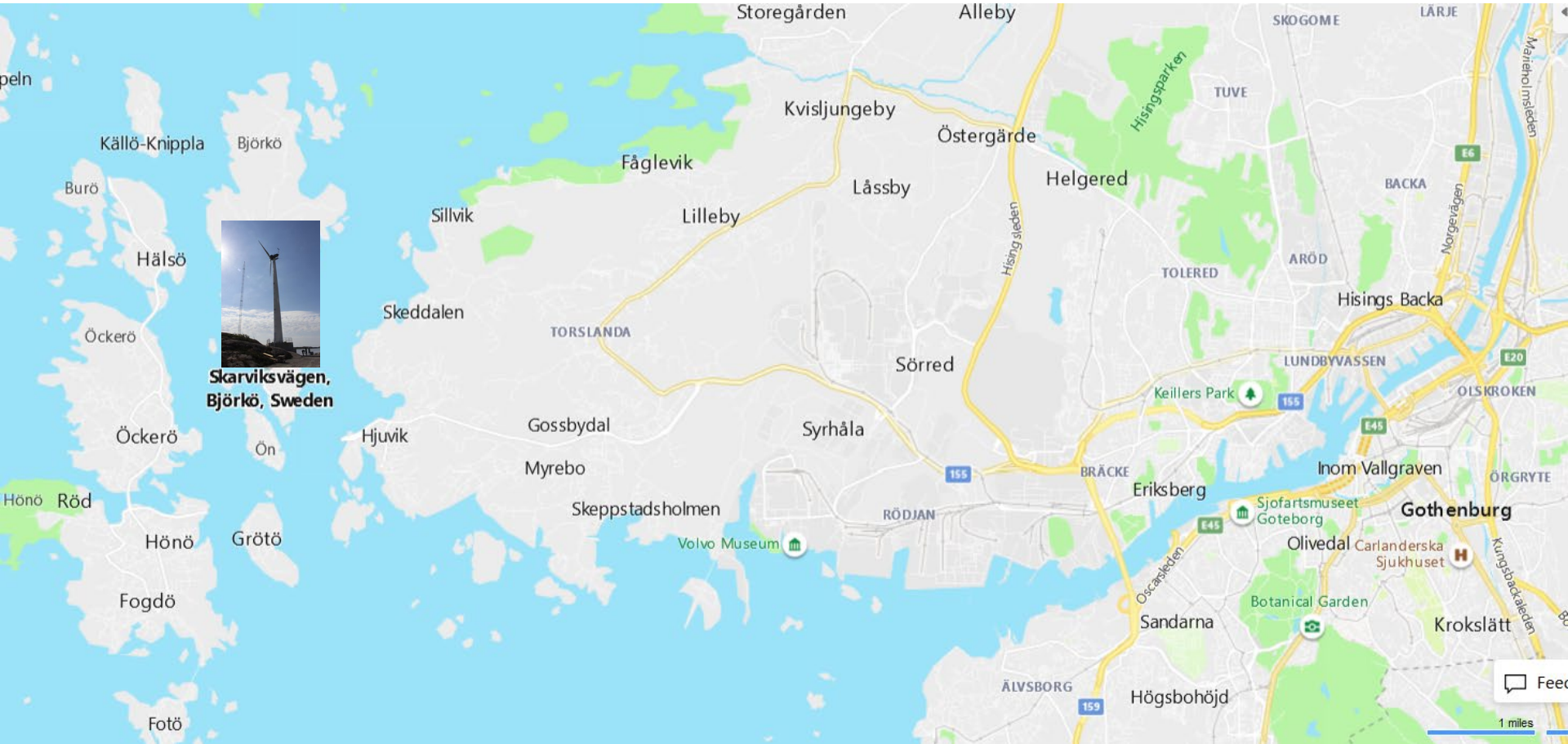




Power: 45 kW  
Height: 30 m  
Diameter: 17 m

# Chalmers wind turbine

- Research
- Education
- Information to society



24 km from Chalmers Univ  
30 min to ferry by car  
5 min by ferry



Erected during spring 2020  
Full operation in spring 2021

Power, 45 kW

Wooden tower, 30 m

Carbon fiber blades, 8 m

Individual electric pitch

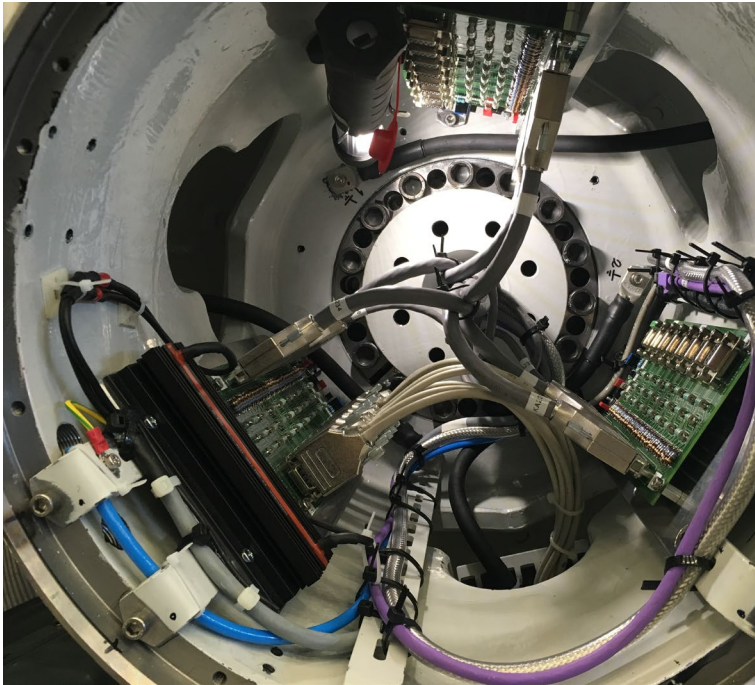
Variable speed operation,

Chalmers control system

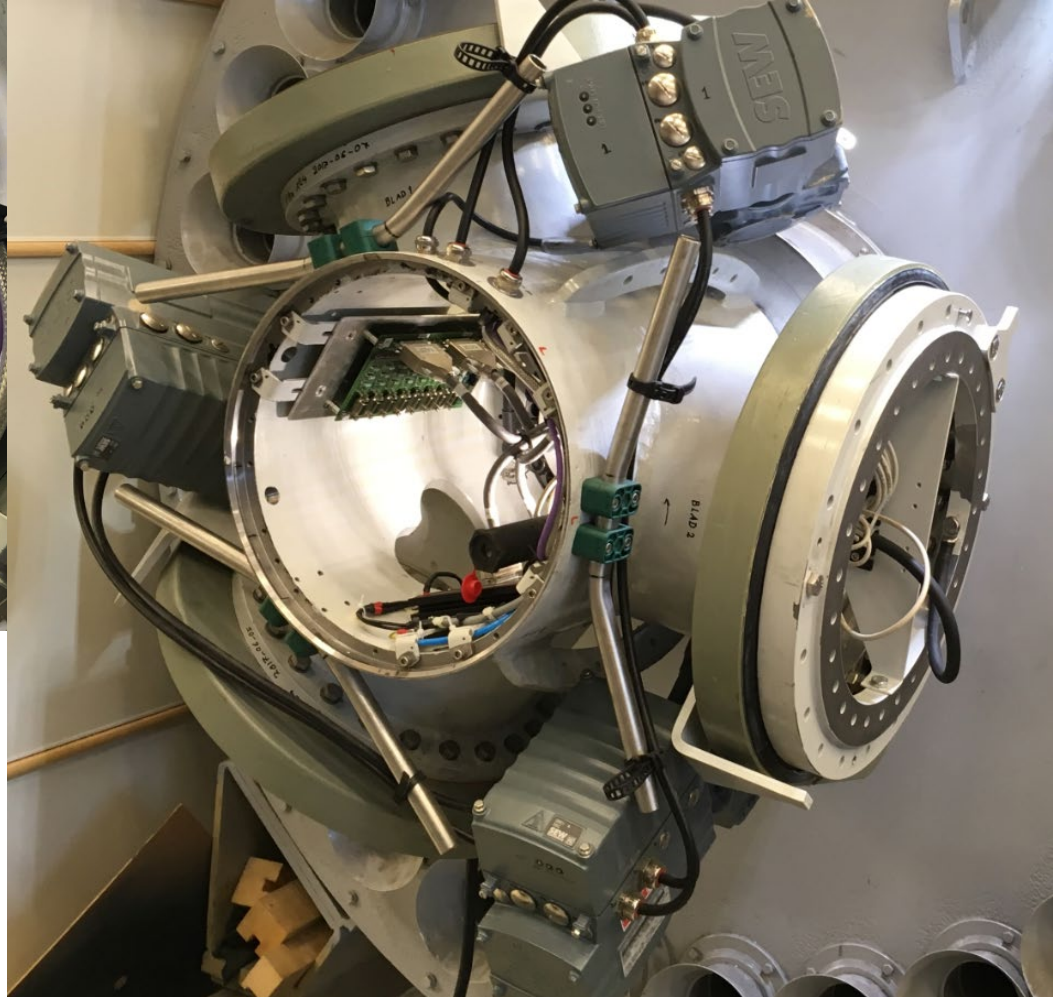
Sensors in foundation, tower, nacelle, electric system and blades



# New hub with pitch system



The pitch system is electric with individual pitching. The control is developed by Chalmers and is preformed in Labview



# Carbon fiber blades. Sensor installation

8 sensors per blade collected in a rotating measurement system



# Sensor calibration

Also 3D scanning of the blades for comparison with the design



# New design of a 30 m wooden tower



There is sensors in the foundation, in the tower and several on the nacelle, strain gauges, speeds, accelerometer,...

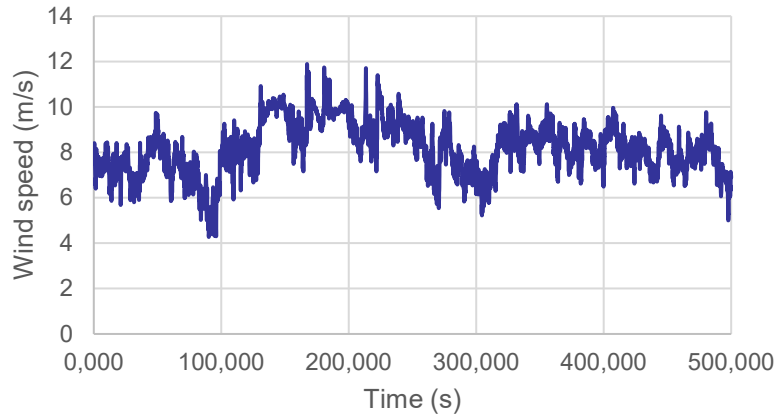
# Wind measurements

- Wind speed and wind direction measurements is preformed at:
- The nacelle: 32 m height from the foundation
- The wind measurement mast located 20 m south of the wind turbine:  
at 22, 30 and 38 m height from the foundation
- The sample rate of the sensors are 20 Hz of the one at 30m , and a bit slower on the ones.

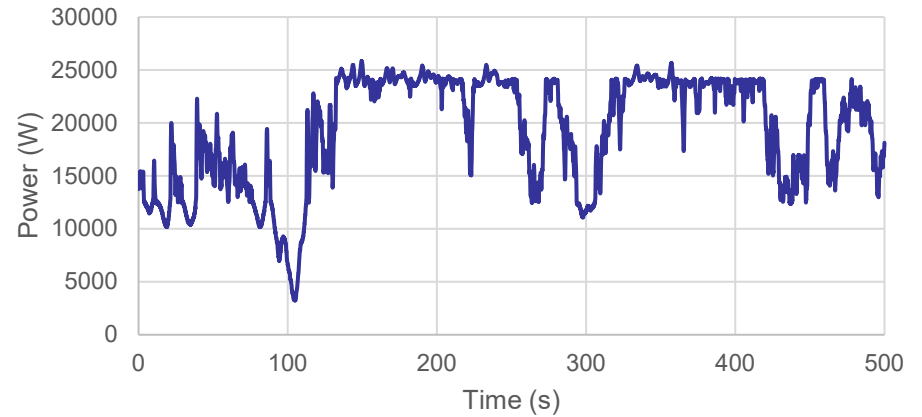


# Wind turbine operation 210707

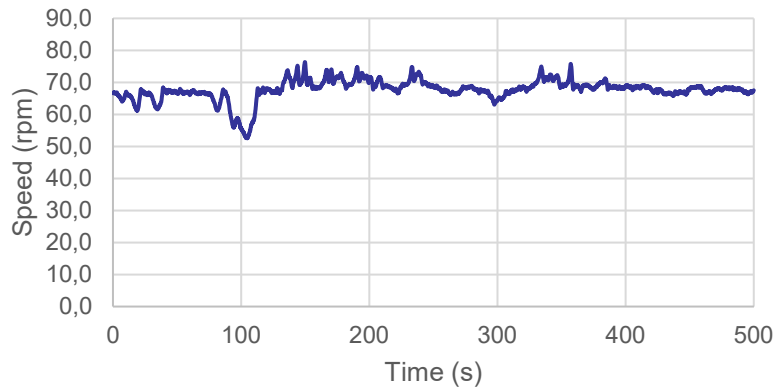
Wind speed



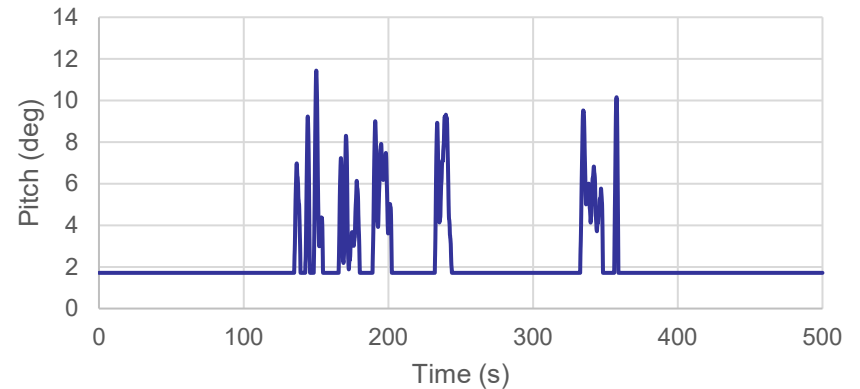
Electric power



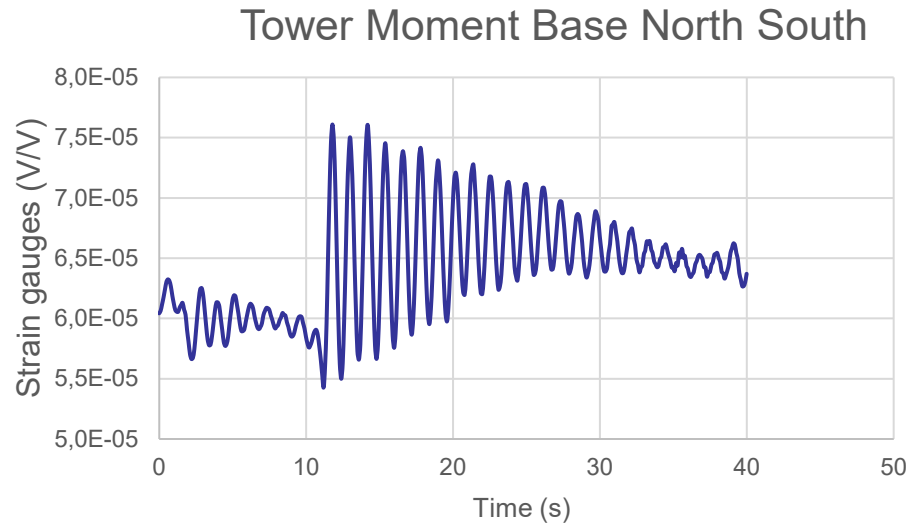
Turbine speed



Pitch angle (deg)



# Tower test



- We poll a rope mounted at the nacelle
- And suddenly release the force
- The outcome from the strain gauges in the tower base is shown
- The damping in the wooden tower is good

# Ongoing research project

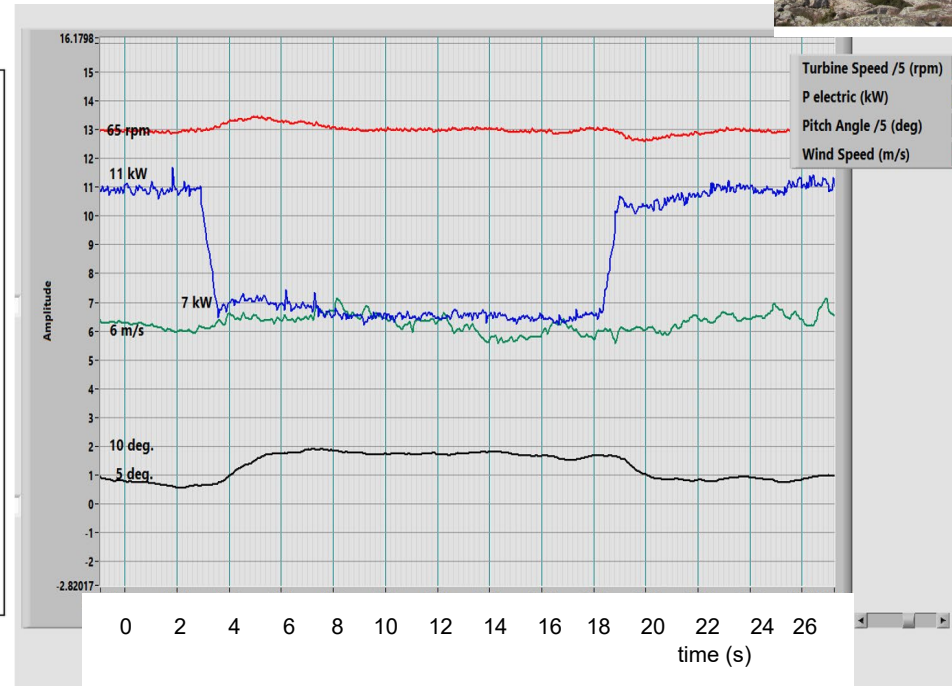
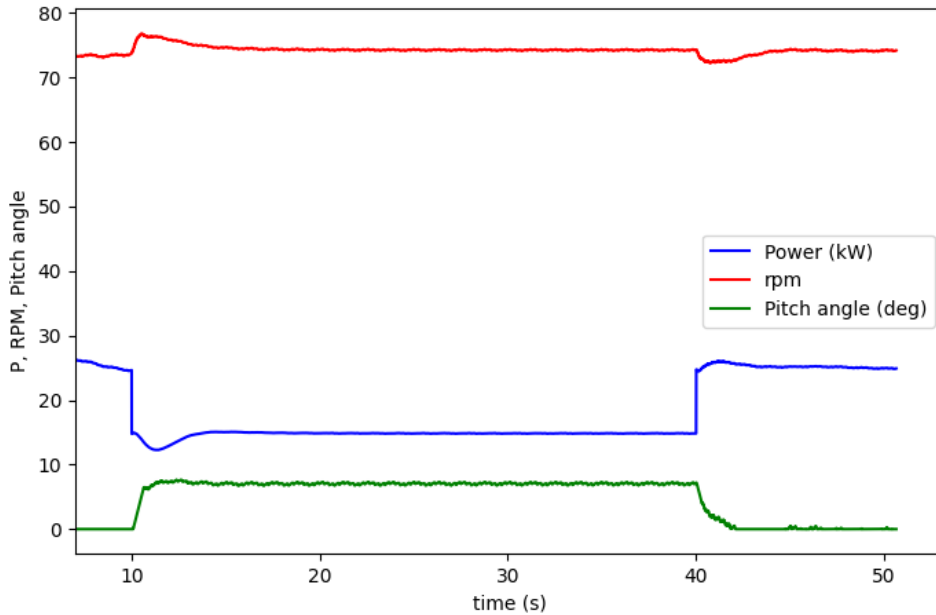
- Frequency control
- Wind speed estimations by .....
- Life time estimations due to load conditions
- Tower and foundation optimization
- Wind speed and power forecast by machine learning

# Simulation with Ashes an aeroelastic code and measurements with Chalmers Wind turbine



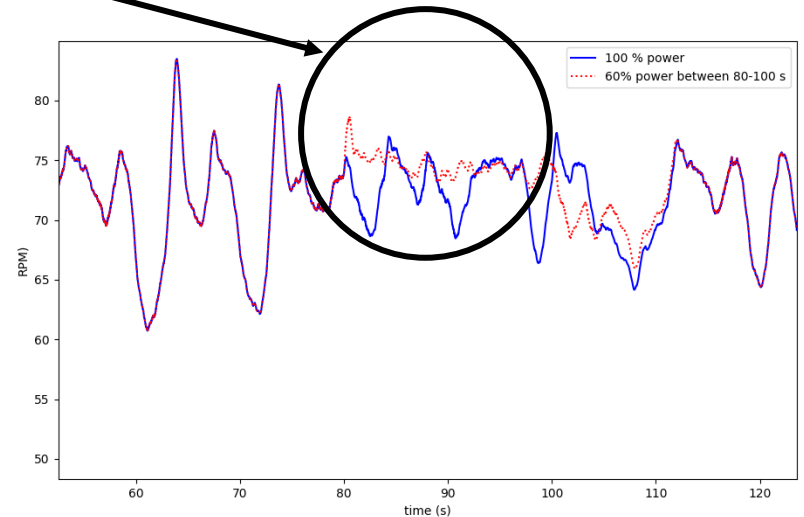
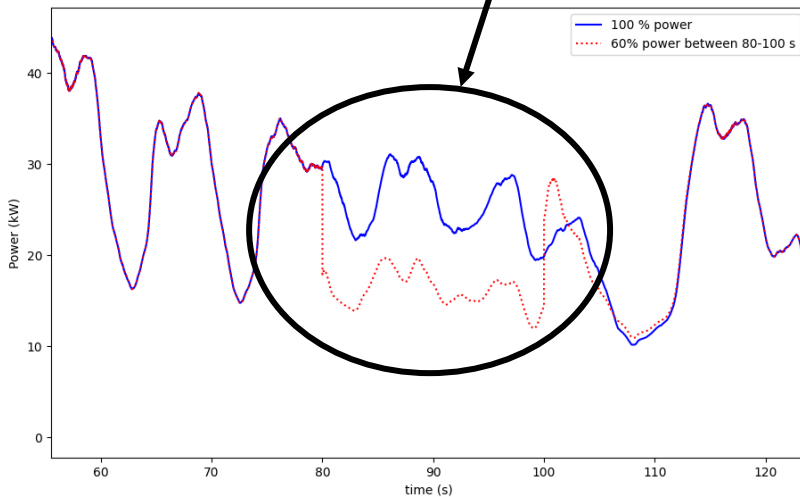
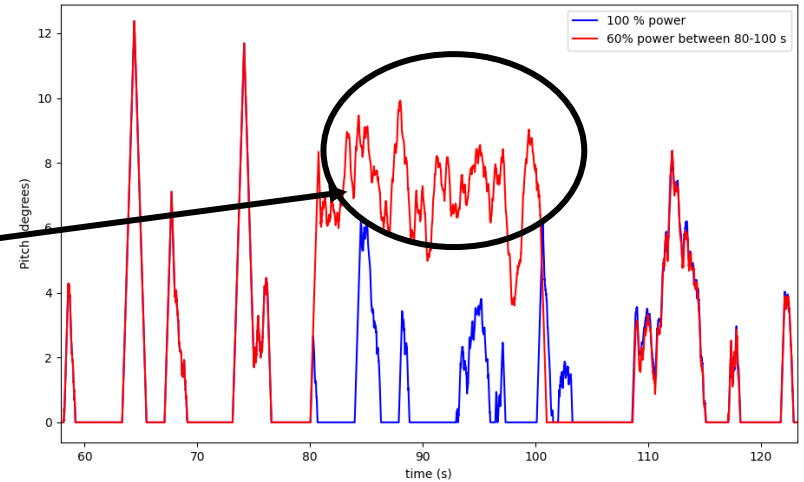
Constant wind speed at 7 m/s  
Step in power – 10 kW  
Response in pitch and speed

Date: 210518



# Simulation with Ashes for Chalmers Wind turbine

- Possible to reduce power and run with a specific of reduced power
- Calculate the available power
- Increased pitch activity
- Increased speed



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