

AcuSolve™

Highly Validated CFD Solutions for the Most Complex Offshore Design Problems

Enabling Technology for the Offshore Industry

The offshore industry is a high tech industry that demands precise engineering solutions. In order to remain competitive, industry leaders continually look for better solutions to engineering problems. Computational fluid dynamics (CFD) is one of such solutions and is gaining increased importance in this industry. CFD solutions are directly contributing to increased oil production by helping to conceive and validate design changes that once were limiting elements, and by reducing downtime for offshore oil and gas production platforms.

AcuSolve™ for the Most Complex Design Challenges

The engineering problems faced by the offshore industry include some of the most difficult challenges. Traditional structural analysis and CFD solutions are often insufficient by themselves due to the need for multidisciplinary design and simulation of coupled fluid flow and structural phenomena.

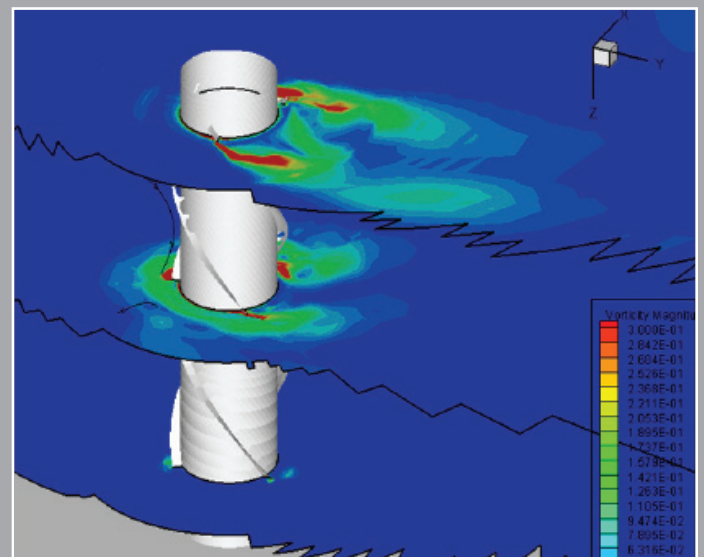
AcuSolve stands out as one of the most efficient, accurate and robust solutions, offering designers and engineers the ability to properly analyze these complex problems, increase the reliability of their designs, and reduce the time and costs associated with physical model tests.

Based on the Galerkin/Least Squares (GLS) finite element method, AcuSolve is a leading general-purpose finite element-based CFD flow solver with superior robustness, speed, and accuracy. AcuSolve uses its Arbitrary Lagrangian-Eulerian (ALE) mesh motion and free-surface, 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 the sea bottom, transient turbulence with boundary layer, flow separation, wake-free shear and other complex problems found offshore.

Solving Complex FSI Problems

Two powerful FSI capabilities are provided by AcuSolve for simulating fluid structure interaction and response to fluid forces:

- **Practical FSI (P-FSI)** predicts linear solid/structural responses.
- **Direct-Coupled FSI (DC-FSI)** predicts large deformation and non-linear solid/structural responses.



Spar vorticity magnitude calculation.

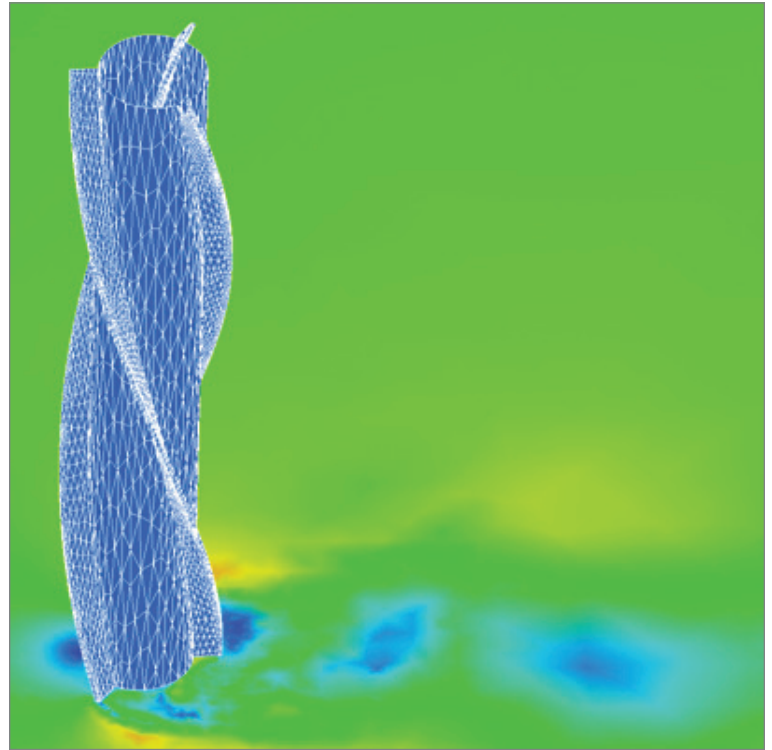
Extensive progress in offshore simulation have been made based on both of these capabilities. In the case of long risers, with the first method, the riser structure is modeled using a linear vibration analysis model or modal analysis of the riser. The linear model is solved within AcuSolve as part of the FSI solution. The response of very long risers with length/diameter (L/D) ratio of over 4,000 has been modeled with this method. The second method available within AcuSolve is to directly couple the CFD solution with a general purpose nonlinear solid/structural code such as Abaqus. This is done without any intervening third party software. This coupled methodology is superior for transient applications that exhibit nonlinear structural response due to large deformations, material nonlinearities, or complex contact.

Highly Validated Solutions

AcuSolve provides high quality validated solutions in an easy to use framework. Some of the most challenging design accomplishments include:

- Design of mooring systems for spars and other “floaters” under the action of waves and currents - in particular, the potential for vortex induced motions (VIM) of platforms. A related problem is anticipating unfavorable motions when floating bodies are moored together. To solve these problems, engineers often turn to tow tank tests, an expensive and time consuming process. AcuSolve has proven that CFD can be used to replace or supplement some tow tank testing thus providing rapid solutions and the opportunity for exploratory studies.
- Suppressing “moon pool” motions, tank sloshing and related internal/external flow problems.
- Vortex induced vibration (VIV) of risers and other structures ranging from buoys to jumpers and transfer lines, and wind induced vibration of above-deck structures. In particular, engineers must often decide whether or not to use costly strakes or fairings on these structures. Until recently, the fatigue design analysis of long risers depended on simple heuristic models and associated software. Recent solutions using AcuSolve, however, demonstrated that fluid/structure interaction (FSI) modeling of long risers is feasible and promises to predict riser VIV from first principals.
- Heat transfer and cooling problems including natural convection.
- The dispersion of smoke plumes, pollutants and such.
- Analyzing complex flows through riser arrays, such as the case of risers located in the truss section of a truss spar. It is especially difficult to predict and correct VIV response using traditional tools that were meant to analyze single risers rather than riser arrays. AcuSolve again demonstrated that CFD can be used as part of the design process within the workflow of a typical oil industry project.

The successes of computational fluid dynamics in offshore will continue propel the use of CFD in the overall Oil and Gas exploration and production (E&P) industry. ACUSIM will continue to be on the forefront of this industry to provide a technology leading and versatile CFD solution to solve more and more applications in this field.



Riser VIV Simulation with L/D=1400.

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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