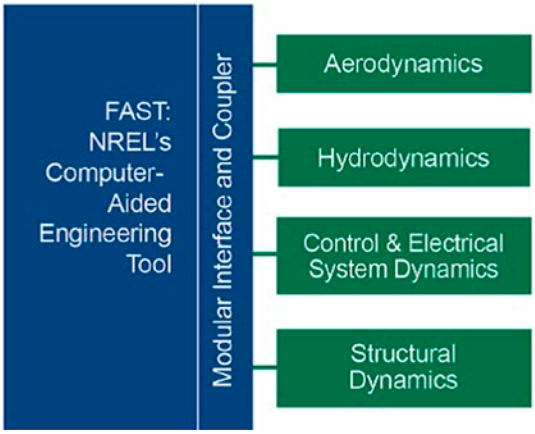
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

New Framework Transforms FAST Wind Turbine Modeling Tool

Highlights in Research & Development

A recent overhaul of the tool makes it a powerful, robust, and flexible modeling software to aid the development of innovative wind and water power technologies.

The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) recently released an expanded version of its FAST wind turbine computer-aided engineering tool under a new modularization framework. The new release includes: an upgraded version of the AeroDyn aerodynamics module that includes tower drag loading; the capability to analyze multimember offshore wind turbine substructures; a new state-space hydrodynamic theory option in the HydroDyn hydrodynamics module; a new Mooring Analysis Program for modeling multisegmented mooring quasi-static behaviors of floating offshore wind turbines; and full conversion of FAST into the new modularization framework.



Modular approach of NREL's computer-simulated engineering tool, FAST.

Features of the new framework include: mixed spatial discretization between modules; mixed time discretization and solvers between modules; clearly defined interfaces and programming guidelines to support an open-source code-development community; and a framework for advanced modularization features such as tight coupling, full model linearization, parallel computing, etc.

The upgraded version of AeroDyn can simulate both the upwind and downwind influences of the wind turbine tower on the rotor and calculate drag load on the tower.

The new offshore wind turbine capability enables the software to model the hydrodynamic loading and structural dynamics of multimember, fixed-bottom offshore wind substructures such as tripods and jackets. These types of offshore wind structures are being built in water depths between 30 and 60 meters. The substructures can be composed of multiple interconnecting members with incline, and the members can include the effects of flooding and marine growth.

The new state-space hydrodynamics option in HydroDyn enables more computationally efficient time-domain solutions than the previously available implementation, and permits model linearization that is important for modal analysis, linear system-based controls design, and linearized stability analysis.

The Mooring Analysis Program simulates the quasi-static behavior of complex multisegmented mooring systems—a critical component of both wave energy conversion and floating offshore wind systems.

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Reference: "FAST (Modularization Framework)." NREL NWTC Information Portal. *wind.nrel.gov/designcodes/simulators/fast/alpha/.*

Key Research Results

Achievement

NREL released an expanded version of its FAST wind turbine computer-aided engineering tool under a new modularization framework.

Key Result

The new FAST modularization framework improves the ability to read, implement, and maintain source code; increases module sharing and shared code development across the wind community; improves numerical performance and robustness; and enhances flexibility and expandability to enable further developments of functionality without the need to recode established modules.

Potential Impact

This new framework transforms FAST into a powerful, robust, and flexible modeling software to aid the development of innovative wind and water power technologies.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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