TACKLING ICE THROW RISKS

by using sophisticated algorithms of blade-based ice detection

EXPERTS FOR STRUCTURAL DYNAMICS & ACOUSTICS

- Specialists for monitoring of the complete structure
- Experts of Structural Dynamics for 50 years
- References throughout the whole wind industry
- Series supplier for several OEMs & multiple operators
- Global installation base: 2.000+ systems

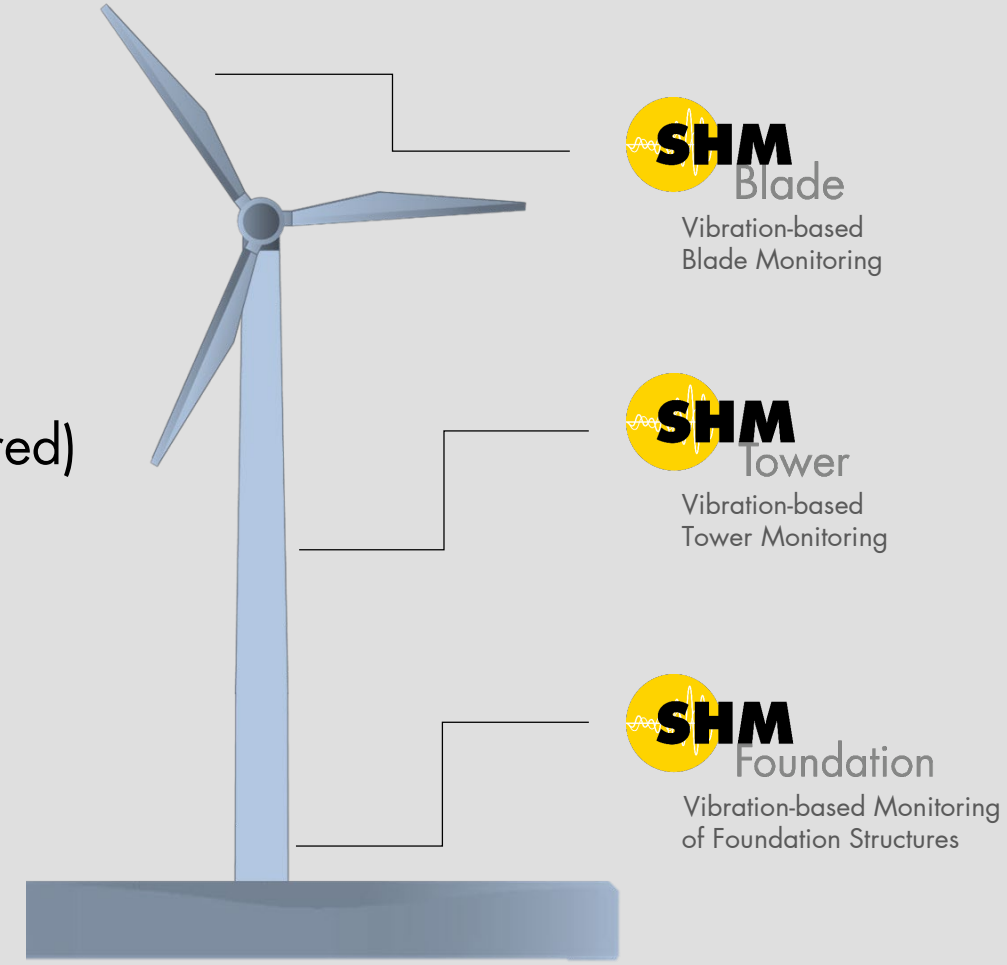
AGENDA

1. Relevance of Structural Monitoring
2. Blade-based Ice Detection
3. Adaptive Model Referencing
4. Take-home Messages

STRUCTURAL MONITORING IS RELEVANT

A general perspective on SHM:

- Life-time extension 20+ (beyond design life)
- Reliable ice detection to protect equipment and environment
- Early detection of fatal structural damage
- Safe continued operation (after damages occurred)
- Rotor imbalance detection and correction

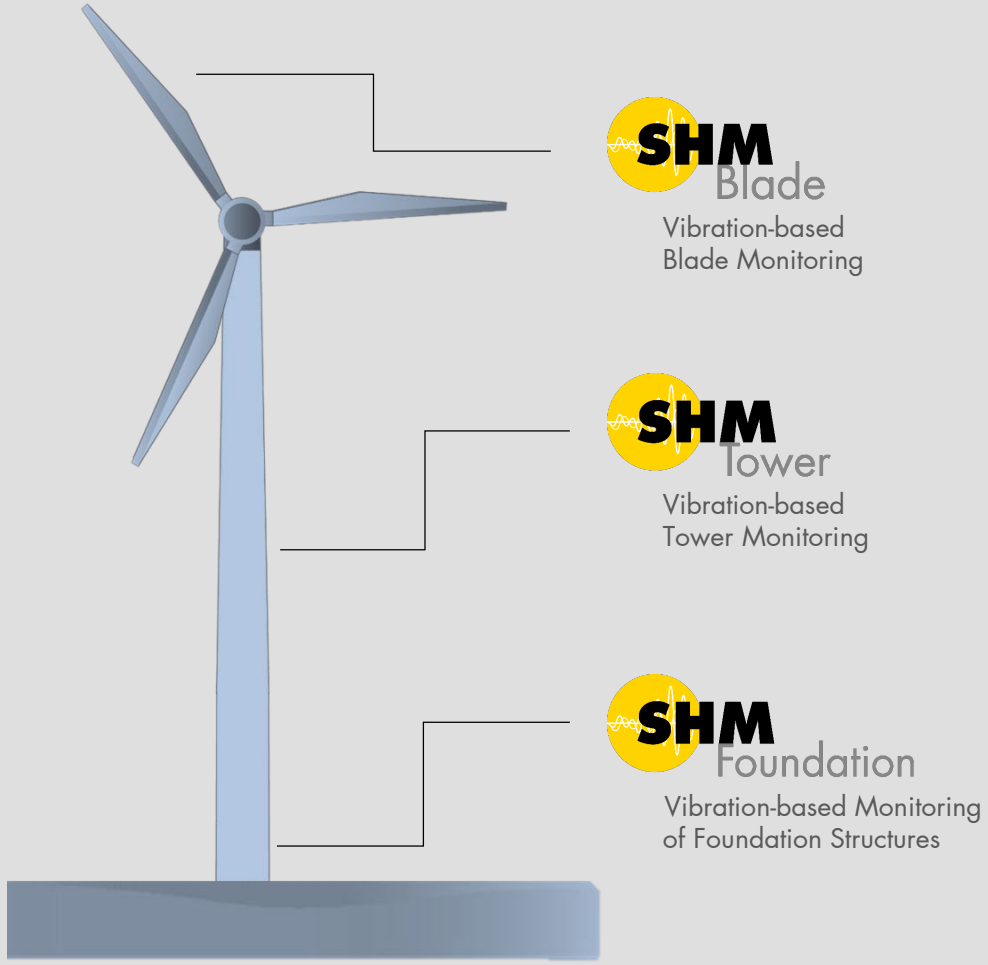


SHM = Structural Health Monitoring

STRUCTURAL MONITORING IS RELEVANT

Key objectives of operator

- Maximizing the profits of the asset
- Operating the asset safely
- Keeping the asset in a good shape!
- Adding value by online monitoring



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VIBRATION-BASED SYSTEMS FOR ICE & DAMAGE

Illustrative field experiences with ice accretion and structural damages

→ Monitoring of rotor blade vibrations gives us the full picture!

Source: Wind Energy Journal 2019, Wei et al., A review on ice detection technology [...] for wind turbines, DOI: 10.1002/we.2427

Source: https://www.windpowerengineering.com/wp-content/uploads/2011/07/Ice-on-Turbine-Blades.jpg

Source: https://nawindpower.com/wp-content/uploads/2016/01/12970_the_elgin_review_1.jpg

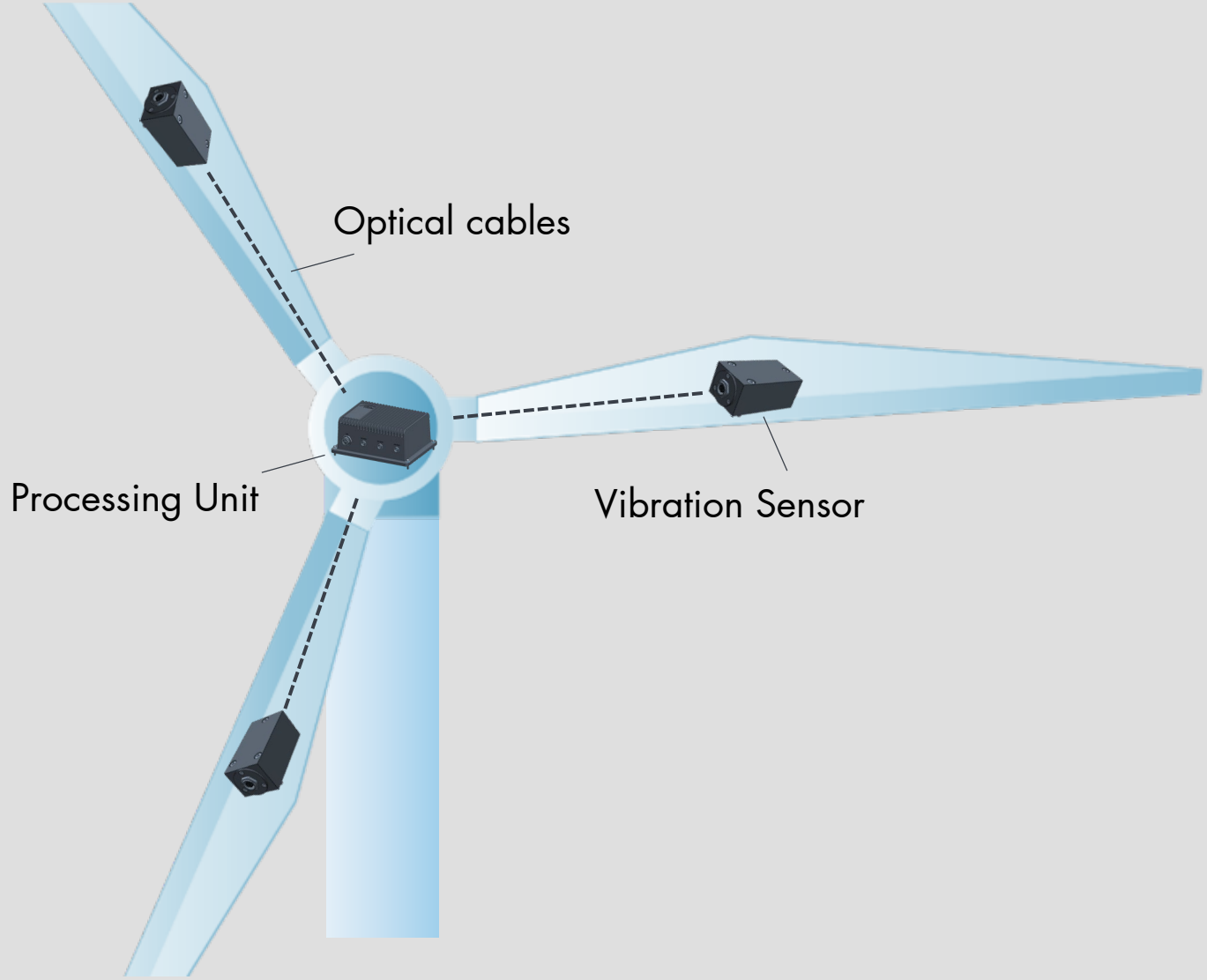
VIBRATION-BASED SYSTEMS FOR ICE & DAMAGE

Safe & sound ice detection involves …

- reliable sensors
- advanced algorithms
- dynamics expertise

Reliability is reached by …

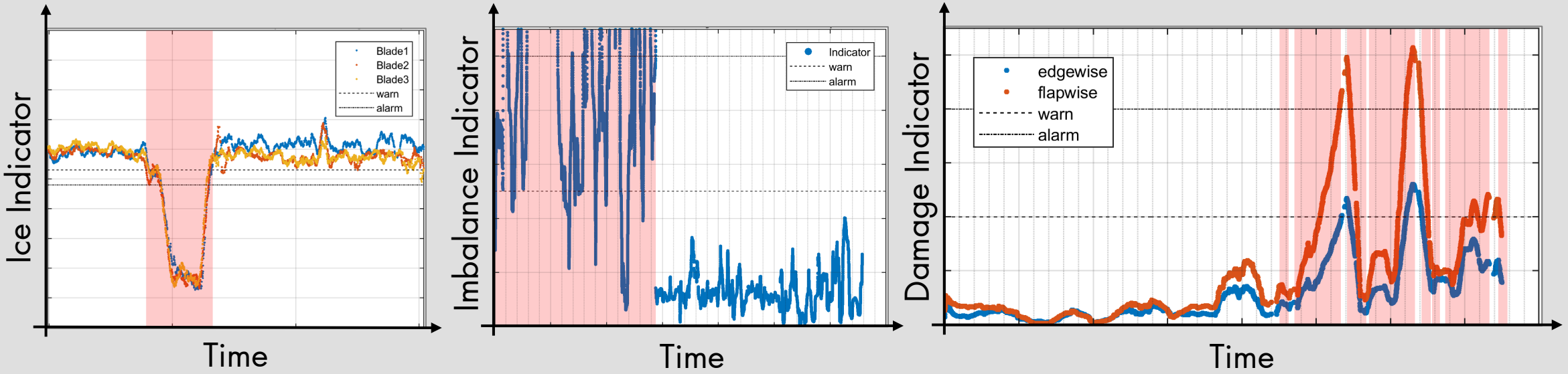
- robust & mature technology
- Holistic state monitoring
- Sensors in a safe environment
- Expected lifetime 20+



VIBRATION-BASED SYSTEMS FOR ICE & DAMAGE

Vibration-based detection is not limited to ice…

… compensation of imbalances & early damage detection.



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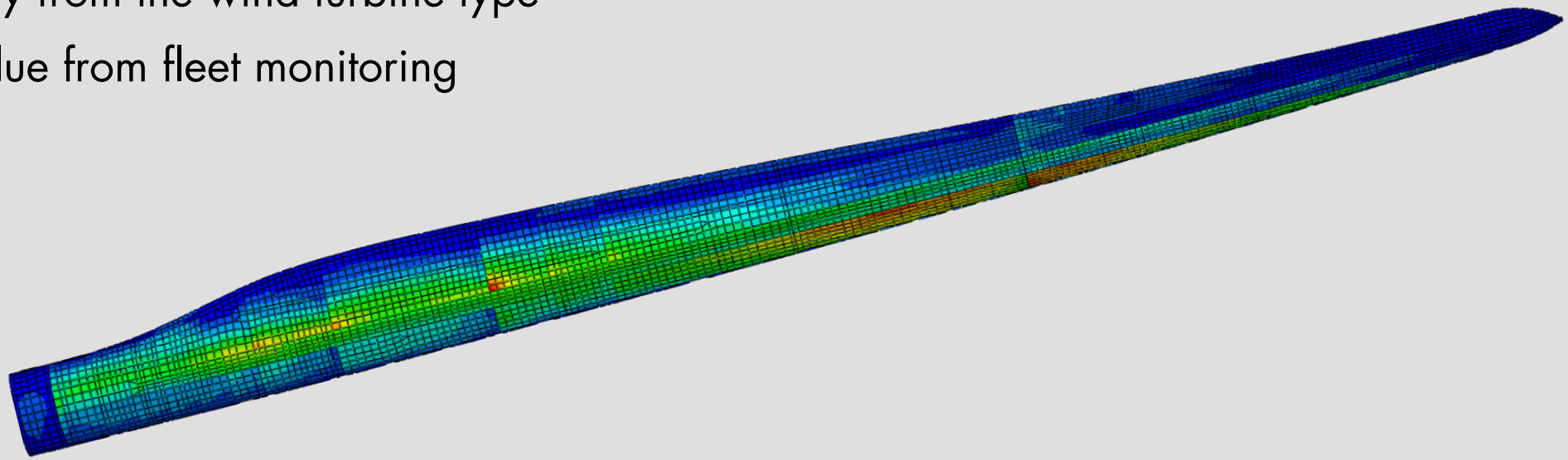
HIGH PREDICTION ACCURACY THROUGH AI MODEL

Ice accretion & structural damages affect the blade properties

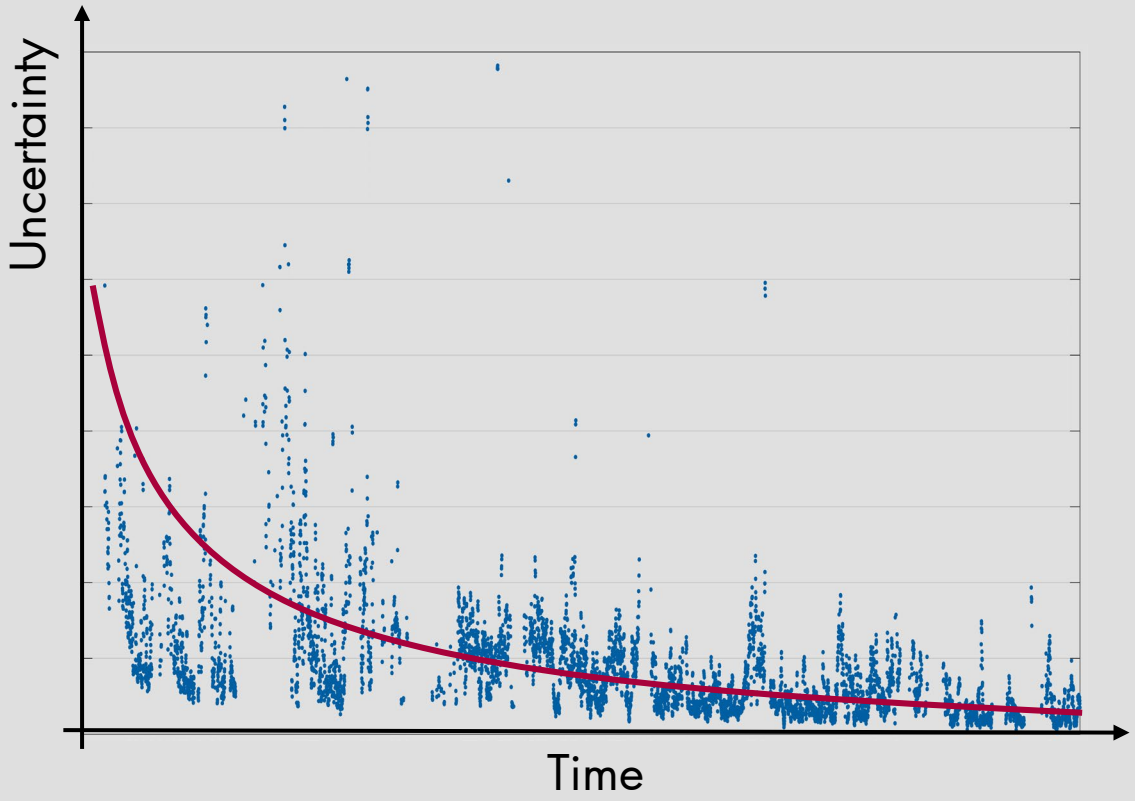
- Continuous learning from past events
- Continuous learning of new behaviour
- Independency from the wind turbine type
- Generate value from fleet monitoring

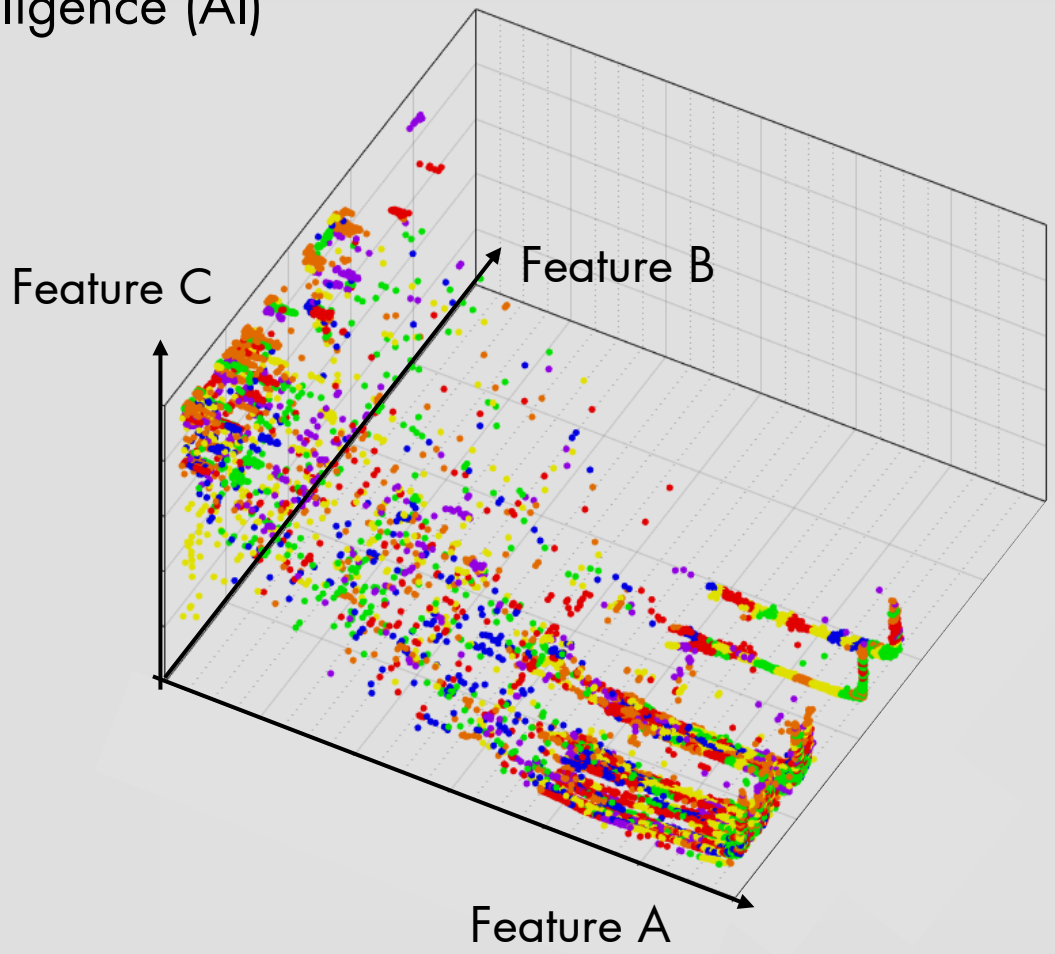


HIGH PREDICTION ACCURACY THROUGH AI MODEL

Clustering the rotor blade model using artificial intelligence (AI)

→ Adaptive & automated model referencing





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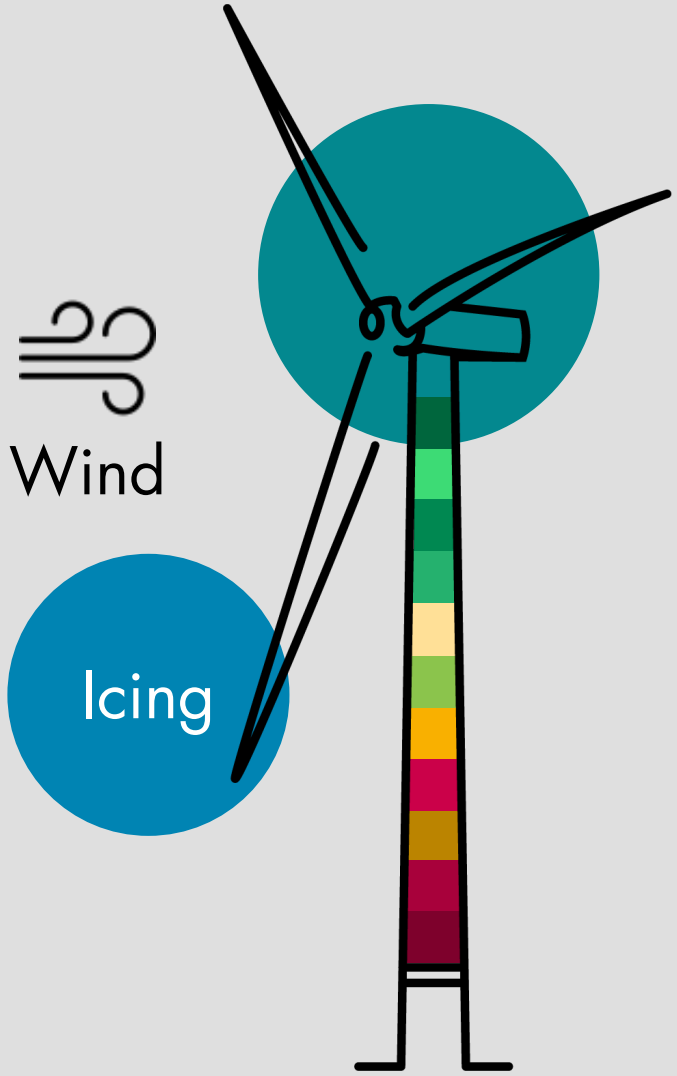
MINIMUM RISK AND INCREASED YIELD

Keys to safe and economical ice detection

- Reliable & robust vibration sensors to assess the current ice state holistically
- Customized model reference for each wind turbine for increased accuracy
- Sophisticated algorithms to generate more value beyond ice

→ Tackle the ice throw risks and maximize the energy yield in safe operation by automatic restart




Wölfel