Announcing FLORIS Version 4.0

The FLORIS development team is very excited to announce the release of [FLORIS (FLOw Redirection and Induction in Steady State)](#) version 4.0. FLORIS 4.0, represents a comprehensive overhaul of FLORIS's code base and API. A key new capability is the inclusion of modes of operation beyond nominal and wake steering, allowing for individual turbine shut-off, derating control, and the implementation of innovative blade pitch-based wake mixing wind farm control strategies, such as the helix approach. The team also added the capability to evaluate the impact of different control strategies and wind plant layouts on the market value of the energy produced as well. These updates not only enhance code clarity and performance but also open avenues for new areas of control studies beyond wake steering, expanding FLORIS's capabilities, making it more user-friendly, and facilitating easier integration with new features and modules.

The full list of changes, along with their corresponding pull request, is available at [the v4.0 GitHub Release](#), and the primary changes are listed below.

ENHANCED CODE BASE AND API FOR IMPROVED PERFORMANCE AND FLEXIBILITY

The code base and API have been completely reworked for improved clarity, performance, and extensibility. The optimization tools were updated to use the new 4D format, allowing for future expansion to more varied wind conditions. These changes make FLORIS more user-friendly and facilitates easier integration with new features and modules.

REVAMPED TURBINE OPERATIONS ALLOWS FOR DERATING AND HELIX CONTROL

The representation of wind turbines has been revamped in FLORIS 4.0 to allow more flexible definitions of turbine operation. This enables both derating and Helix control, as well as providing an entry point for future models on turbine performance under yaw misalignment and other wake mixing strategies.

FLORIS 4.0 introduces a simple model for the "helix" active wake mixing wind farm control strategy is introduced. This strategy uses individual pitch actuation to enhance wake recovery and maximize wind farm power production.

Additionally, FLORIS 4.0 includes the ability to provide a derating setpoint for wind turbines, as well as the ability to shut off individual turbines entirely for specific times or conditions, as well as to apply derating control to wind turbines. These new modes expand FLORIS' capabilities to model observed wind farm data.

INTRODUCING NEW TIME SERIES AND WINDROSE OBJECTS

New objects TimeSeries and WindRose are introduced which can hold wind conditions, and related information such as frequency tables and market values. These objects can be used to drive in a convenient way many of FLORIS' main operations.

ENHANCED LAYOUT OPTIMIZATION WITH MARKET VALUE INFORMATION

FLORIS can now incorporate electricity market value information as a function of time or wind condition, enabling more sophisticated layout and control optimizations that consider revenue in addition to energy production. This feature enhances FLORIS' utility for real-world wind plant design and operation scenarios.

TURBULENCE INTENSITY ARRAY FOR PRECISE WIND CONDITIONS

 Instead of being specified as a single value, turbulence intensity is now defined as an array, allowing different turbulence values for each wind direction and wind speed condition run.

ABSOLUTE POWER PERFORMANCE SPECIFICATIONS

The power performance of a wind turbine as a function of wind speed is now specified in absolute terms (kW) rather than as a power coefficient (Cp, unitless). This change reflects the turbine specifications more commonly available from manufacturers, as well as solving issues with the above-rated power curve in previous versions. Utilities have been provided to convert FLORIS v3 turbine models to v4.

REFERNCE TURBINE AND TURBINE MODELS UPDATES

The reference turbines provided with FLORIS (NREL 5MW, IEA 10MW, and IEA 15MW) have been updated to match the latest publicly available power and thrust curves.

EXPANDED CONTROL MODES FOR BETTER WIND FARM MODELING

Multidimensional turbine power and thrust curves were implemented in FLORIS v3.5 but were limited to use with a specific wake model. In FLORIS v4.0, multidimensional turbines are compatible with all wake and turbine operation models.

IMPROVED USER EXPERIENCE WITH REVAMPED EXAMPLES AND DOCUMENTATION

Terminology has been updated or removed for greater clarity. User-facing examples and documentation have been revamped and improved making it easier for users to understand and utilize FLORIS.