

Oscillation and vibrations of SWT

Small Wind Conference 2018

Minneapolis, USA, 09.04.2018

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Introduction

Observed consequence of increased vibration and oscillation:

- Mast fatigue (concrete tear)
- Mast fatigue (steel break)
- SWT failure (rotor failure)



framework – decentralized energy supply in built environment

- Increased safety requirements
- Body borne noise transmission
- Load reduction (building mounted)

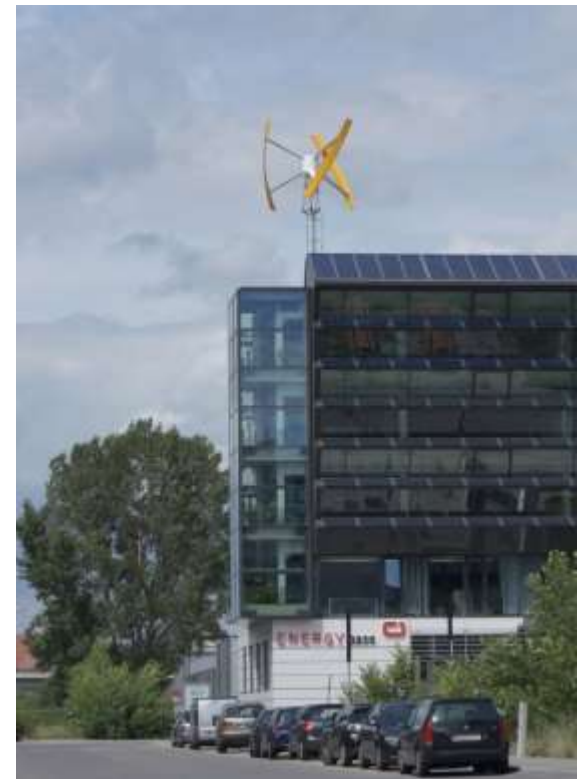
- Environmental impact unknown:
 - Loads on supporting structure
 - Influence on human beings
 - Influence on SWT



Scope of work

Study:

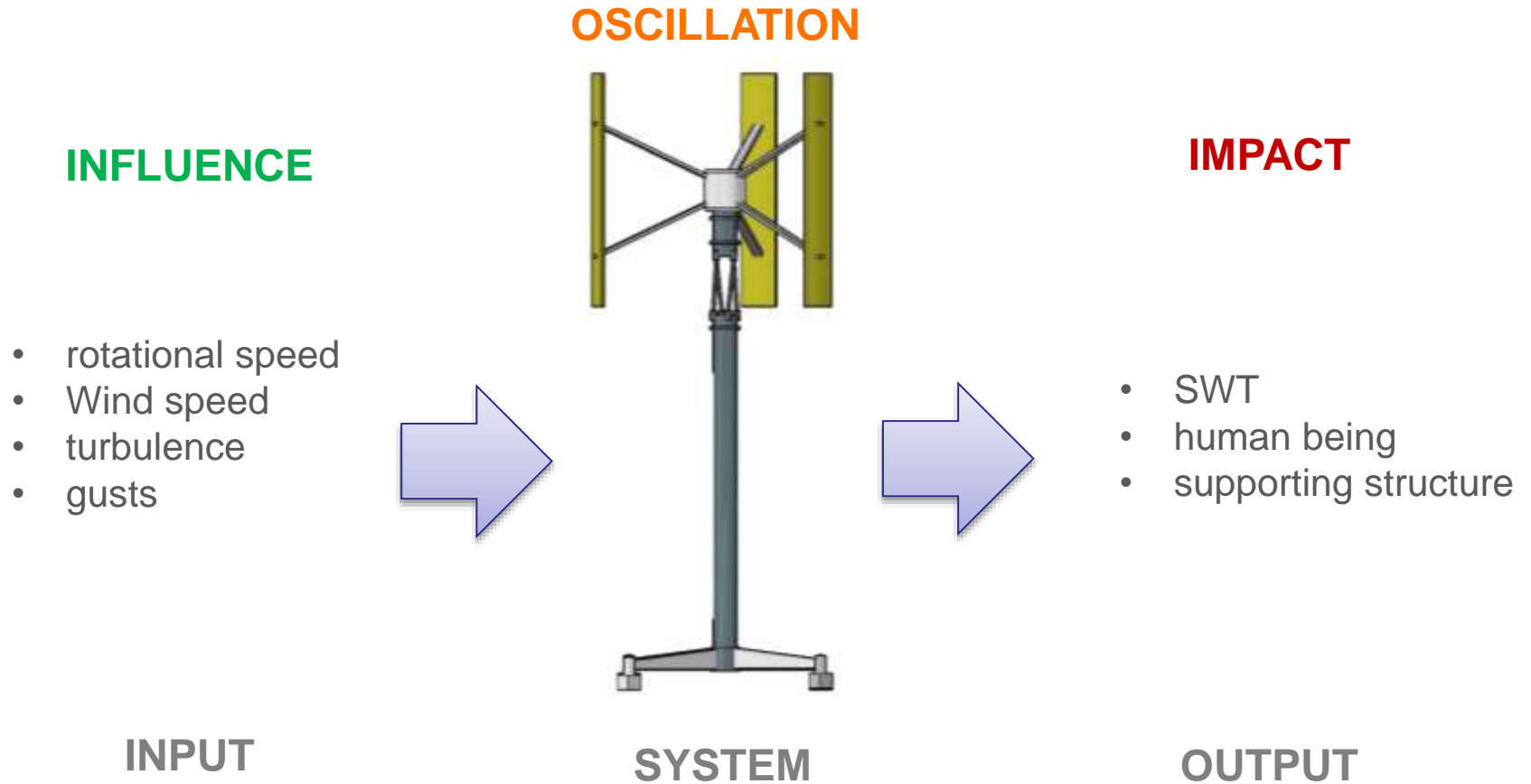
- Cause for increased oscillation and vibration
 - Aerodynamic effects
 - Mechanical effects
 - RPM and Resonance
 - Gusts and Turbulence
- Load estimation
- Estimation of impact on human beings
- Evaluation of oscillation decoupler



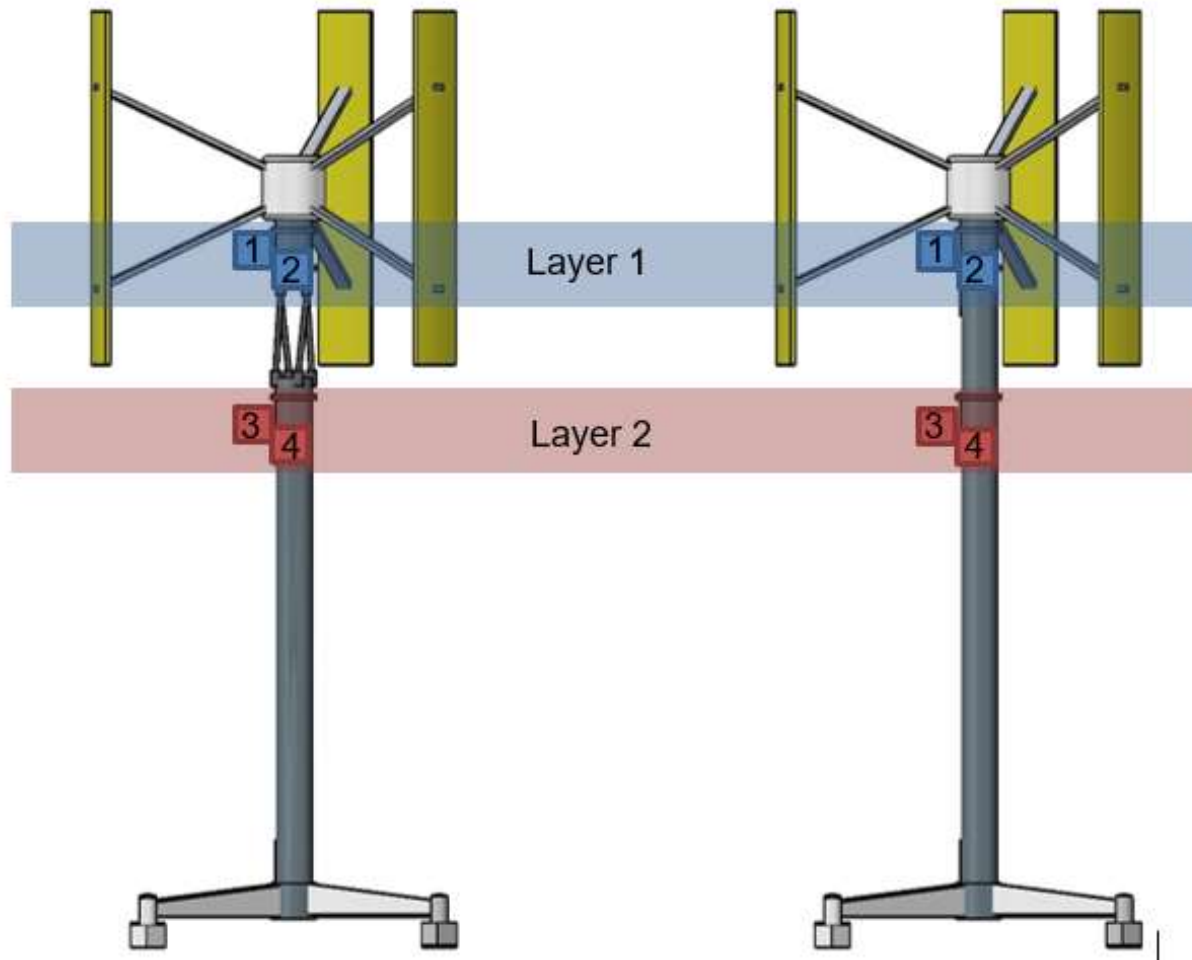
Dynamic loads and decoupler



Method



Measurement concept



Measurements

- Measurement without decoupling element



Measurement concept

Measurement layer 1

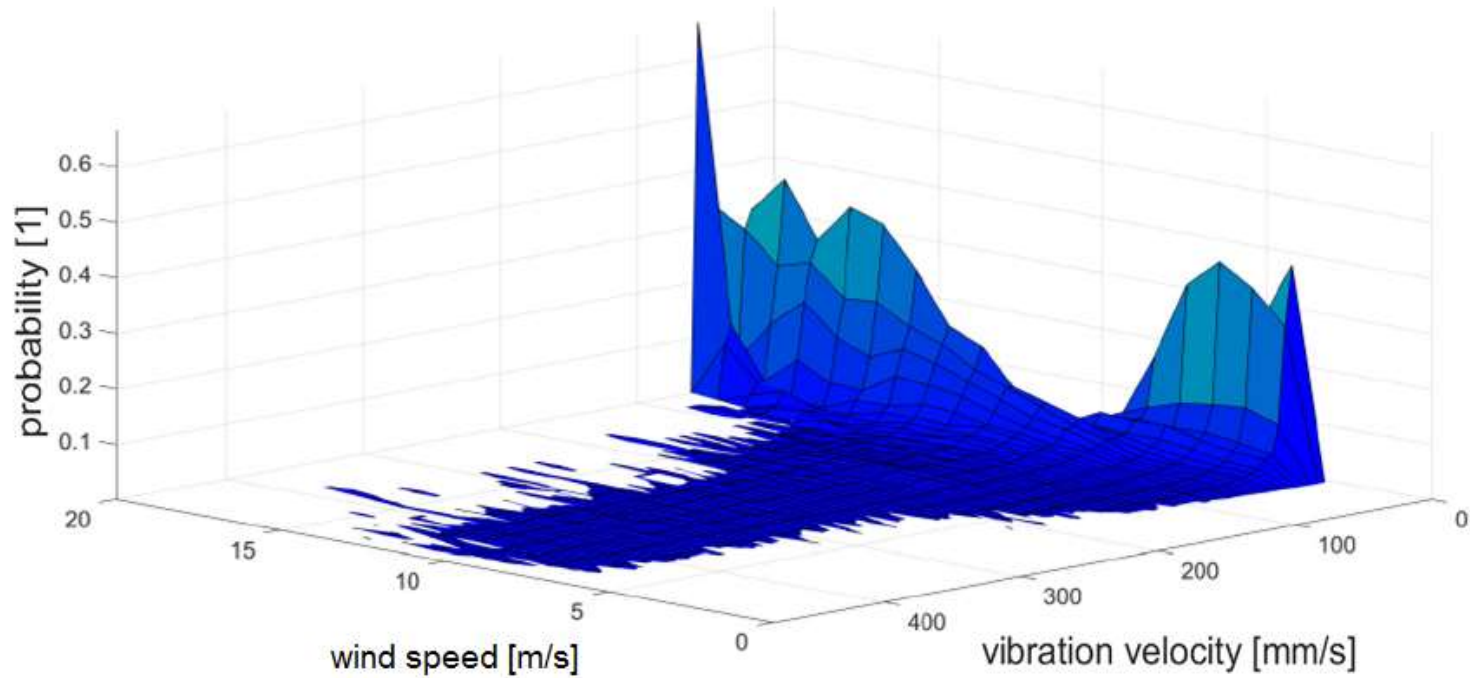


Measurement concept

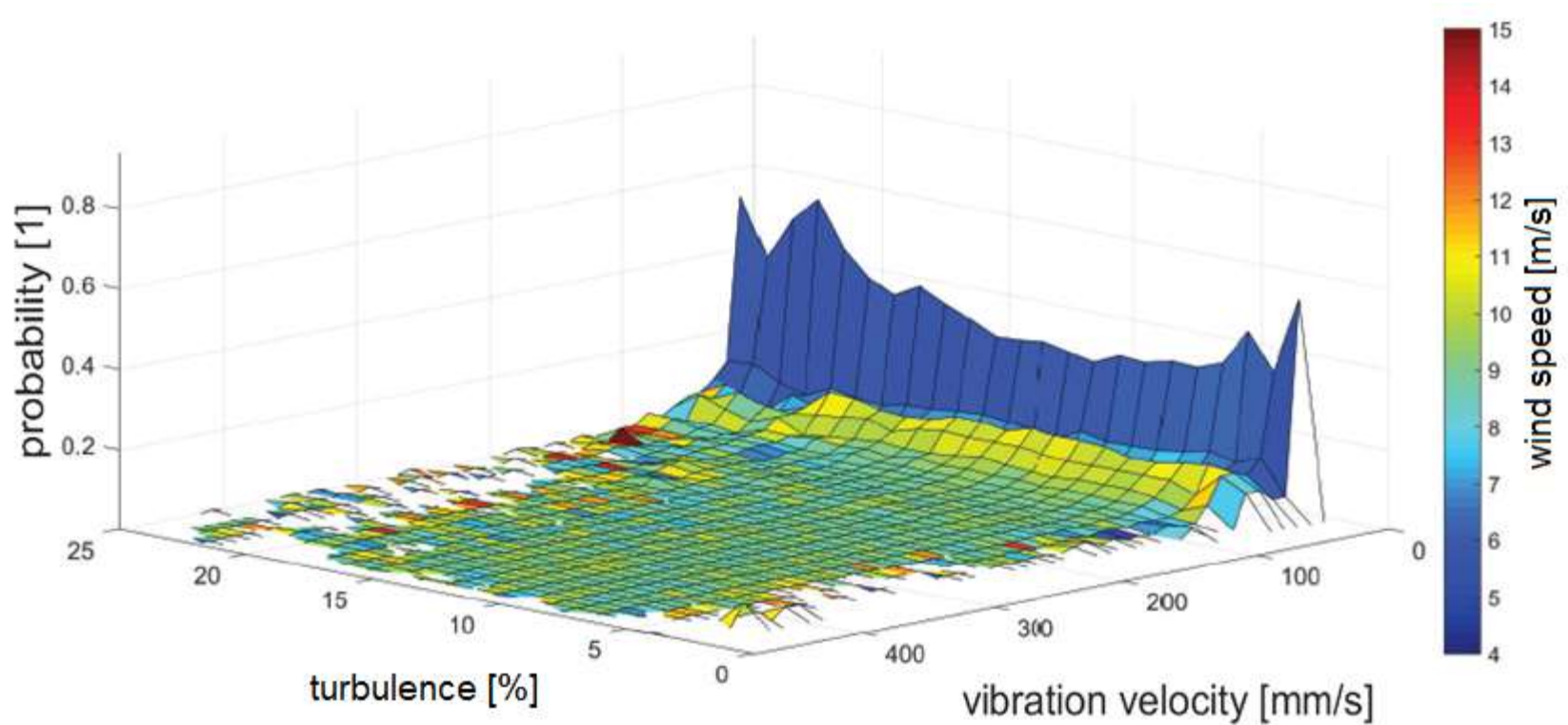
Measurement layer 2



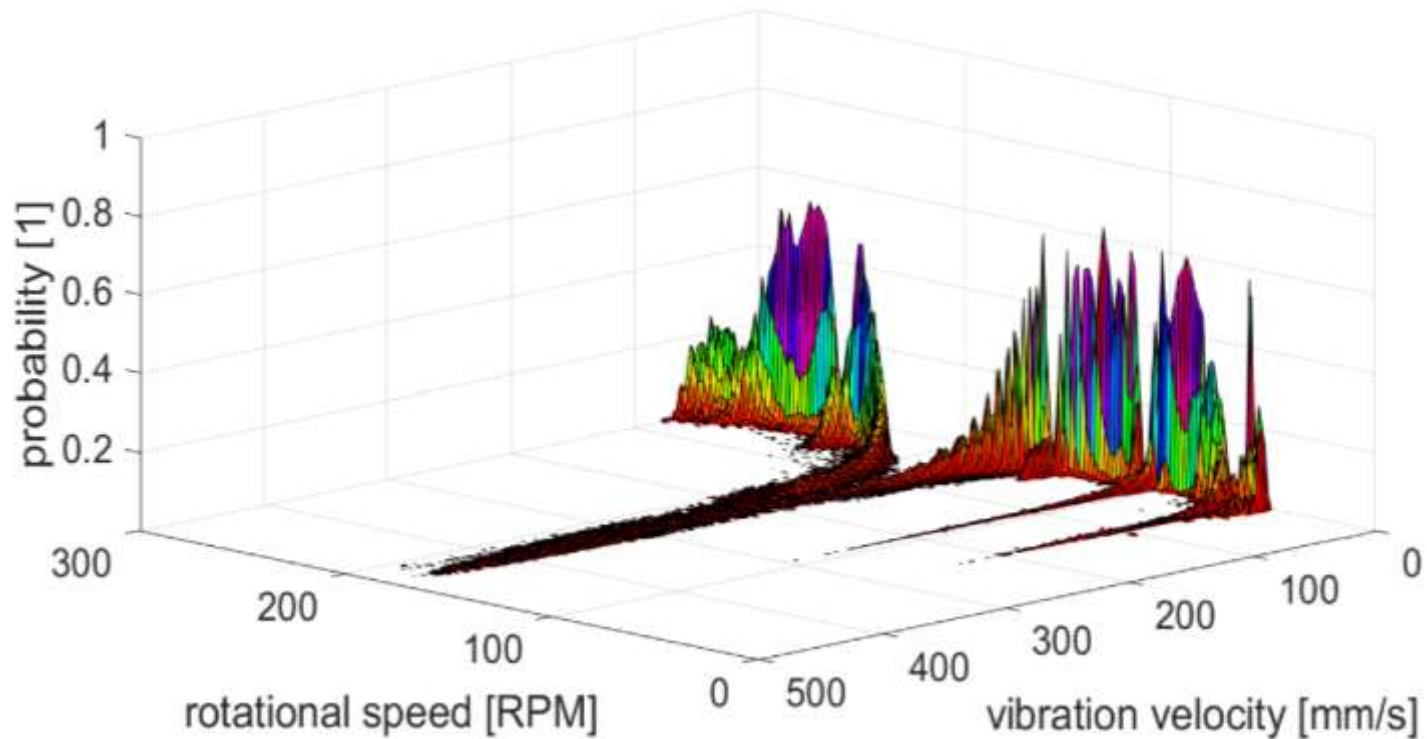
Results – Oscillation vs. wind speed



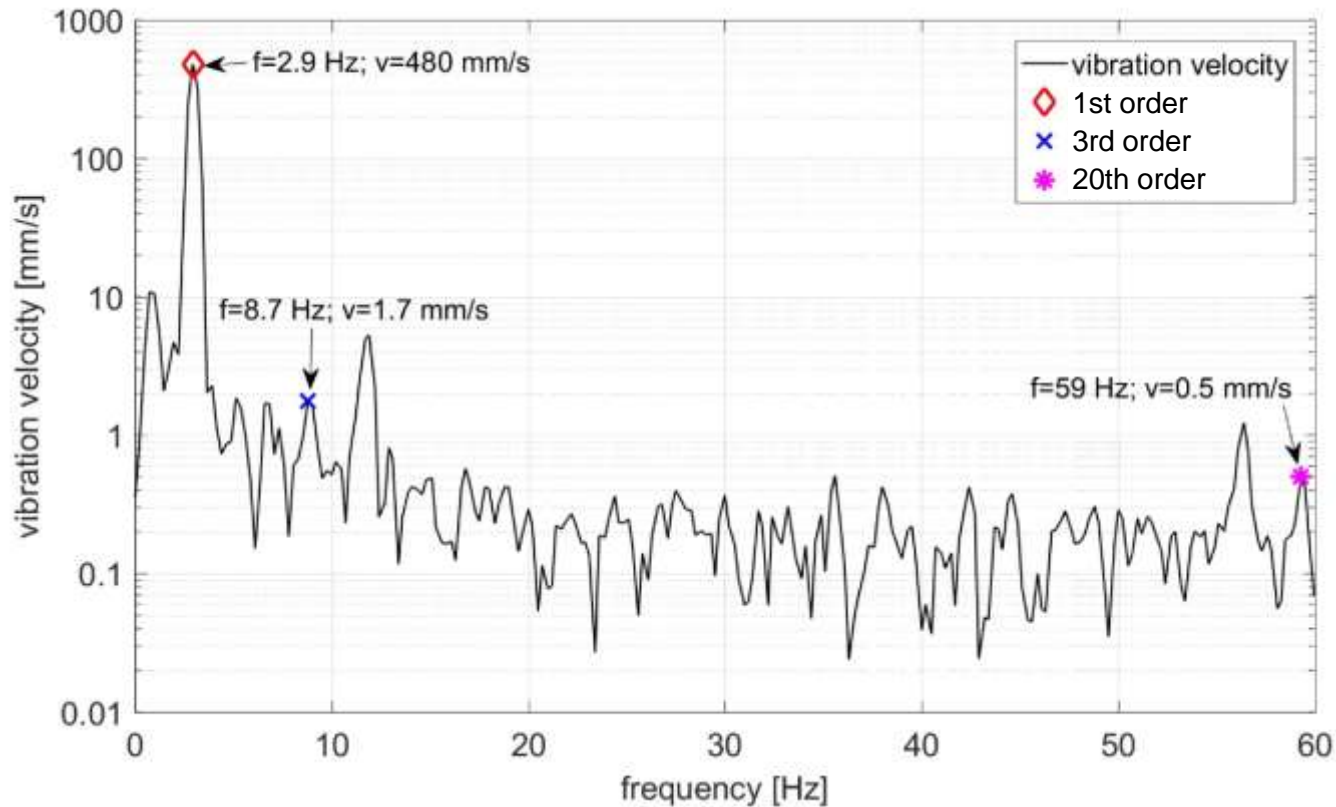
Results – Oscillation vs. Turbulence Intensity



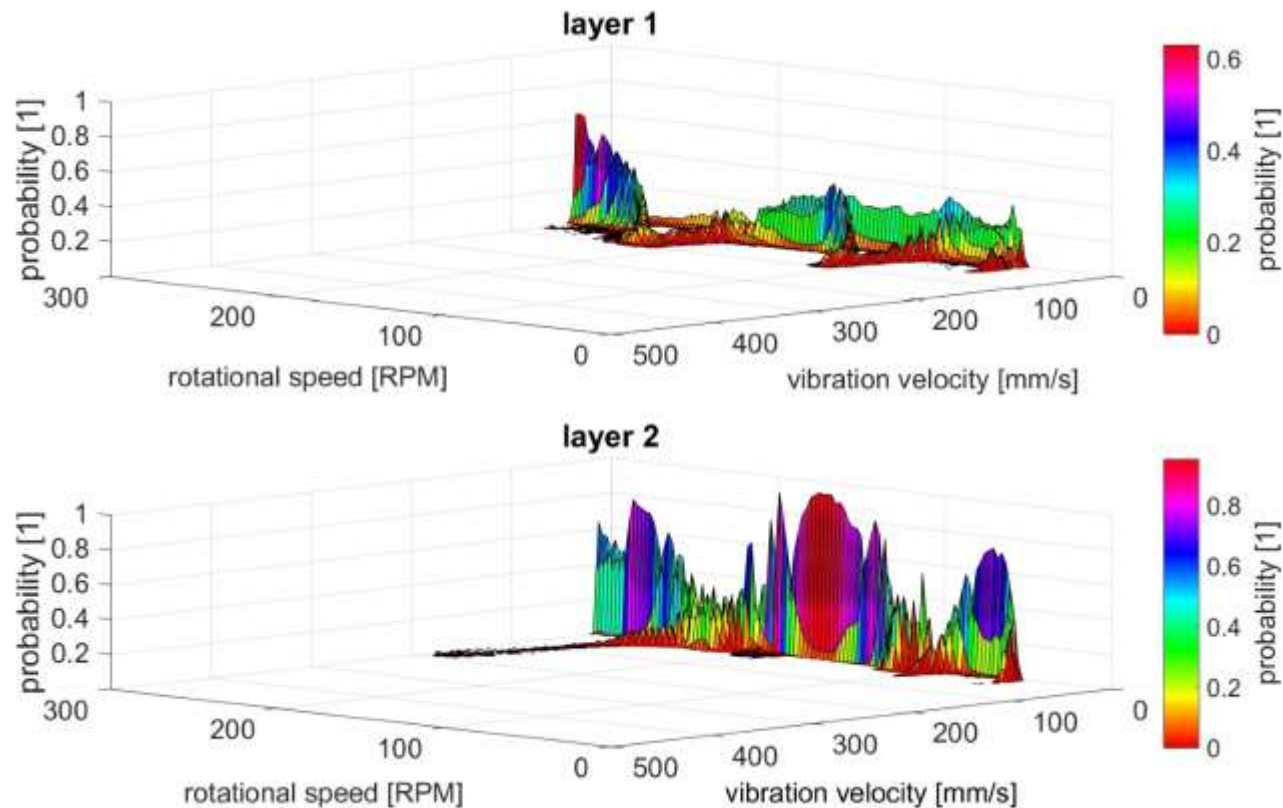
Results – Oscillation vs. RPM



Results – Oscillation vs. RPM



Comparison with decoupling element



Results – environmental impact

Limit values for SWT (VDI 3834/1)





- Acceleration 11 m/s²
 - measured peak 70 m/s²
- Vibration velocity 60 mm/s
 - measured peak 495 mm/s

Limit values for machines in residential environment (EU-directive 2002/44/EG)




- Max. tolerated acceleration 1,15 m/s²
 - measured peak 11,1 m/s² (average)

Conclusion and outlook

Influencing parameters:

- rotational speed 
- wind speed 
- turbulences 
- gusts 

Impact on:

- people 
- SWT 
- structure 

Reduction of vibration:

- decoupling element 

Outlook:

- Automation of measurement plots (Campbell Chart)
- Modal analysis and validation of natural frequencies
- Numerical load calculation
- Comparison with steady state measurements in Wind Tunnel
 - Collaboration with University of Perugia initiated
- Measurement of vibrations in a building

Thank you for your attention!



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