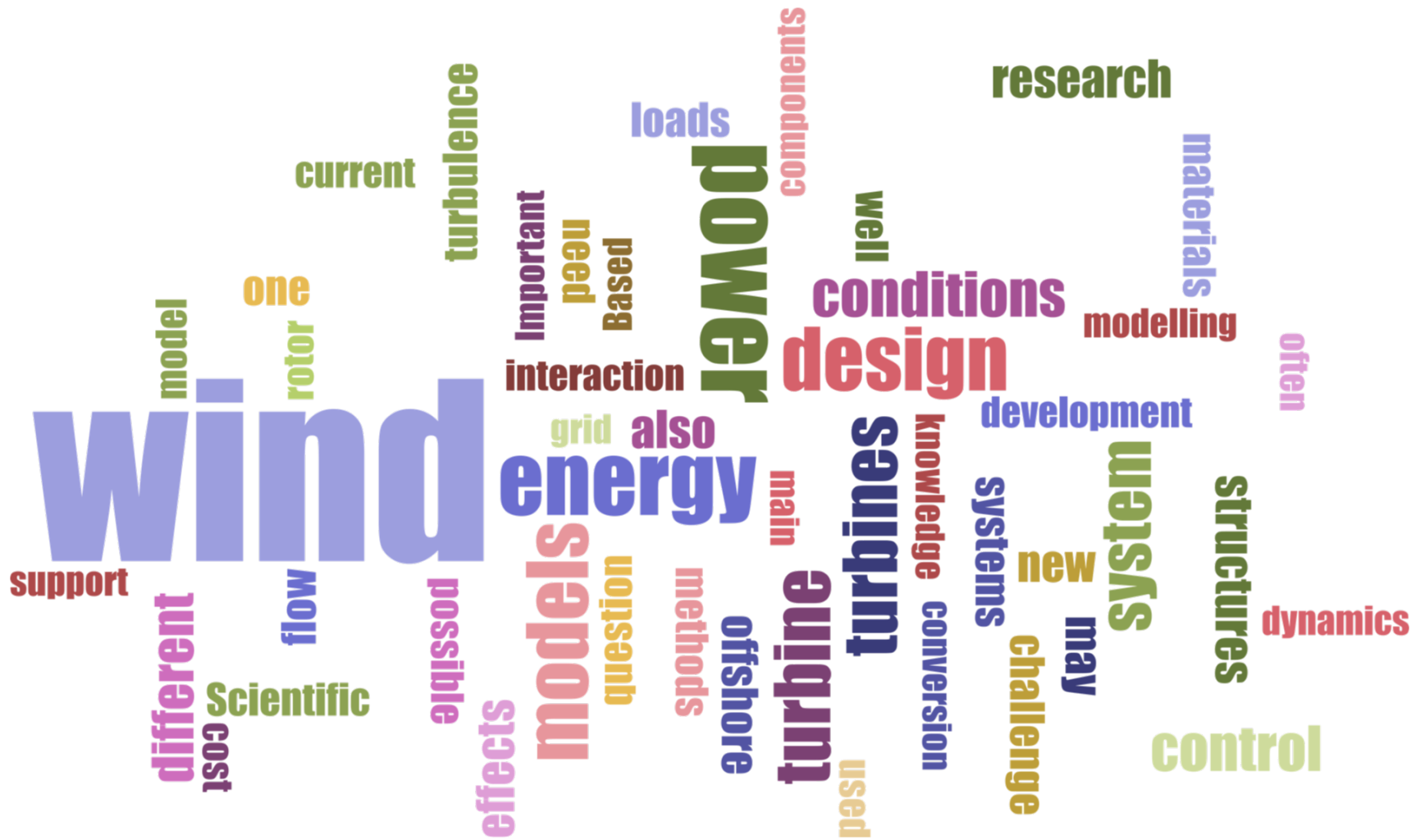


Uncertainty quantification for research challenges in wind energy

Benjamin Sanderse



Centrum Wiskunde & Informatica



Physical modelling

- Numerical weather prediction
- Wake and blade models
- Structural models
- Load flow computations

Data-driven modelling

- Met mast data
- Turbine operational data
- Lidar measurements
- Electricity grid data

Model uncertainty

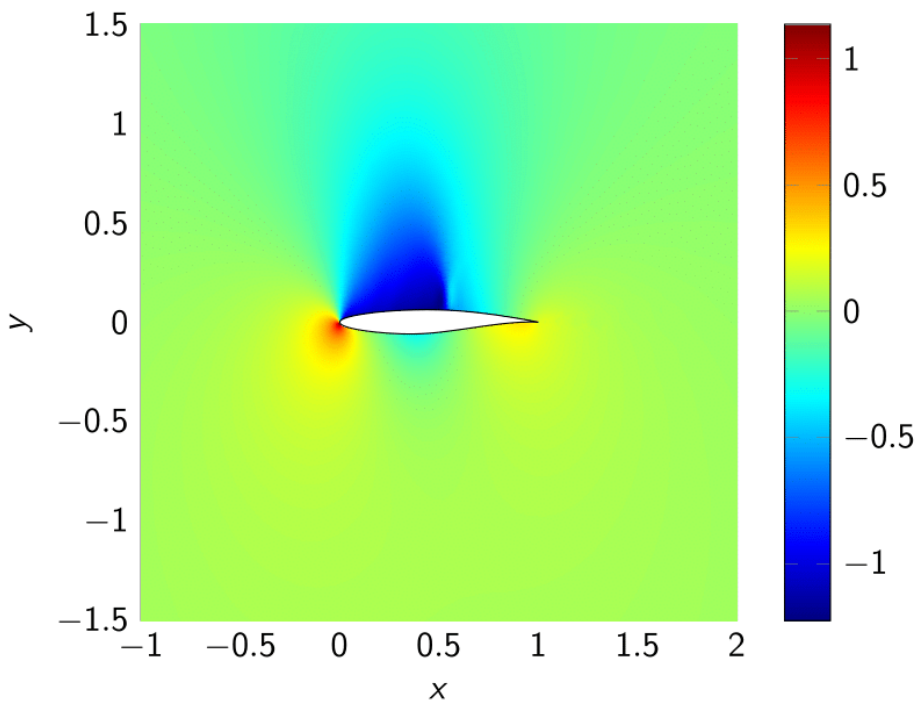
Uncertainty quantification

Data assimilation

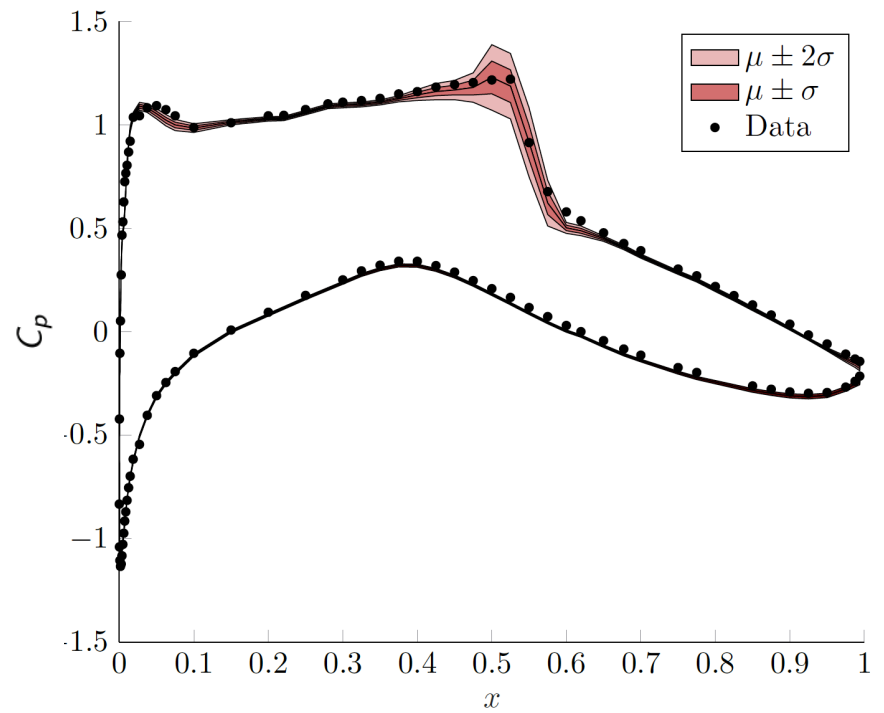
Machine learning

CWI

Measurement uncertainty



Physical model alone



Calibrated physical model with uncertainty bounds



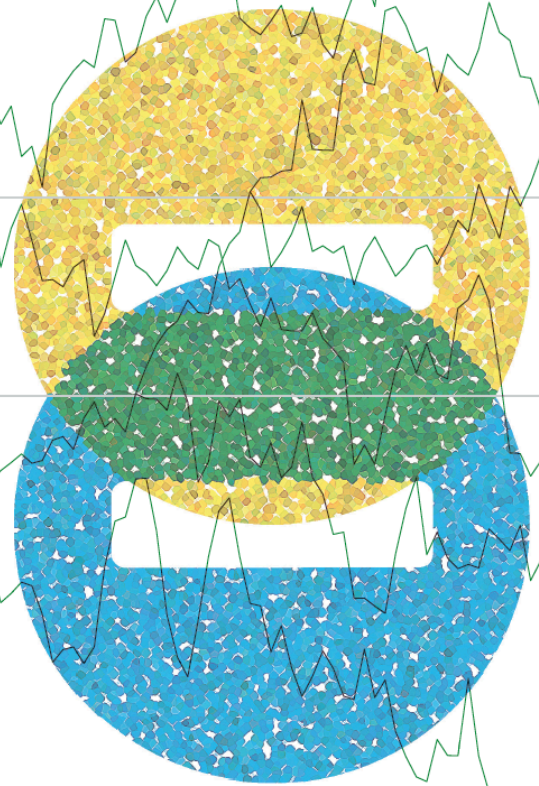
Assessing power grid reliability using rare event simulation

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ISBN 978-94-6299-059-3

Wadman



Wander Wadman

Can we do real-time wind turbine control by coupling CFD models to data?

Can we use sensor data to drive neural networks for maintenance and failure predictions?

Can we integrate digital twins of wind turbines and farms into the power grid?

Laurent van den Bos, Benjamin Sande

Uncertainty quantification for wind energy applications



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