Wind farm control applications for Windscanner infrastructure

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Windscanner

Lidar:
-> sends out a laser beam and detects the weak return, reflected or scattered from natural aerosols like dust, pollen and droplets
-> the wind speed is calculated from the Doppler shift for the backscatter in the beam direction
-> two types: pulsed or continuous wave type

Short range Windscanner:
-> three continuous wave wind lidars
-> Measuring area: a few 100 meters

Long-range Windscanner:
-> three or more pulse wave scanning lidars
-> suitable for measuring wind over a large area

Control objectives

Windscanner could:

Increase energy production: by reducing wake losses
-> reducing the power of the most upwind turbine(s)
-> controlling the yaw and redirect the wake to avoid it hitting the downwind

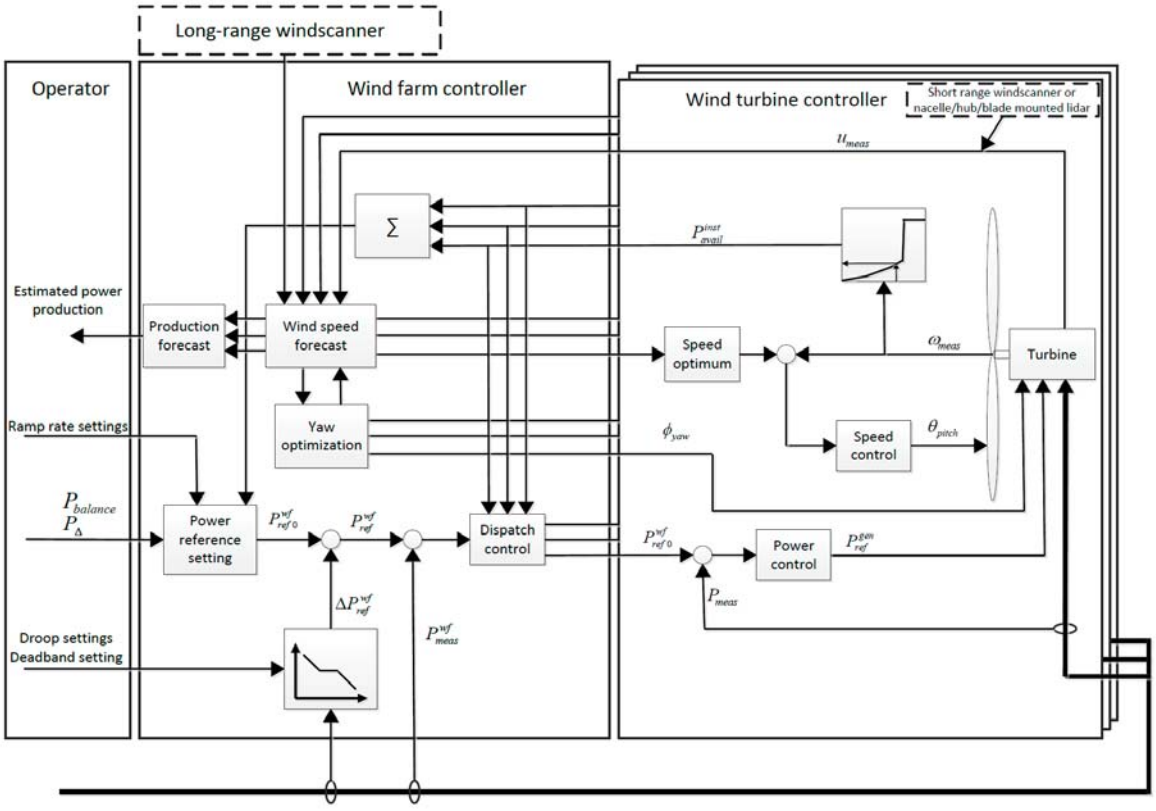
Increase lifetime: by reducing mechanical loads
-> improving pitch control and tip-speed ratio

Increase availability: by reducing extreme loads
-> detecting strong wind gusts and control pitch and tip-speed ratio

Improve ancillary services to the electric grid:
-> Improving production forecast

Increase lifetime performance:
-> large-area, long-time wind data are used for finding the optimal trade-off between energy production, wake losses, structural loads, downtime and revenue from sold energy.

A PI control strategy for active power control at PCC with yaw optimization and production forecast



Up-front measurements

1)Mapping of wind field and wakes in different conditions with Windscanner

2)Create look-up tables or similar

3)Use these in wind farm control: “Wind speed forecast” and “Yaw optimization“

or Real-time input

Windscanner measurements -> Input to wind farm controller

1)Long-range Windscanners or

2)Short-range Windscanners (in all or some wind turbines)

High precision Windscanner measurement in real time is not presently possible

Validation of control strategies

Windscanner could:

-> Provide measurement series showing the relationships between operation condition of the turbines

-> Provide data for optimizing power production and reducing structural loads by pitching or yaw misalignment

-> Validate analysis tools

-> Provide open data