

NETTUNO experiment 1

Dataset companion document

The purpose of this document is to provide information about the structure of the dataset from the first experiment of the NETTUNO project. The scope of the first experiment was to characterize the wake of a scale model wind turbine subjected to harmonic platform motion. The wind turbine object of the experiment has a rotor diameter (D) of 2.38 m and the experimental setup is shown in Figure 1.

The experiment and some key results are presented in the article included in the dataset.

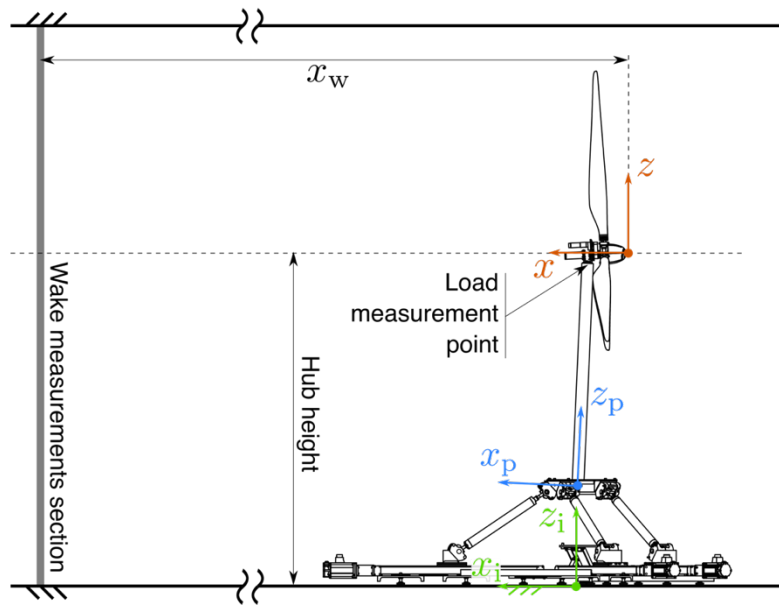


Figure 1. Schematic representation of the experimental setup with the coordinate systems: $(x_i - y_i - z_i)$ is the inertial reference frame, $(x_p - y_p - z_p)$ is the platform reference frame, and $(x - y - z)$ is the hub reference frame. x_w is the distance from the wind turbine hub to the section where wake measurements were conducted.

Dataset

The dataset consists of two parts:

- ☐ Measurements of aerodynamic rotor loads.
- ☐ Hot-wire measurements of the wind velocity in the wind turbine wake.

Aerodynamic rotor loads

Loads measurements are provided as files of comma-separated values (.csv). File name provides information about the test conditions, as in the example below:

surgesway_F0d5_A0d032_gamma30

Motion scenario	Motion frequency [Hz]	Motion amplitude [m or °]	Motion direction [°]
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In the files names, the “d” character replaces the decimal separator. Information about motion direction is present only in files of surge-sway and roll-pitch motions. When “Motion scenario” is “Static” there is no platform motion.

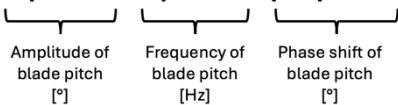
Every line in a file consists of 8 values:

Value number	Units	Description
1	s	Time
2	m or °	Platform displacement
3	N	Tower-top x shear force
4	N	Tower-top y shear force
5	N	Tower-top z axial force
6	Nm	Tower-top x moment
7	Nm	Tower-top y moment
8	Nm	Tower-top z moment

Loads are in the hub reference frame (x - y - z coordinate system of Figure 1).

In some cases, the blade pitch was varied sinusoidally. The amplitude, frequency, and phase shift with respect to motion are specified in the file names as in the example below:

surge_F1d0_A0d048_Ap1d5_Fp1d0_php-80



Files relative to cases with platform motion and dynamic blade pitch have an additional value on every line:

Value number	Units	Description
1	s	Time
2	m	Platform displacement
3	°	Blade pitch setpoint
4	N	Tower-top x shear force
5	N	Tower-top y shear force
6	N	Tower-top z axial force
7	Nm	Tower-top x moment
8	Nm	Tower-top y moment
9	Nm	Tower-top z moment

In the file relative to the scenario with fixed tower base and dynamic blade pitch, the platform displacement is replaced by the blade pitch setpoint.

Wake velocity

The wind velocity in the turbine wake was measured using a single-sensor hot wire anemometer. The hot wire probe was moved in the crosswind (y_i - z_i) plane. Velocities were measured along lines centred on the rotor hub, both in the horizontal direction (along the y_i -axis) and in the vertical direction (along the z_i -axis). Horizontal measurements were made at 35 evenly spaced points, and vertical measurements at 27 points. The distance between consecutive measurement point is 0.1 m. The traversing system was positioned at three distances downstream of the rotor: $x_w = [3,4,5]D$, to study wake evolution.

Table 1 provides the measurement grid for the horizontal direction, while Table 2 provides the grid for the vertical direction.

Table 1. Horizontal measurements grid.

x_i [m]	y_i [m]	z_i [m]
3D, 4D, 5D	-1.7:0.1:1.7	2.19

Table 2. Vertical measurements grid.

x_i [m]	y_i [m]	z_i [m]
3D	0	0.99:0.1:3.59

Three-components wake-velocity measurements are provided as tab-delimited (.dat) files. File name provides information about the test conditions, as in the example below:

rollpitch_A1d3_F1d0_gamma45_hori_3D_1component

Motion scenario Motion amplitude [m or °] Motion frequency [Hz] Motion direction [°] Meas. direction Meas. distance (x_w) Number of velocity components

In the files names, the “d” character replaces the decimal separator. Information about motion direction is present only in files of surge-sway and roll-pitch motions. “Number of velocity components” is the number of velocity components measured by the hot-wire probe. When “Motion scenario” is “static” there is no platform motion.

In every file:

Column Number	Column name	Units	Description
1	Time	s	Acquisition time
2	u_1	m/s	Velocity x at measurement station 1
3	$disp_1$	m or °	Platform displacement at measurement station 1

4	bld_1	–	Blade 1 passing through the 0° azimuth position
5	u_2	m/s	Velocity x at measurement station 2 at measurement station 2
6	$disp_2$	m or °	Platform displacement at measurement station 2
7	bld_2	–	Blade 1 passing through the 0° azimuth position at measurement station 2
...
$3*N-1$	u_N	m/s	Velocity x at measurement station N
$3*N$	$disp_N$	m or °	Platform displacement at measurement station N
$3*N+1$	bld_N	–	Blade 1 passing through the 0° azimuth position at measurement station N

N represents the number of measurement stations, which is 35 for horizontal and 27 for vertical measurements. "bld_i" passes from 0 to 1 when blade 1 is at 0° azimuth.

Contacts

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