



OWENS

Offshore Wind Energy Simulator



The Offshore Wind Energy Simulator (OWENS) is a toolset developed for the analysis of offshore or land-based vertical-axis wind 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 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 the ability to modify control inputs or specify additional control elements or methods.



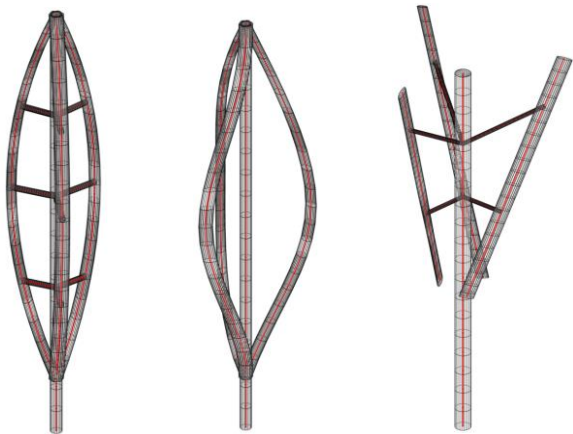
VAWTAero consists of steady and unsteady analysis methods for aerodynamic load prediction of three-dimensional VAWT models using either the Double Multiple Streamtube or the Actuator Cylinder methods. Dynamic stall models are included for capturing unsteady aerodynamic effects and an improved solution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



GyricFEA 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).



Additionally, direct coupling to the **OpenFAST Hydrodyn**, **Moordyn**, and **InflowWind** modules have been integrated to enable simulations with wave and current forcing on floating platforms and simulation with turbulent inflow. Pre-processor capabilities include mesh generation of user-defined floating platforms and calculation of hydrostatic properties, hydrodynamic coefficients, and pre-service stability analysis.



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
- Floating system modal analysis including platform and mooring properties calculated using parameterized inputs
- System optimization using algorithmic gradients

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