3 MW	BEL
BARD 6.5	6.5 MW	GER
ADWEN 8 – 180*	8.0 MW	GER

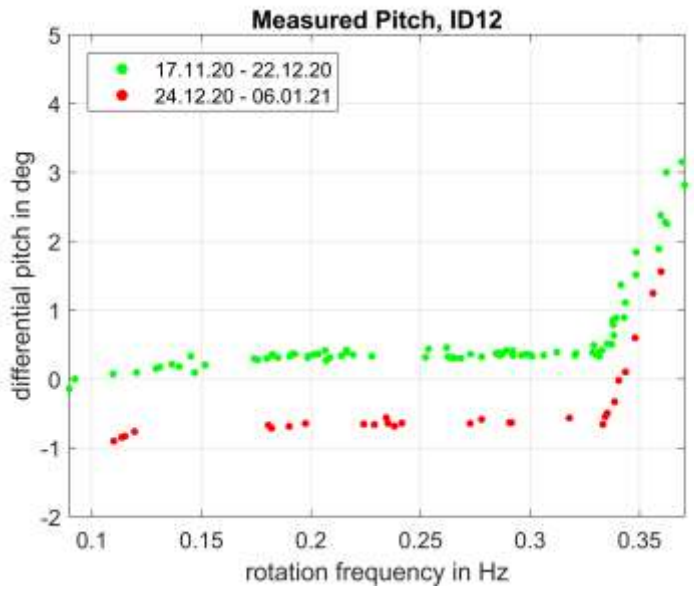
*installation in progress

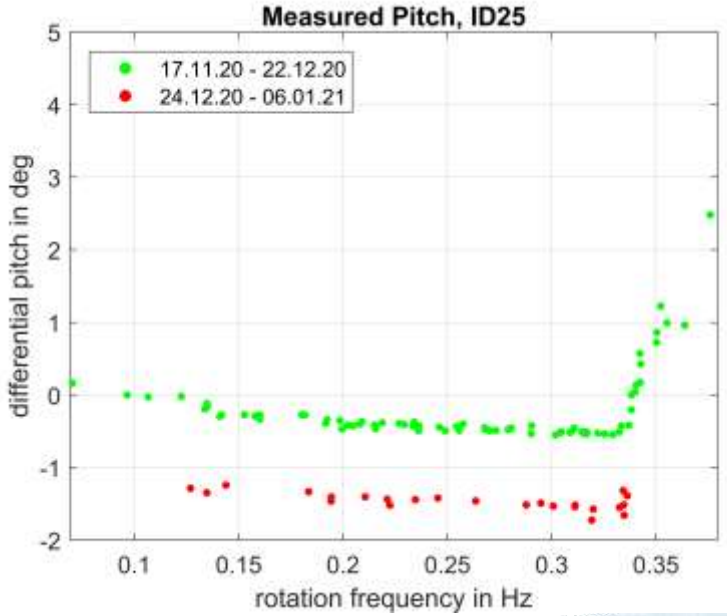
Pitch angle (1)

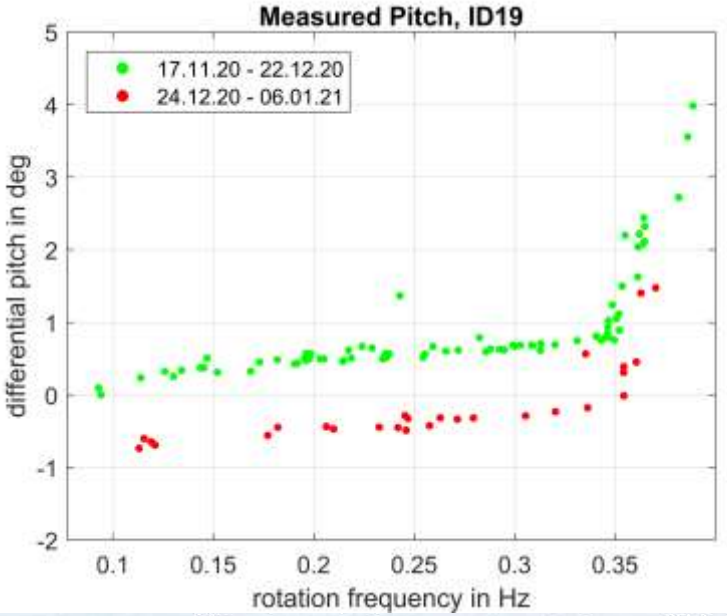
Estimation of pitch angle change



- each dot equals one measurement of ~10 seconds
- pitch has been changed on purpose by 1°

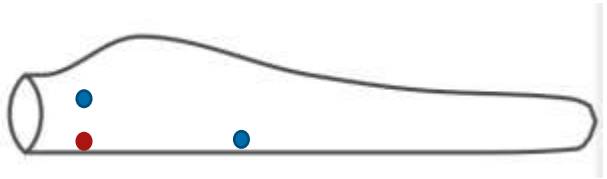






Pitch angle (1)

Estimation of pitch angle change



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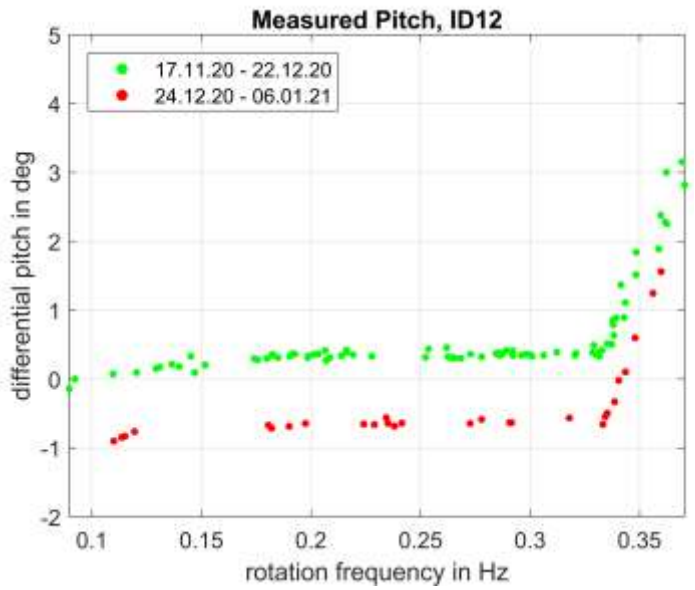
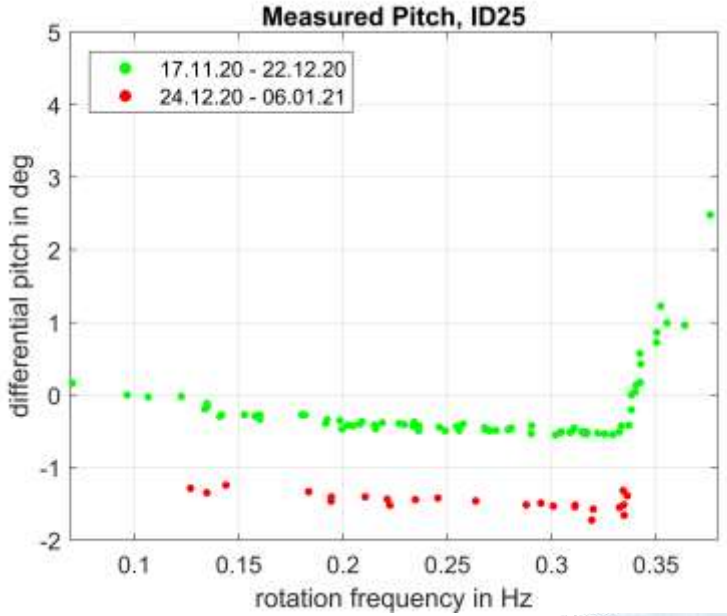
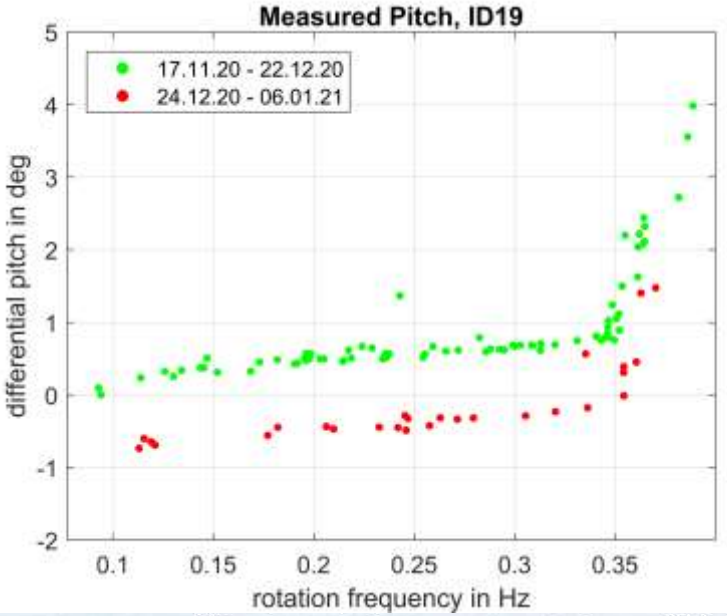


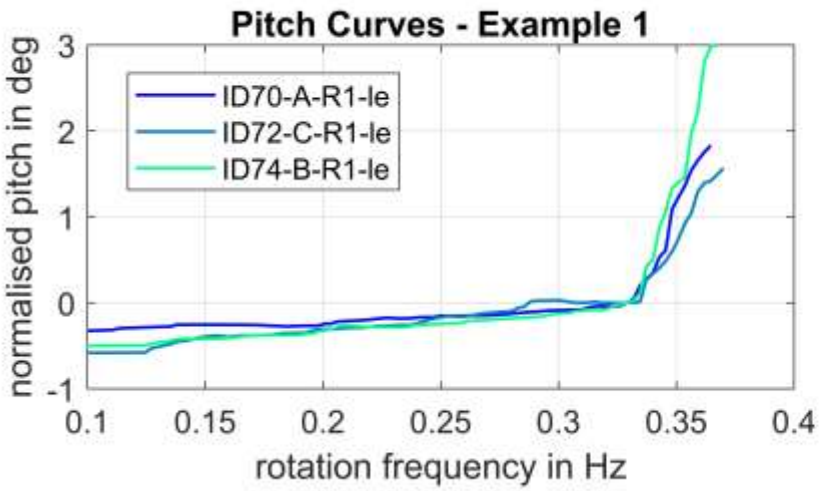


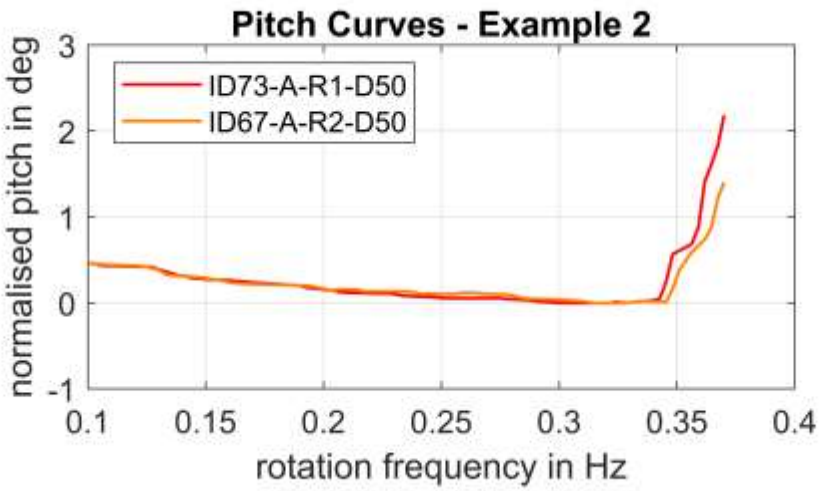


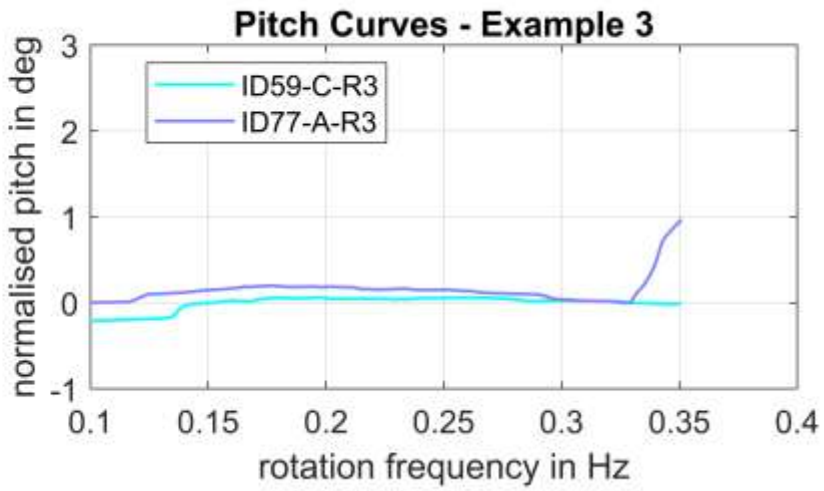
Pitch angle (2)

Pitch characteristics

- Different behaviour over pitch, load dependent blade torsion

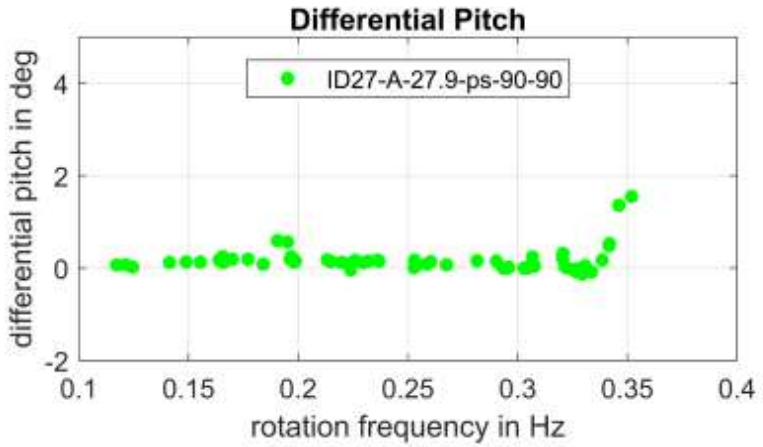


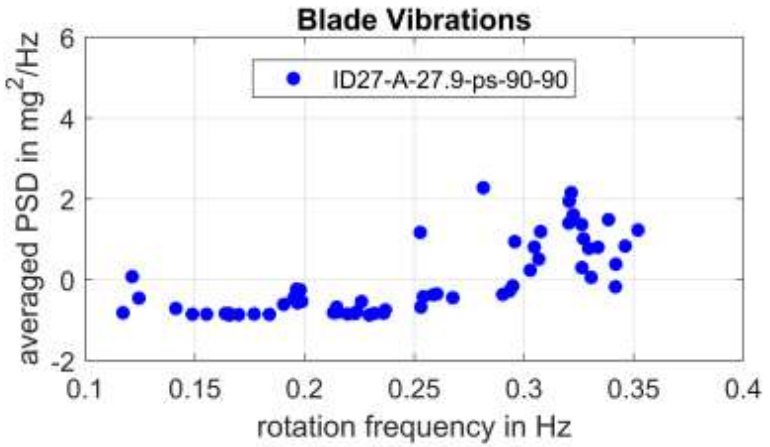


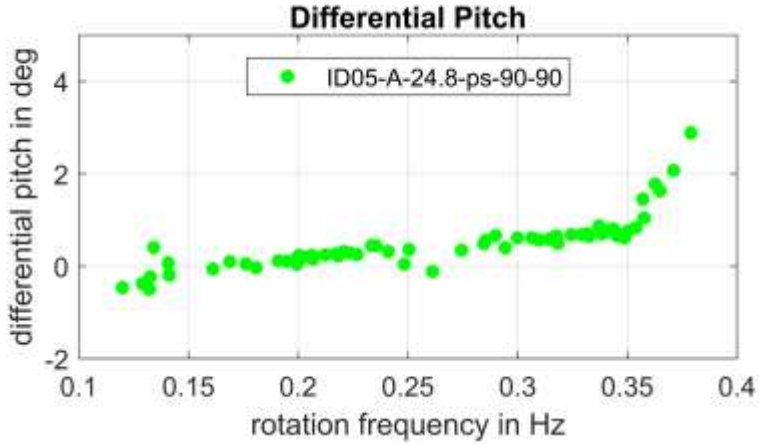


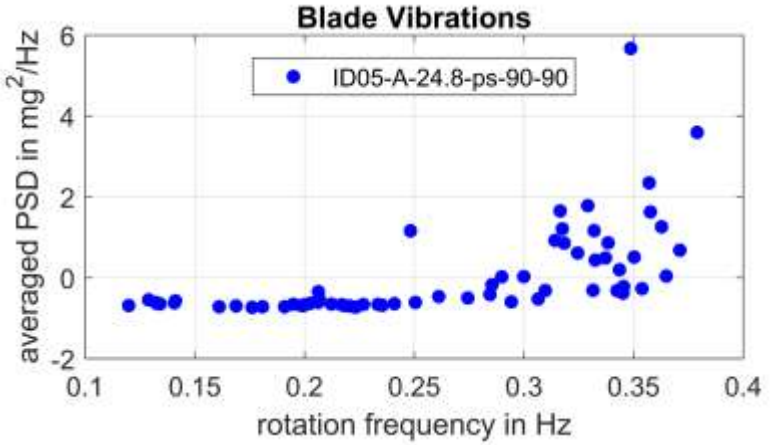
Vibration Patterns (1)

Same blade, two sensors close to tip



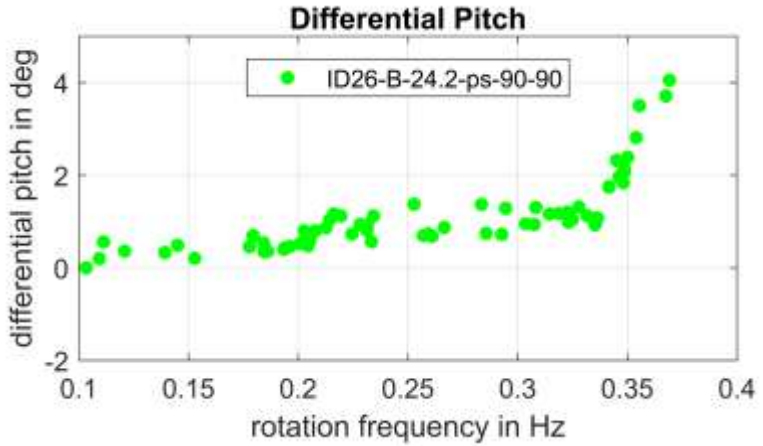


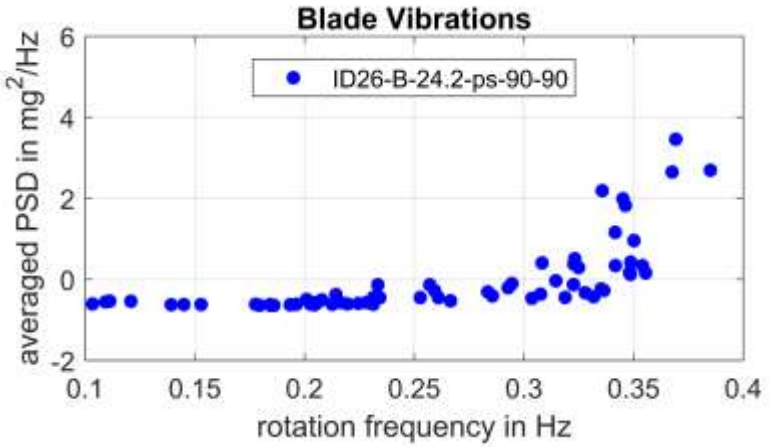


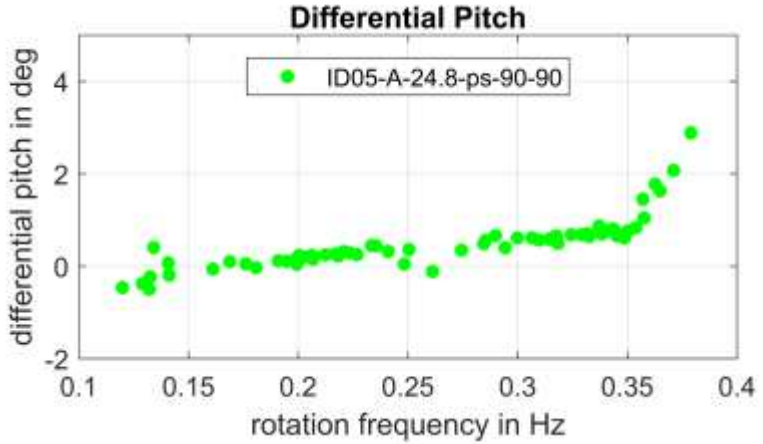


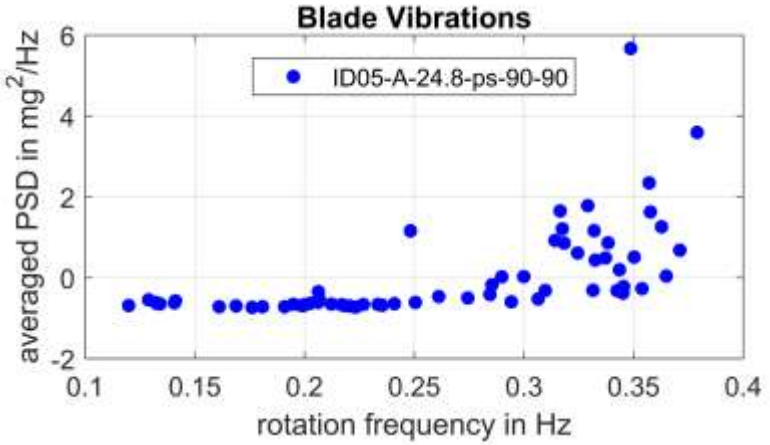
Vibration Patterns (2)

Same position, two blades



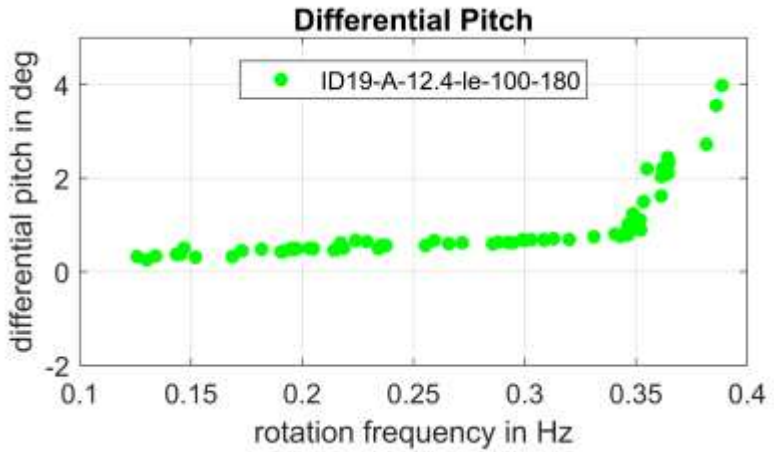


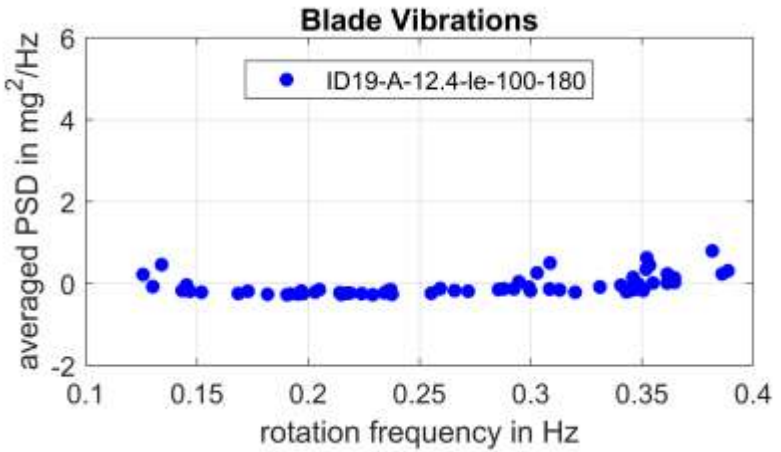


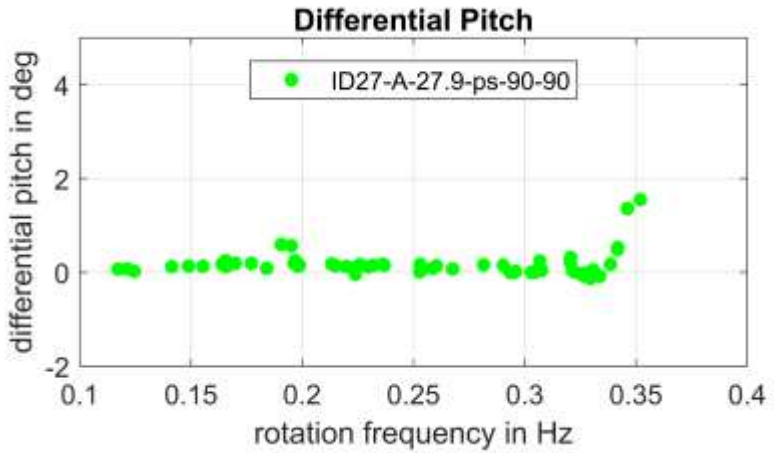


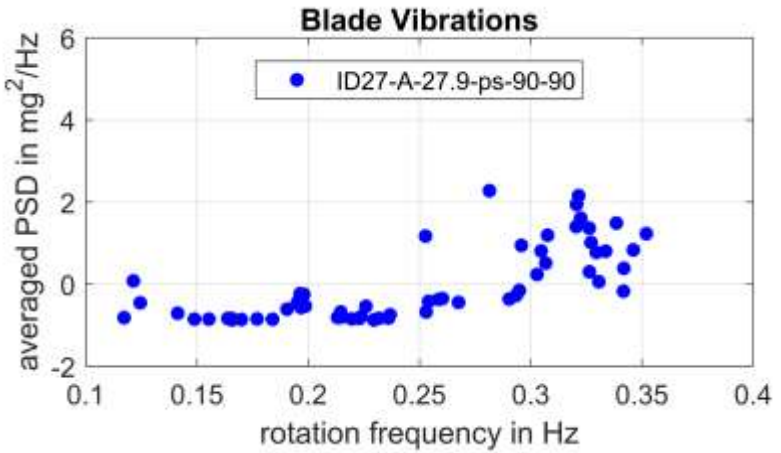
Vibration Patterns (3)

Same blade, ~40% radius vs. tip









Conclusion & Outlook

Conclusion

- Collected data look promising for a variety of applications
- On-purpose pitch intervention is accurately measured
- „Local pitch“ at sensor position is affected by load and can be measured continuously
- Local vibrations are quantifiable and can be analyzed from raw data

Outlook

- Further development ongoing…
- New products & services available soon!

ANY QUESTIONS?

Get in touch.

michael.moser@eologix.com

+43 316 931215 200

Kratkystrasse 2
8020 Graz, Austria