

The MISTRALWIND-Project

Monitoring and Inspection of Structures at Large Wind Turbines

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Abstract

The MISTRALWIND project's research activities are focussed on developing innovative and reliable methods and sensor systems for estimating the remaining useful lifetime (RUL) of wind turbine structures. To reach that goal, sensor systems for structural health monitoring and non-destructive testing were employed at a scaled wind turbine (g) and permanently installed at an operating 3 MW test wind turbine (a) featuring a hybrid tower made of a lower concrete and an upper steel part. In parallel, a high-fidelity finite element model (b) of the test wind turbine was created based on construction plans and updated according to the modal parameters of the real structure. The model was used to

determine highly stressed areas ("hot spots") and will be deployed to calculate material stresses at these points based on measurement data. Suitable material fatigue and damage models (c) were identified and will be used to determine the local structural lifetime consumption based on monitoring and inspection data. This data is gathered together with further information in a service life and damage database (d) to support service and maintenance planning and builds the foundation for an integrated asset management (e). Besides estimating the RUL also the possibility of actively controlling its consumption is investigated using model predictive control that minimizes oscillations and thus fatigue.

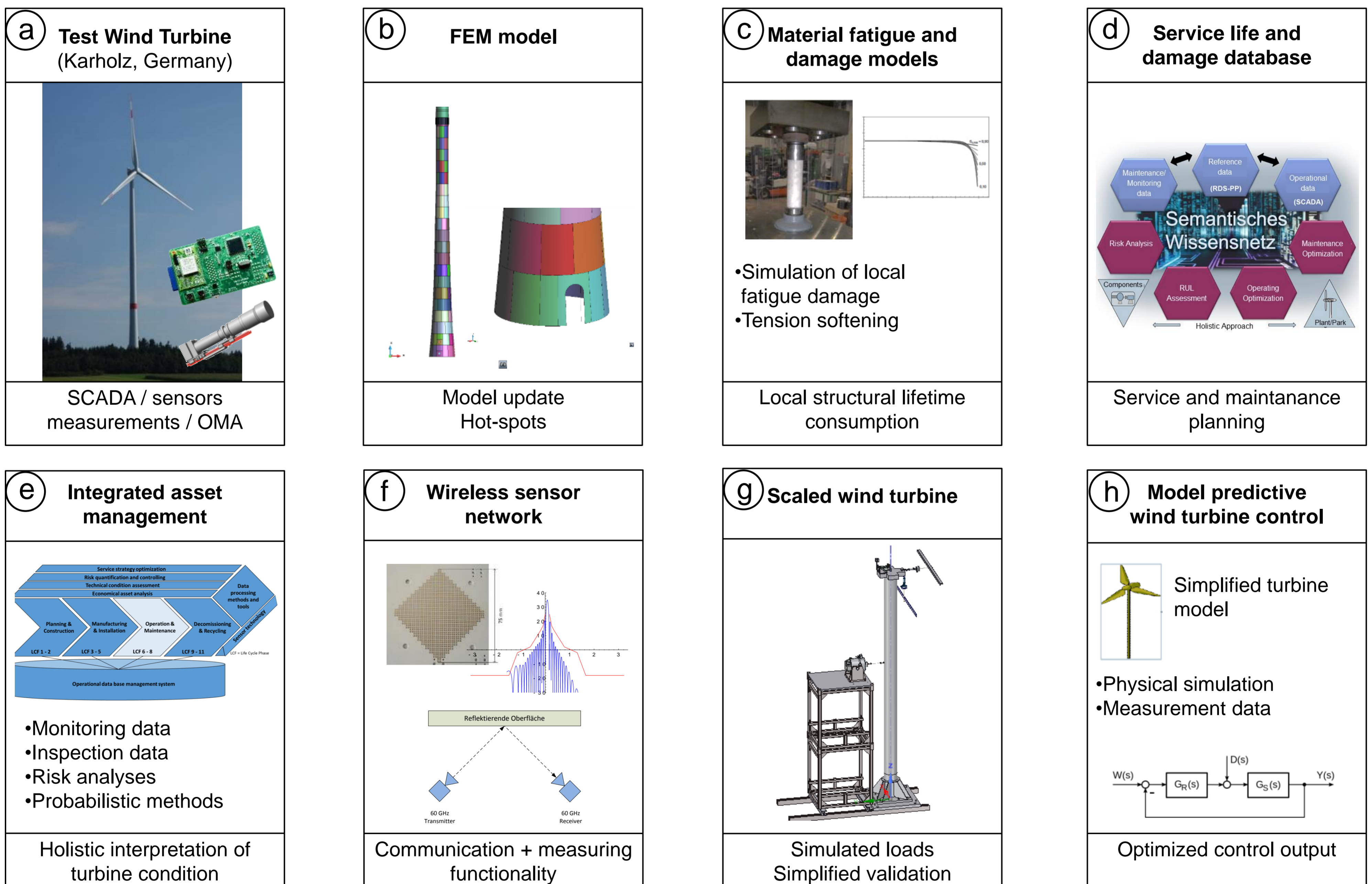


Figure 1: Overview of work packages, employed methods and experimental setups

Activities Chair of NDT

NDT-inspections

- Measurement of ultrasonic p- and s-velocity to estimate concrete fatigue damage (Figure 2)
- Camera-based DIC displacement measurements

Monitoring

- Design, installation and operation of monitoring system (Figure 3), running since 05/2016
- Automated Operational Modal Analysis
- Calculation of external loads from strains
- RTK-GPS and LDV displacement measurements
- Wireless sensor network (Neomotes) for acceleration measurements

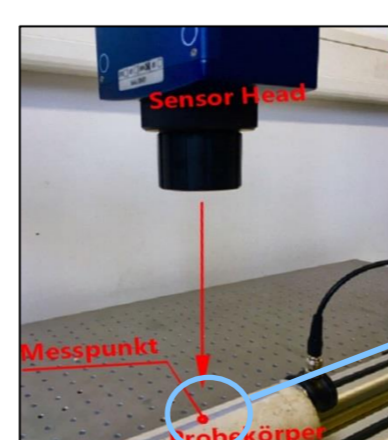
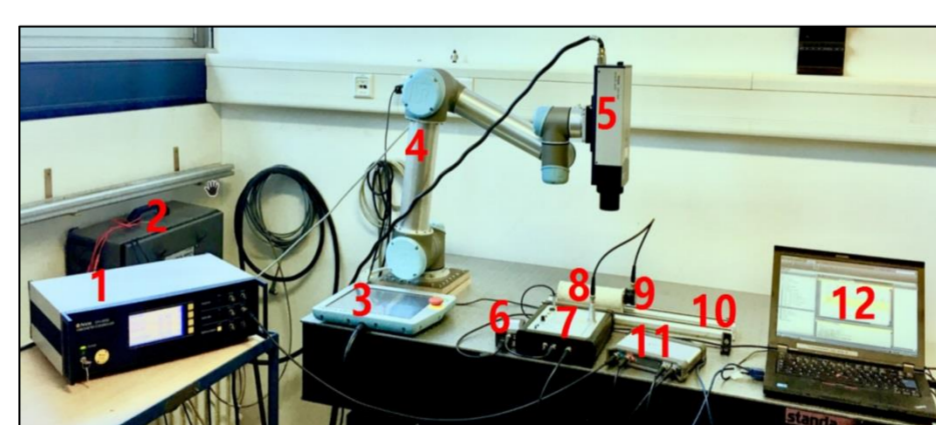


Figure 2: Automated US-velocity measurement

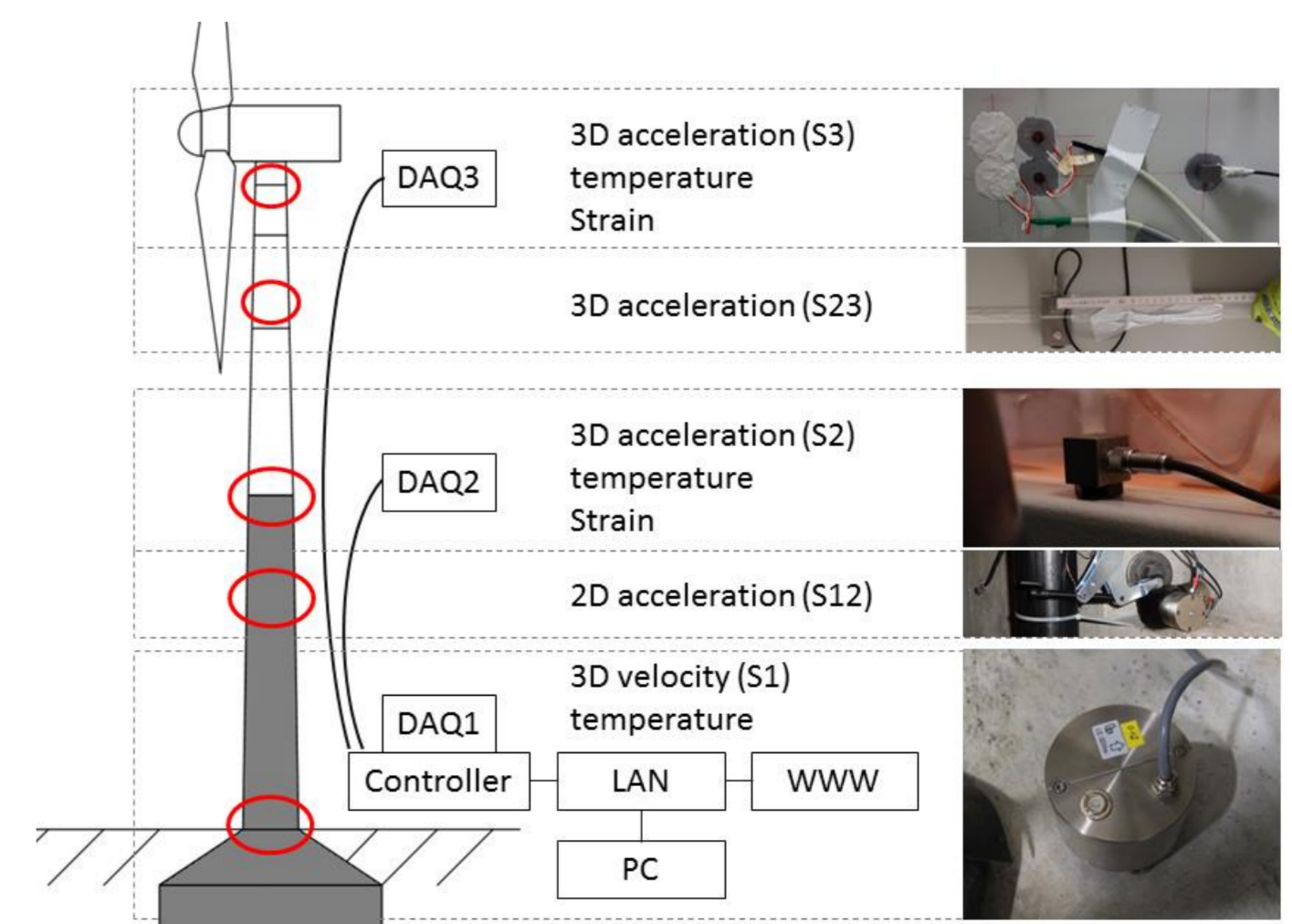


Figure 3: Monitoring System