# IET & NCEPU wind turbine at Zhangbei County, China



## General description of turbine

IET & NCEPU wind turbine is an upwind and 3-blade HAWT with rated power of 100 kW. The rotor diameter of wind turbine is 21.9 m and the hub height is 26.2 m. Rated wind speed and rotor speed are 11.3 m/s and 62 rpm, respectively. The blades in the test have a length of 10.292 m with a maximum chord of 0.76 m at the span of 1.54 m. The maximum twist angle is 15 deg. The wind turbine runs at the variable-speed mode, which is same with the mainstream control mode of modern large-scale wind power generation systems. To operate at the optimal tip speed ratio (TSR) and obtain the maximum power coefficient, maximum power point tracking (MPPT) controls are employed to regulate rotor speed according to wind speed variations below the rated wind speed. Above the rated wind speed, the blade pitch angle is collectively controlled with the wind speed to maintain the rated power production. The yaw angle is controlled by a hydraulic motor according to the comparison of the nacelle orientation and the inflow direction

## Location of IET & NCEPU wind turbine

The turbine is situated 20 km west of Zhangbei County and 200 km northwest of Beijing. Self-driving is required for the 20-kilometer journey from Zhangbei County to the turbine.

## Control and measurements equipment at IET & NCEPU wind turbine

The wind turbine is equipped with a control system built up around the hardware PLC from Siemens, and a measurement system with the inflow conditions, aerodynamic loads, and strains measured synchronously. As can be seen in Figure , the signals of the inflow conditions are from two wind masts, anemometer on the nacelle, 5 seven-hole probes at the leading edge of the blade. The aerodynamic loads can be measured by the pressure taps on 5 dominant airfoils of the blade. The strains signals are from

the strain gauges installed on the inner of the blade root. The acquisition of all the signals is controlled at the sampling period of 20 ms by a sync pulse generator.
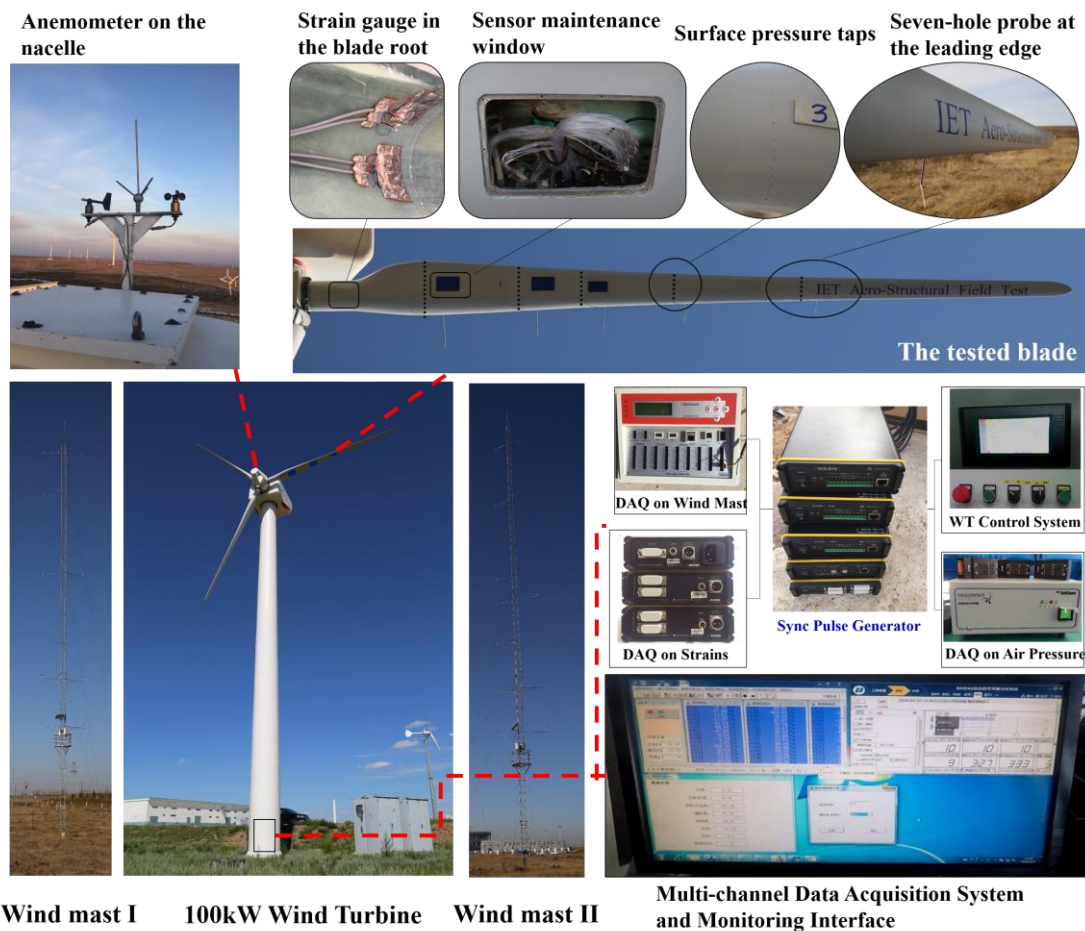


*Figure 1. Layout of the control and measurement system of IET & NCEPU wind turbine.*

## Measurements and control signals at IET & NCEPU wind turbine

**Hub and Blades**
Pitch angle x 1
5 pressure sections with total number of 256 pressure taps
4 strain gauge sensors in one blade
5 seven-hole probes near the pressure sections
Azimuth angle of the rotor

**Nacelle:**
Control of yawing & yaw damping by hydraulic valves
Yaw angle
Generator temperature
Turbine speed
Anemometer

**Control room:**
Electric power

Analog input: grid voltages & currents
Digital inputs: Cable twist, converter ok
Digital outputs: converter on/off, mechanical brakes on/off

**Meteorological mast:**
Mast I with height of 40 m installed at three times the rotor diameter away from wind turbine: including 5 anemometers and 4 wind vanes.
Mast II with height of 50 m installed at two and a half times the rotor diameter away from wind turbine: including 7 anemometers and 4 wind vanes.
Air pressure, temperature, humidity

**Total of 160 signals to measurements files at a time.**

## Research possibilities

IET & NCEPU wind turbine is developed to mainly focus on the investigations of wind turbine aerodynamics, including but not limited to angle of attack, aerodynamic behaviour of airfoils, blade loads, and strains under different control strategies. Turbine simulation models have been developed in Bladed and Ansys Fluent.

## Contact data and more information

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