Chalmers wind turbine at Björkö, Göteborg, Sweden

General description of turbine

Chalmers wind turbine has variable speed operation with a direct driven generator and a frequency converter, it also has a digital control system developed by Chalmers. The wind turbine has a rated power of 45 kW and rated speed of 75 rpm. The wooden tower is 30 m high, the blades of carbon fibres are 7.5 m long, and the turbine diameter is 15.9 m. The individually blade pitch system is electrical. The wind turbine is simulated in FAST and Ashes.

Location of Chalmers wind turbine

The turbine is situated on the island Björkö at Skarviksvägen, 20 km west of Göteborg city. The site is available by public transportation and some walking. The coordinates are: 57.71818820625921, 11.683382148764485

Control and measurements equipment at Chalmers wind turbine

The wind turbine is equipped with a measurement and control system built up around the hardware Compact Rio from National Instrument. The code is made in Labview. The system has a control loop with the sampling period of 10 ms. Some measurements are done with the rate of 5 ms. As can be seen in Figure 1 the turbine controller with measurements is connected via EtherCat bus to an expansion chassis in the nacelle and tower.
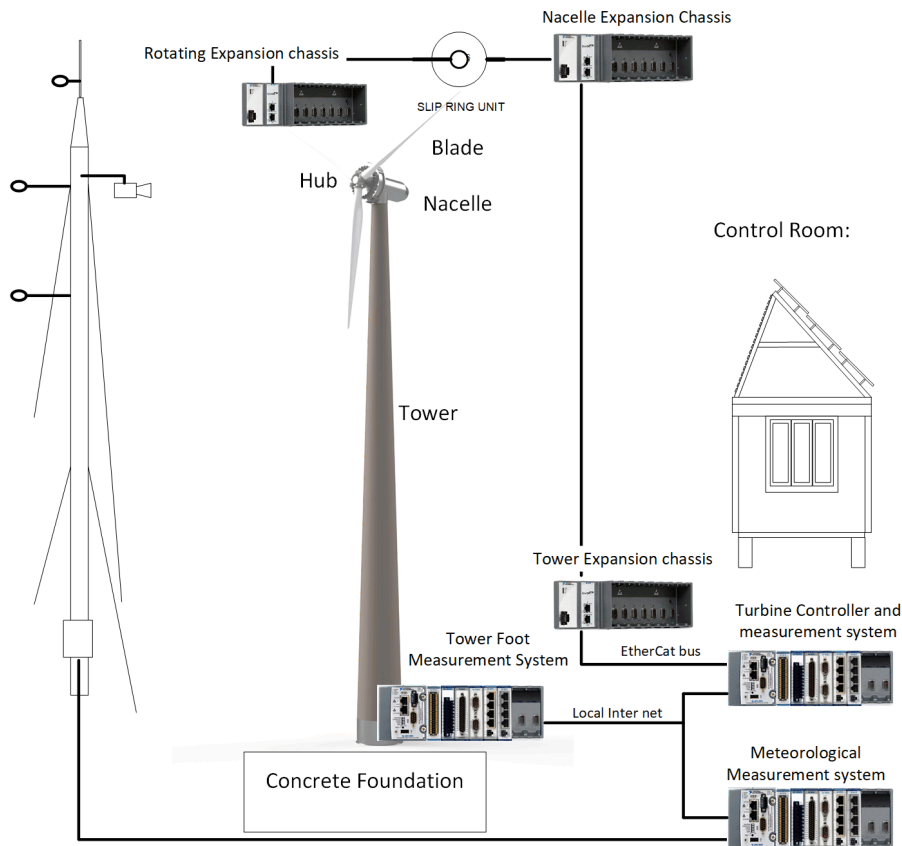
Figure 1. Layout of the control and measurement system of Chalmers wind turbine.

Measurements and control signals at Chalmers wind turbine

Hub and Blades
Pitch angles x 3
8 strain gauge sensors in each blade
Shaft torque sensor

Nacelle:
Control of yawing & yaw damping by hydraulic valves
Yaw position and No. of turns
Generator temperature x4
Turbine speed, two sensors
Accelerometers, x,y,z in direction

Tower foot:
Generator coil voltage & current
Tower steel base of 2 m; strain gauge sensors E-W, N-S and torsion, five signals
Wood tower; strain gauge sensors at 5m &10m, 8 signals
Foundation; 4 strain gauge sensors on the reinforcing bars

Control room:
Analog input: grid voltages & currents
Analog input: DC-link voltage & current
Analog input: DC-link current reference
Digital inputs: Cable twist, converter ok
Digital outputs: converter on/off, mechanical brakes on/off

Meteorological mast:
3 ultrasonic anemometers, high resolution wind speed and wind direction at 3 different heights
Air pressure, temperature, humidity
Precipitation
Network camera of wind turbine

Total of 64 signals to measurements files.

Research possibilities

Chalmers with its partners have designed and erected the wind turbine, with full control of design, drawings, hardware, and software. Turbine simulation models have been developed in FAST, Ashes and Vidyn. The control program is developed and implemented by the staff of Chalmers. The wind turbine can be used for different types of wind turbine research. Research collaborations can be small investigations, for example checking tower eigenfrequencies, or a larger one about for example lifetime estimation of pitch bearings due to frequency control or wake development in complex terrain. There can also be a project with the wind turbine in a micro grid and control of the voltage in the grid by reactive power control from the converter.

Contact data and more information

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