TotalControl Newsletter

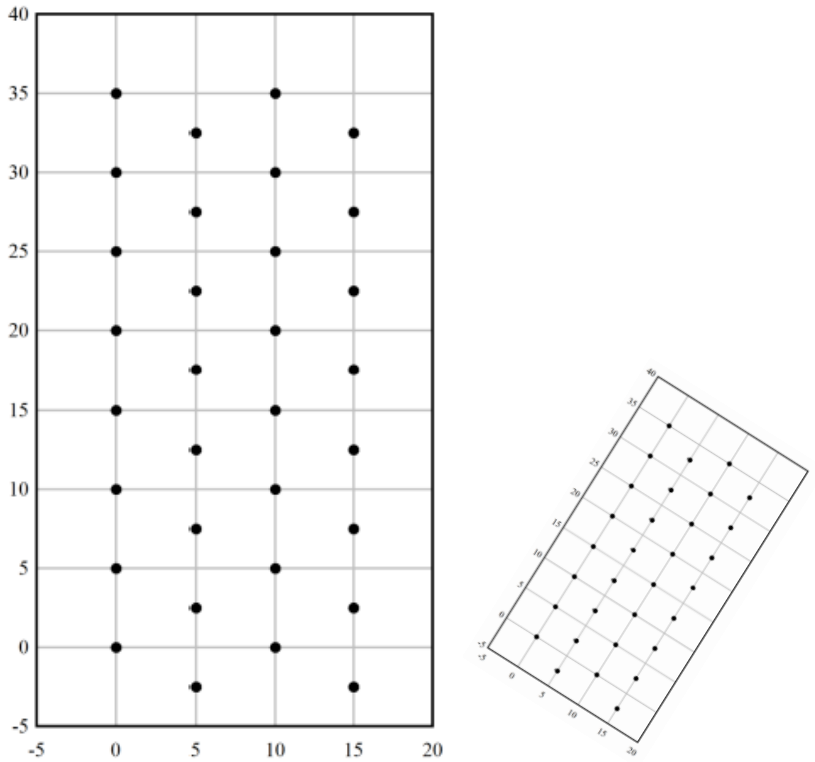
The TotalControl project is finishing its second year, and the first results are ticking in. In particular, we will show those results:

- The design for a reference offshore wind farm
- Precursor LES runs for realistic wind fields publically available
- Measurement campaigns going on at Lillgrund and Levenmouth

Reference wind farm

Four partners worked together to first, find other possible candidates for a reference wind farm on which to develop and try out the control algorithms, and second, developed their own reference farm.

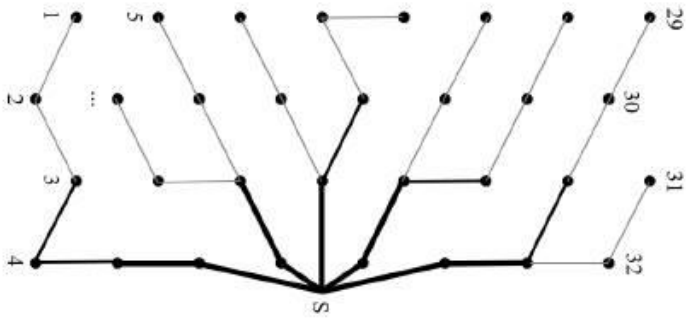
The project will use the IEA reference wind farm and the new layout:



The farm layout can be rotated to have a long farm, a wide farm, and different inter-turbine distances when the wind farm is turned.

The wind farm consists of DTU 10 MW turbines, but the scaling is independent of the turbine type, as the numbers given in the plot are in rotor diameters.

For the electrical optimisation, the reference wind farm has a grid connection with 66kV inter-array grid voltage and a 220kV cable to the shore



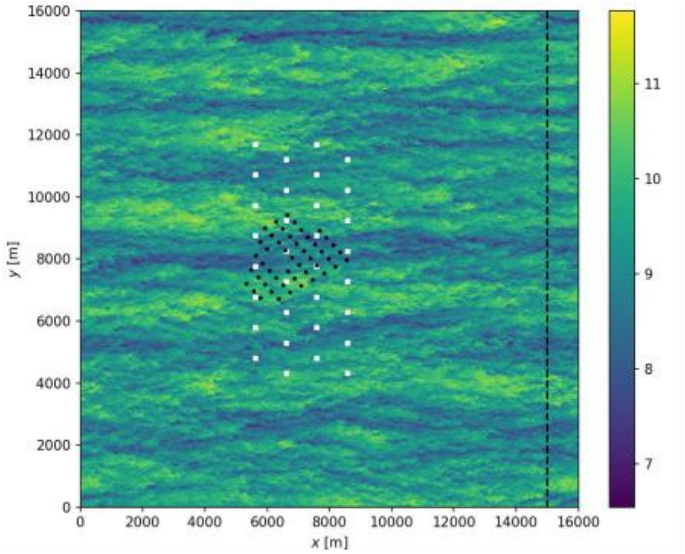
The details of the reference wind farm can be found in the public deliverable.

LES Precursor runs

The development of wind farm control algorithms requires a fast model to develop the controllers, and a high-fidelity model to verify them in realistic wind flow. The latter is done with Large Eddy Simulation, which is a complex but very realistic computer code run on supercomputers.

The problem here can be broken down in two: First, the computation of a realistic and self-consistent fully turbulent flow field, split up in different wind speeds and atmospheric conditions, and the flowing of this field over the wind farm. The first one is called a precursor, and needs quite heavy computations; the ones done by partner KU Leuven ran on 900 cores for 5-6 days.

The latter is much quicker to compute, which is why the process is divided in two. The precursors were calculated with the SP-Wind code of KU Leuven and the EllipSys3D code from DTU.



The precursor fields are large enough to contain the virtual wind farm, here either the newly defined reference wind farm (white turbine locations) or the Lillgrund wind farm (black dots) which is used for the measurement campaign.

The precursors are described in a public deliverable.
A subset of this dataset is also freely available on Zenodo.

Measurement campaigns

A verification of novel control schemes would not be complete without full-scale verification. In this project, we work on two measurement campaigns, one of a turbine controller optimised for wind farm control, and the other one in a full scale offshore wind farm.

The turbine controller needs have certain features to be most useful for wind farm control. We test those features on the Samsung 7MW turbine on ORE Catapult's test bed in Levenmouth, Scotland. The controller for this turbine had originally be developed by project partner DNV GL, and therefore they are ideally suited to teach the turbine some new tricks. The verification of the features is done by looking at the wind upstream and downstream of the turbine with a lidar, a wind measurement system based on lasers, which measures the speed of aerosol floating with the wind.

The full scale measurements are currently underway at project partner Vattenfall's Lillgrund offshore wind farm, between Malmö and Copenhagen. Several strain gauges measure the mechanical loading of the turbines, and three scanning lidar systems measure the incoming wind and a "wall" of measurement points inside the wind farm. At the moment, they just record the normal operation of the wind farm, but eventually the setup will also test new wind farm control algorithms aiming at reducing the wake effect and reducing the loads on the turbines.

About TotalControl

The ambition of the TotalControl project is to develop the next generation of wind power plant (WPP) control tools, improving both WPP control itself and the collaboration between wind turbine (WT) and WPP control. To do this, TotalControl will use high-fidelity simulation and design environments that include detailed time resolved flow field modelling, nonlinear flexible multi-body representations of turbines, and detailed power grid models.

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Website: www.totalcontrolproject.eu