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A Novel Mechanical Stress Measurement Method Applied to Wind Turbine Rotor Blades

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Presentation Summary

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1. Introduction
2. Forces applied to wind turbines
3. Simulation in COMSOL Multiphysics
4. Results and discussion
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Introduction

Introduction

- **Wind energy is interesting as a climate friendly source of energy. This interest is driving an increase in the size of rotor blades. The rotor blades have to be designed to withstand wind and weather over their approximately 20 years of lifetime [2].**

- **Shown below is the Enercon E-126 wind turbine [3]:**

  - Hub height: 135m.

  - Rotor diameter: 127m.

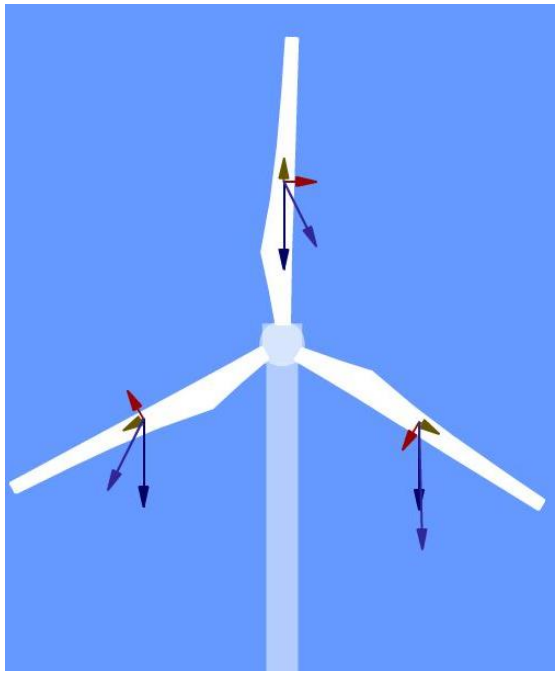
  - Rated power: 7.6 MW.

  - Weight:20t.

Forces applied to wind turbines

Forces applied to wind turbines

- The stresses and strains to which rotor blades of wind turbines are exposed at 135 meters above the ground are truly immense [2].



- Tangential force
- Weight
- Centrifugal force
- Total force [4]

- The ability to monitor the mechanical stress of rotor blades is crucial in order to reduce the maintenance costs and to maximize the operational availability.

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Simulation in COMSOL Multiphysics®

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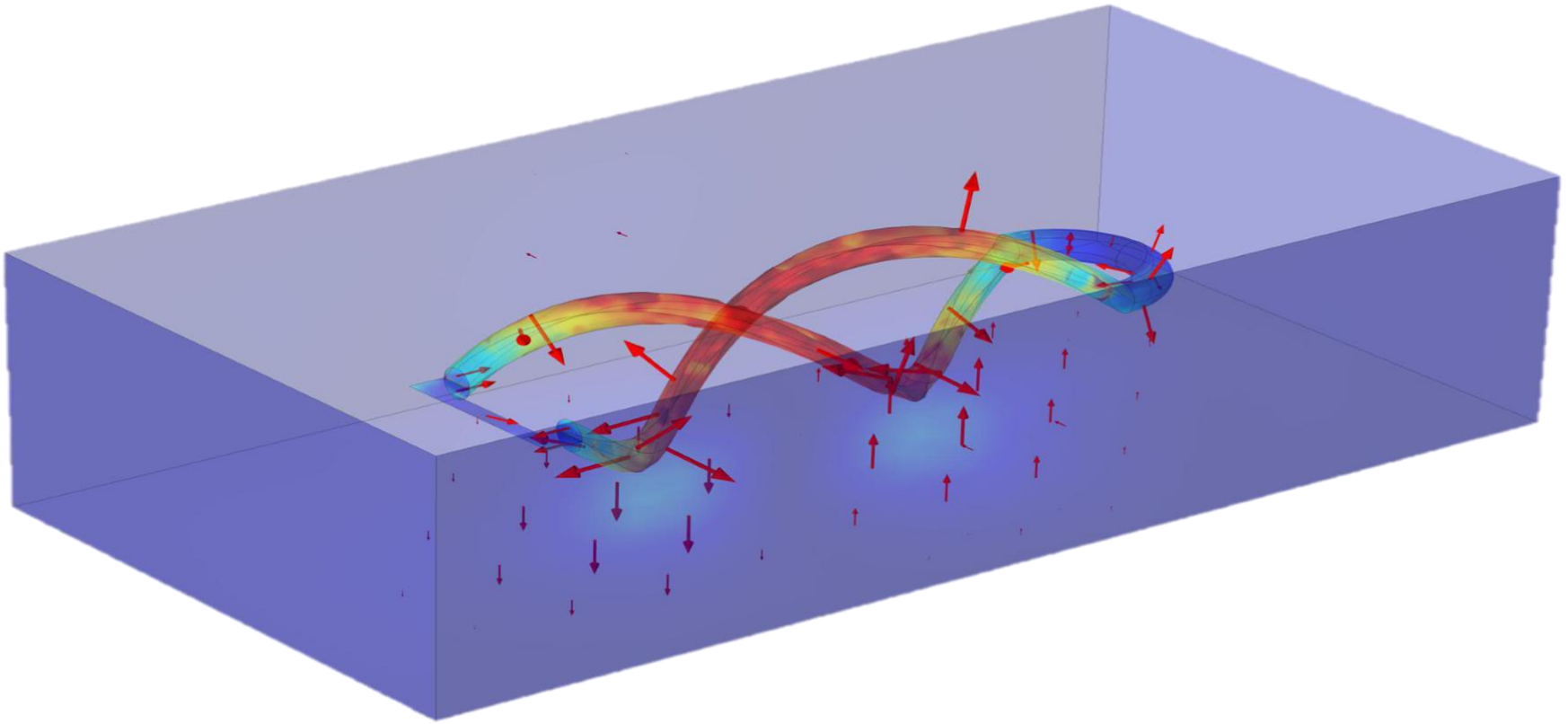
Simulation in COMSOL Multiphysics®

- **The simulation model of the hereby shown novel rotor blade condition monitoring system (RBCM) is based on the combined power of COMSOL multiphysics® and LTSPICE®**

- **A 3-D glass-fiber reinforced plastic (GFRP) rotor blade with an integrated twisted pair cupper wire is FEM- modeled by its physical properties and geometry using the COMSOL RF-module and electromagnetic wave (emw) as a modelling function.**

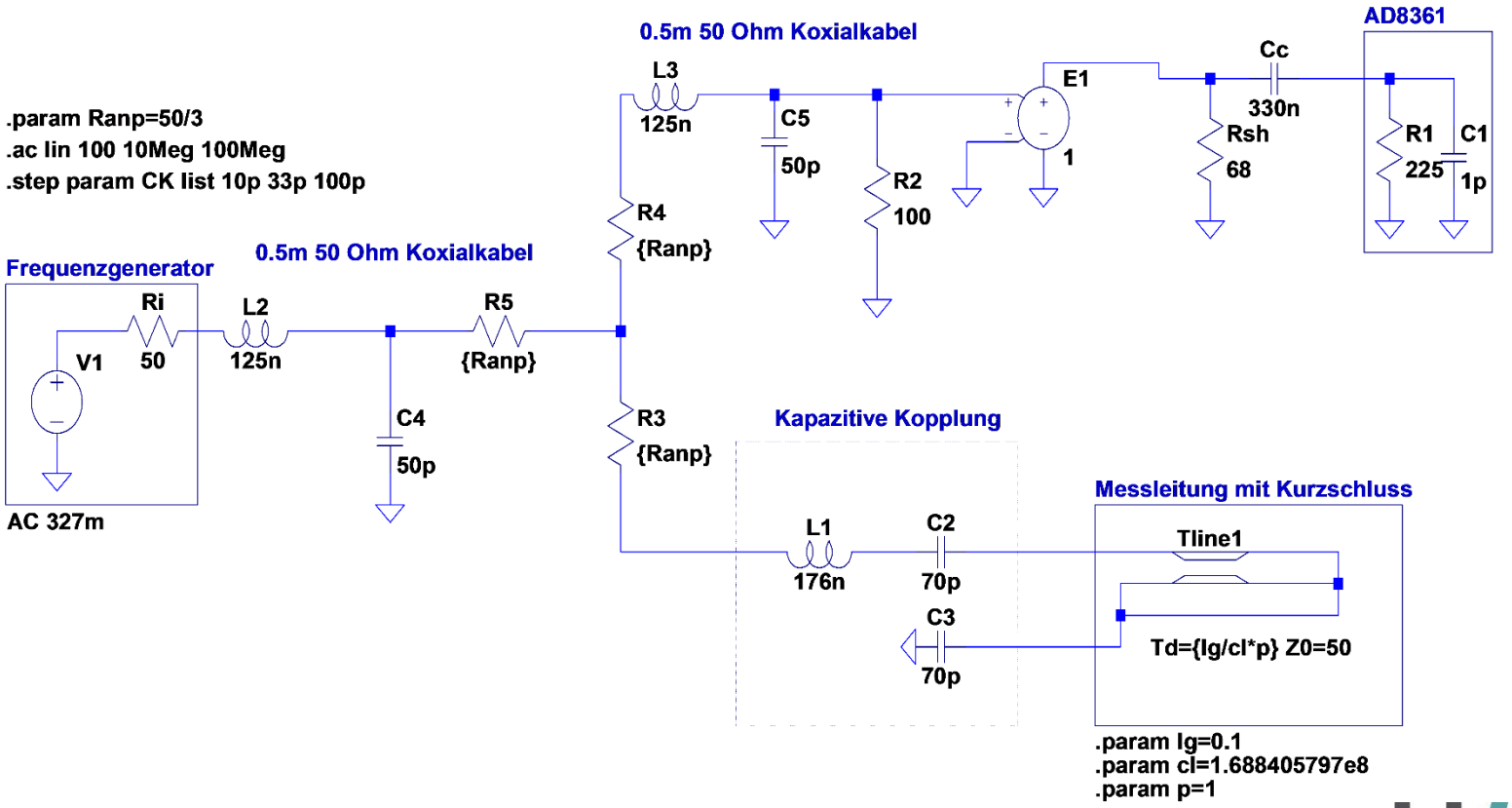
Simulation in COMSOL Multiphysics®



Simulation in COMSOL Multiphysics®

- **The other components which are necessary to detect the stress detection hardware is described in SPICE®. The SPICE® model is connected to the COMSOL® model through the AC/DC module and the electrical circuit (cir) modelling function**

Simulation in COMSOL Multiphysics®



Results and discussion

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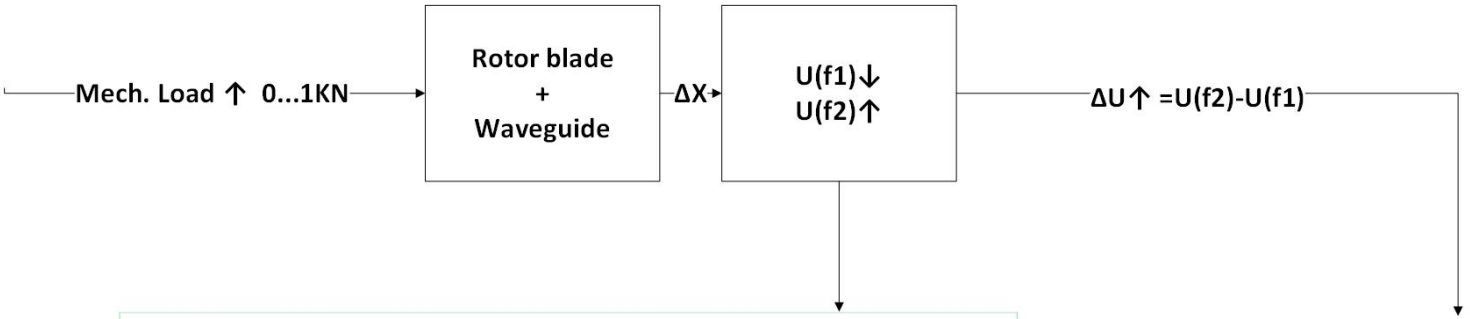

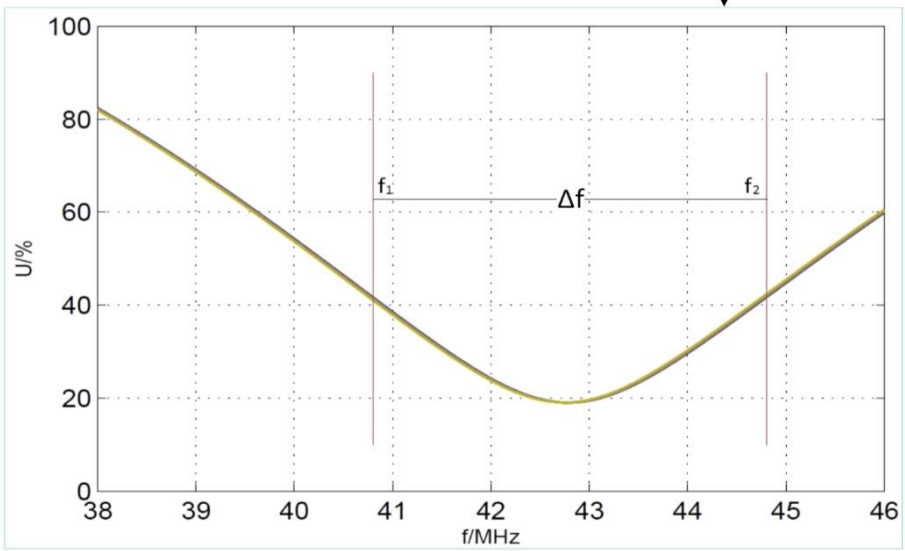

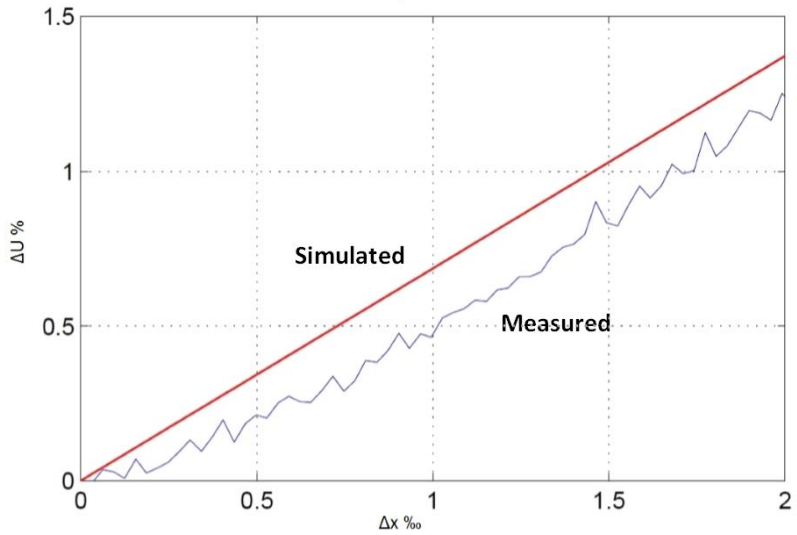

Conclusion

Conclusion

- **A novel mechanical stress measurement method applied to wind turbine rotor blades has been demonstrated.**
- **A new generation of rotor blade condition monitoring (RBCM) system has been shown.**
- **the shown method offers a suitable performance for the design and the conception of RBCM systems.**
- **The simulation results and the results from the empirical measures can provide useful information and empirical data about this novel RBCM method.**

Acknowledgement

- **This work is included into the research project High-Performance Fiber-Composite Rotor Blades for Wind Turbines through Plasma-Treatment. Which is founded by the Arbeitsgruppe und Geschäftsstelle Innovative Projekte (AGIP)**

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Thank you for your attending

Questions ?

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References

[1]: Background image of slide 1: http://goo.gl/8zzyNy,08-10-2013

[2]: http://www.basf.com/group/pressrelease/P-10-224,08-10-2013

[3]: http://www.enercon.de/de-de/66.htm,08-10-2013

[4]: This rotor blade image is adapted from Sebastian Rikowski with his permission on 16-09-2011.