

OWENS

Onshore/Offshore Wind/Water ENergy Simulator

The OWENS toolkit was developed for the analysis of land based or offshore novel wind and water turbine systems. The tool has the required physics models to enable coupled analysis of aero-hydro-servo-elastic simulations necessary for design and certification of wind and water energy systems. It is comprised of the following modules, written in the Julia programming language:

OWENS combines the modules into a continuous analysis workflow from basic parametric inputs to response outputs for steady, transient, and modal analyses. While it has been tuned for stability and accuracy, it also makes a wide range of fidelity and solution parameters accessible to the user for case-specific tuning. This driver also includes drivetrain control, pre- and post-processing, enabling fully automated runs spanning internally calculated composite sectional properties to fatigue and limit state results.

OWENSAero consists of steady and unsteady analysis methods for aerodynamic load prediction of three-dimensional VAWT models using either the Double Multiple Streamtube or the Actuator Cylinder methods. Dynamic stall models are included for capturing unsteady aerodynamic effects and an improved solution procedure is an option which enables faster than real-time aerodynamic calculations of full turbines.

OWENSFEA solves the elastic response of a gyric system defined by a finite element mesh using Timoshenko beam elements. There are multi-fidelity solution options including linear and nonlinear transient analysis, reduced order modes analysis, steady state analysis, and modal analysis with centrifugal stiffening. The program validates well against higher fidelity models even for high deflections (>20% of length).

OWENSPreComp uses classical laminate theory to calculate beam sectional properties for use in the several options of multibody beam finite element models used in OWENS.

OWENSOpenFASTWrappers provides direct coupling to the OpenFAST Hydrodyn, Moordyn, InflowWind, and AeroDyn libraries, which have been integrated to enable simulations with wave and current forcing on floating platforms, simulation with turbulent inflow, and higher order vortex aerodynamics of multiple turbines.

With the full suite of OWENS, a designer can do the following:

- Prescribe a free-form finite element mesh to represent arbitrary structures and generate elastic solutions
- Aero-hydro-servo-elastic unsteady non-linear time domain analysis with atmospheric turbulence for prescribed metocean conditions
- Perform floating or fixed bottom modal and automated Campbell diagram analysis
- System optimization using algorithmic gradients



Software Access:

<https://github.com/sandialabs/OWENS.jl>

