

# HAWC2 – The Frontier of Aeroelastic Simulation

## HAWC2 for wind turbine response calculation

HAWC2 (Horizontal Axis Wind turbine simulation Code 2nd generation) is an aeroelastic code intended for calculating wind turbine response in time domain. HAWC2 has been used in numerous research projects and industrial applications. The code has been verified through measurements and comparisons with other codes. It has been used to simulate more than 100 different wind turbines. The HAWC2 has many significant features, particularly related to design and load simulation of large wind turbines in multi MW size.

## Effective tool for turbine design

During a design process it is important to assess the aeroelastic behaviour of a wind turbine, both with respect to production, noise and loads. HAWC2 is able to simulate new concepts like a Jacket substructure, floating turbines, turbines with trailing edge flaps and even vertical axis wind turbines

## Wake Meandering

The developed Dynamic Wake Meandering model is capable of capturing the response of turbines operating in wakes which is very important for wind farms in order to evaluate the correct design loads.

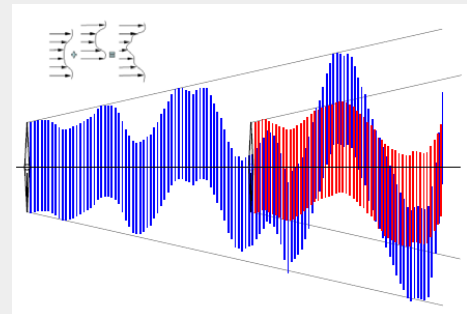
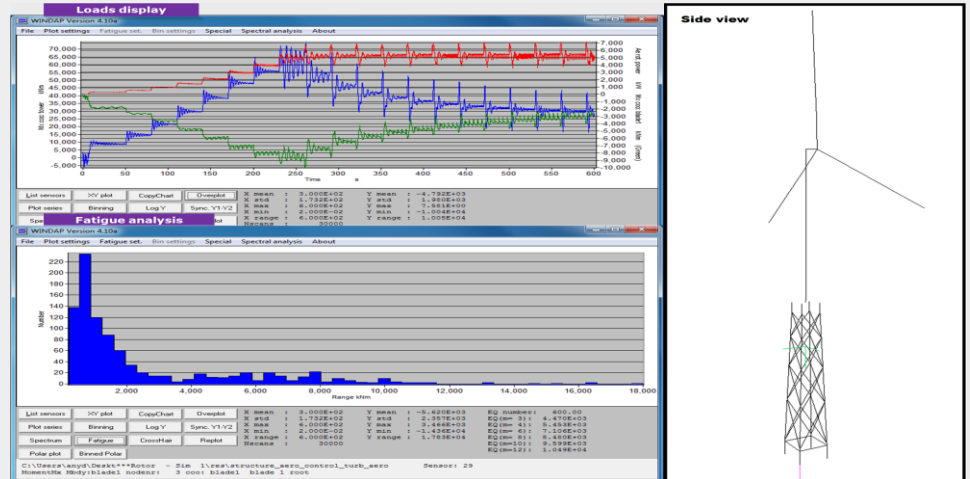


Illustration of wake pattern according to the DWM theory. The downstream turbine is only once in a while subjected to full wake loading.



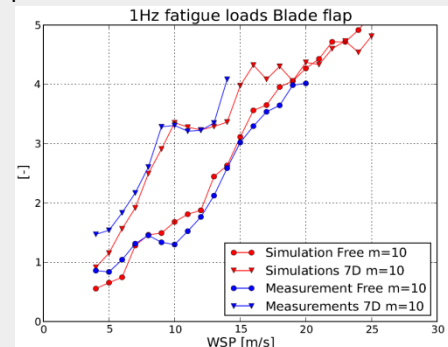
Example of simulations results and animation of a wind turbine on a jacket substructure

## The HAWC2 software platform

HAWC2 is the main member of the software platform developed by DTU Wind Energy. Another part of this platform is HAWCstab2 which is a tool for computing and analyzing the modal properties of a wind turbine with or without the unsteady aerodynamic forces and in open- or closed-loop operation.

## Constant development

HAWC2 has been developed since the early 1990'ies and have evolved constantly with the introduction of new concepts and designs which has pushed the development of new models. The development of new models is pursued by measuring campaigns and/or CFD computations for test and validation.



Comparison of simulation and measurements for selected load sensors in free sector and 7D wake at the Egmond aan Zee wind farm.

## Facts about HAWC2

- Nonlinear aeroelastic model based on a multibody formulation that can handle complex structures including large rotations and deflections of all structural components.
- Detailed aerodynamic model that includes dynamic inflow, skew inflow, shear effect on induction, effect from large blade deflections, tip loss, dynamic stall models: a modified Beddoes-leishmann model a model for ATEF (Active Trailing Edge Flaps).
- Eigenvalue analysis at stand- still.
- HAWC2 is constantly being developed at DTU Wind Energy.
- HAWC2 is today used in both academia and industry.

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