

## AcuSolve™

## High Fidelity CFD for Wind Power Applications

### The Promise of Tomorrow Delivered Today

Wind energy offers the promise of a renewable energy source that can help us meet our energy requirements while promoting a greener environment. While engineering advances have made wind power one of the world's fastest-growing energy sources, many challenges remain. Wind turbine engineers and designers continuously strive to deliver designs that are more efficient, reliable, safer, and cheaper.

### Modeling Requirements Reach New Heights

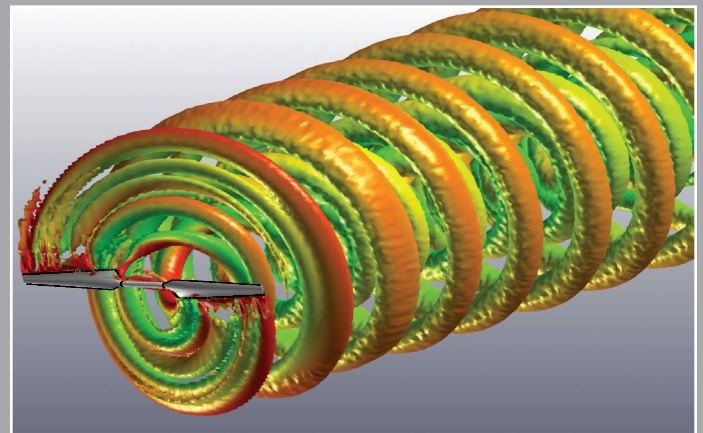
As wind turbine towers grow higher and blade radii increase, the design and simulation challenges facing engineers and designers become even more critical. These include the need to:

- Simulate the full transient turbulent flow around the blades
- Model the structural responses of a large, coupled wind turbine system
- Predict noise sources and analyze acoustic performance
- Position wind turbines in complex terrain to optimize output
- Predict thermal stability, wind speed and power density
- Forecast performance and reliability
- Calculate subsea Vortex-Induced Vibration and Motion (VIV/VIM) for offshore wind farms

Thus, the requirements of wind turbine simulations have gone far beyond the scope of traditional Finite Element Analysis (FEA) or Computational Fluid Dynamics (CFD) solutions. Any simulation gap can easily result in the inability to solve a problem or obtain accurate results. In fact, these new classes of Fluid/Structure Interaction (FSI) problems require a new simulation technology approach with closely coupled co-simulation of FEA and CFD.

### AcuSolve Bridges the Simulation Gap

AcuSolve is uniquely positioned to bridge the gap between traditional FEA and CFD solutions. A CFD solver based on the finite element approach, AcuSolve delivers robust, fast and accurate results with the stability and maturity typically found in structural FEA programs. AcuSolve can be directly coupled to leading FEA solvers to predict the interaction between structures and fluids – without the use of 3rd party software and without the massive computing overhead that traditional solutions demand.



US National Renewable Energy Laboratory (NREL) Wind Turbine Wake Resolution (10D) Downstream.

### ACUSIM and Fluid/Structure Interaction

Some of the most challenging wind turbine simulations involve complex Fluid/Structure Interactions and ACUSIM Software offers the best in class solutions for these types of problems. AcuSolve's Practical FSI (P-FSI) capability predicts linear solid/structural response to fluid forces; AcuSolve's Direct-Coupling FSI (DC-FSI) predicts large deformation and non-linear solid/structural responses to fluid forces. DC-FSI is superior for transient applications exhibiting nonlinear structural response due to large deformations, material non-linearities, and complex contact.

## AcuSolve Delivers Solutions Faster

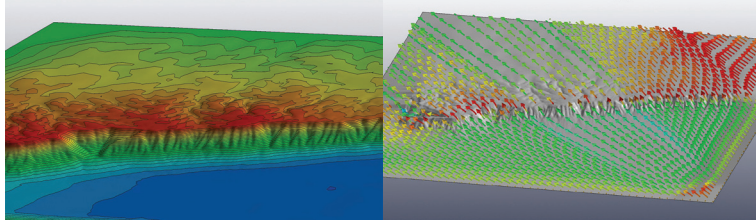
Traditional CFD codes require structured mesh or extremely dense unstructured meshes to obtain accurate results. AcuSolve, however, uses unstructured meshing technology (an automatic mesh generator) to deliver highly accurate results in greatly reduced solution times. Thus, engineers and designers can spend less time building the mesh and input files, and more time evaluating results when using AcuSolve.

## AcuSolve and Offshore Simulation

Today's offshore wind turbines usually stand on towers driven deep into the ocean floor. Strong currents can produce Vortex-Induced Vibration and Motion (VIV/VIM) of risers leading to fatigue damage or sea bed erosion. AcuSolve simulations of wind turbine towers combine CFD with FSI to predict tower stress from wave motion and VIV. Engineers and designers can use calculations from AcuSolve to help them optimize their designs by taking into account changes in current speed and direction varying by depth.

AcuSolve uses its Arbitrary Lagrangian-Eulerian (ALE) mesh motion, Fluid/Structure Interaction (FSI), Detached-Eddy Simulation (DES), and transient turbulence model capabilities to analyze the effects of:

- Wave motion
- Multiple structures
- Riser shapes and motions including nonlinear response
- Interaction with sea bottom and other complex problems
- Transient turbulent processes including boundary layer phenomena, separation, and free shear of wakes



High Fidelity Siting Prediction for Wind Park Performance



AcuSolve has won many Fortune 500 customers, including leading wind turbine manufacturers.

## An Ideal Solution for Wind Turbine

With its acclaimed next-generation CFD solver approach, AcuSolve is well suited to meet the challenges of wind turbine design and simulation, allowing users to:

- **Maximize energy efficiency**  
Model both single turbine optimization and large scale, full farm simulation
- **Improve aerodynamic and structural performance**  
Couple CFD simulation with structural responses
- **Optimize aeroelastic design to produce stronger and lighter structures**  
Analyze wind flutter with speed and accuracy
- **Improve acoustic performance**  
Perform accurate sliding mesh computations and simulate transient flows
- **Select sites on land and sea**  
Assist in micro-siting and conduct wake modeling

## About ACUSIM Software, Inc.

ACUSIM Software provides engineers and scientists with superior Computational Fluid Dynamics (CFD) solutions. ACUSIM's products are used globally in a wide variety of industries such as automotive, electronics, chemical, bio-medical, consumer products and energy, as well as national labs and universities.

Headquartered in Mountain View, California, ACUSIM Software markets its flagship product, AcuSolve™, and its associated pre-processor, AcuConsole™, post-processor, AcuFieldView™, and desktop solution, AcuDesktop™, through direct sales and distributor channels.

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