ENERGY

Guidance for Design and Certification of Wind Turbines with LiDAR Assisted Control

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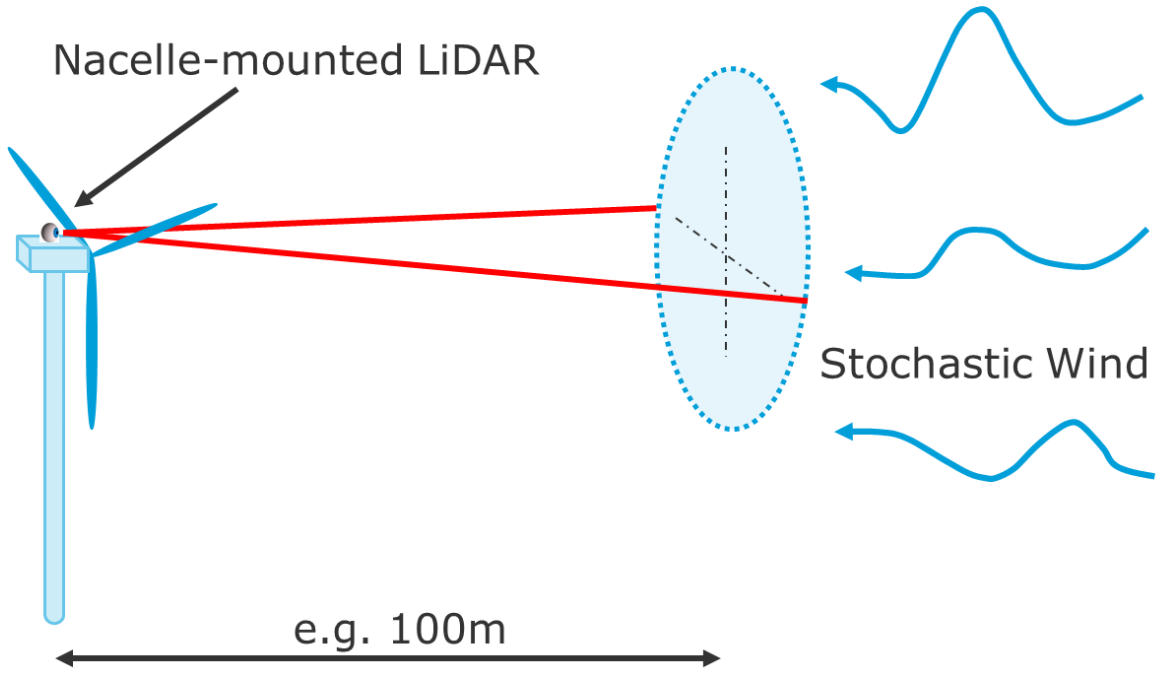
LiDAR Assisted Control for Wind Turbines - Introduction

- LiDAR (Light Detection and Ranging)
- LiDAR system
  - Remote measurement of wind
  - Wind field estimation algorithm
- Classic feedback plus feedforward control based on LiDAR system
- Potential for improved turbine control
  - Reduction of loads
  - Improved energy yield



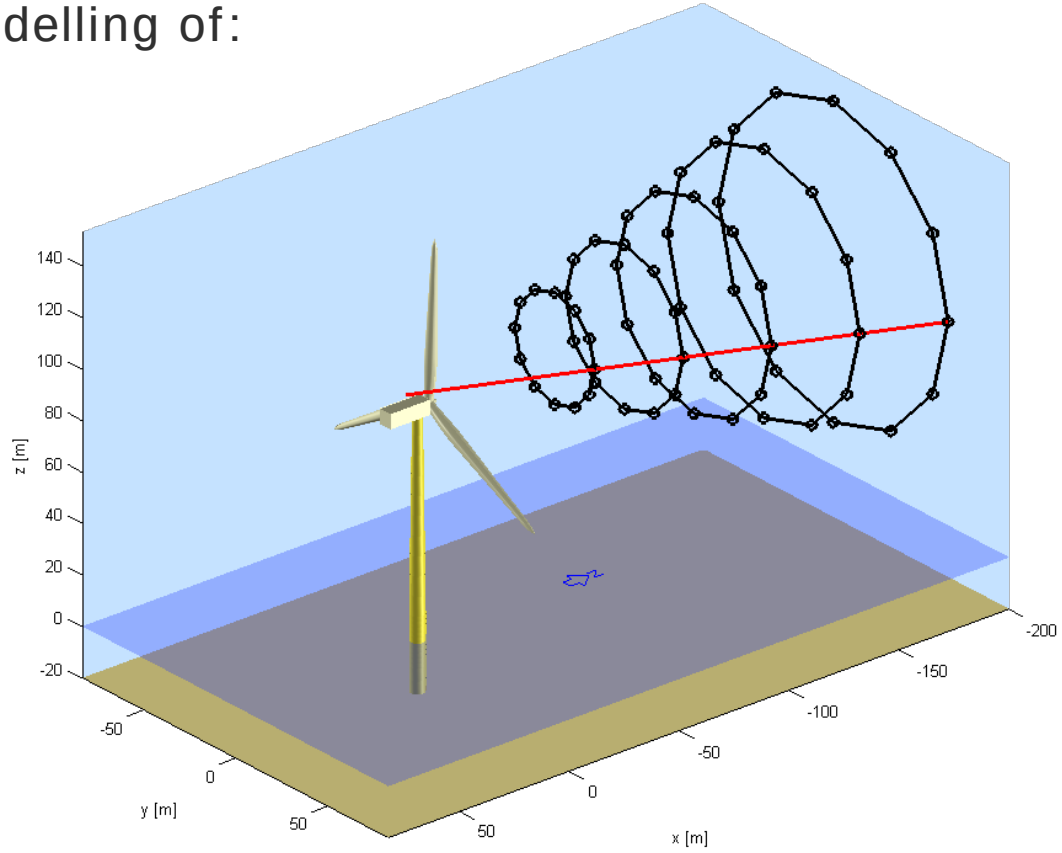
Requirements for the Control and Protection System

- LiDAR system
  - Tracked reliability and availability
- LiDAR Assisted Control (LAC) system
  - Sanity checks
  - Failure Mode and Effect Analysis (FMEA) or similar
    - Normal operation
    - Detected failures → fallback-strategy
    - Undetected failures

source: DNV GL Renewables Advisory

Requirements for Design Loads - Simulation Model

- Additional to the standard dynamic load simulation modelling of:
  - LiDAR system incl. wind field estimation algorithm
  - “Frozen turbulence“ / wind evolution model
  - LiDAR assisted control system incl. fault cases



source: DNV GL Renewables Advisory

Requirements for Design Loads - Load Cases

- Fatigue and extreme loads to be simulated
  - Fatigue: proportionately with LAC and fallback-strategy
  - Extreme: loads with fallback-strategy may be higher than with LAC
  - Individual solution to be defined in the *Design Basis* (incl. EOG extreme operating gust, …)

source: www.zephirlidar.com

Type Certification

- Certification on basis of existing standards (DNV GL, IEC, …)
- Turbine specific *Design Basis* determines individual additional requirements
- *Design Evaluation*
- *Prototype Testing*
  - Verify uncertainties in e.g. rotor average wind speed measured, simulation model, …
  - Extreme and fatigue loads, switching operations, fault cases

source: www.zephirlidar.com

Conclusions

- LAC suitable to improve control – technical requirements identified
- NEW: DNV GL offers Type Certification for wind turbines with LAC
- NEW: DNV GL testfield for LiDAR system validation services

source: DNV GL Renewables Advisory

Questions?

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