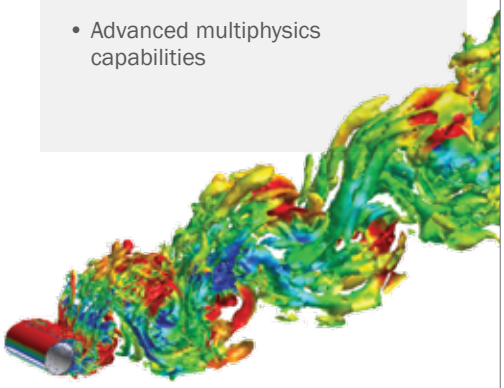
Altair® AcuSolve®

When Flow Matters

Altair AcuSolve is a leading general-purpose Computational Fluid Dynamics (CFD) solver that is capable of solving the most demanding industrial and scientific applications. AcuSolve's robust and scalable solver technology empowers users by providing unparalleled accuracy on fully unstructured meshes. Applications ranging from steady RANS simulations to complex, transient, multiphysics simulations are handled with ease and accuracy.

Product Highlights

- Unparalleled accuracy on fully unstructured meshes
- Insensitivity to element quality and topology
- Fast and efficient transient and steady-state solutions
- Excellent scalability and parallel efficiency (3000+ computing cores)
- Advanced multiphysics capabilities



Isosurface of Turbulent Structure From Large Eddy Simulation (LES) of Flow Over a Smooth Cylinder at Re = 140,000.

AcuConsole – A Powerful GUI-Based Pre-Processor

AcuSolve comes with a powerful yet easy to use GUI-based pre-processor, AcuConsole™. It has a built-in mesh generator which operates on most 3D CAD models. It also allows users to import an existing mesh in various formats. Through an intuitive menu structure, AcuConsole helps the user fully set up a problem, generate an input file, and launch AcuSolve. CAE automation is available through the Python scripting language, allowing users to customize menus and functions for specific applications.

Advanced Technology, Accurate Results

AcuSolve is based on the Galerkin/Least-Squares (GLS) finite element method. GLS is a higher-order accurate, yet stable formulation that uses equal order nodal interpolation for all variables, including pressure. The method is specifically designed to maintain local and global conservation of relevant quantities under all operating conditions and for all meshes.

In addition to excellent spatial accuracy, AcuSolve has a second-order time integration option. Since AcuSolve obtains rapid nonlinear convergence within each time step, temporal accuracy is achieved in practice.

AcuSolve has a very rich mathematical foundation, translating into superb numerical behavior. AcuSolve can easily solve the largest and most complex mission critical industrial problems.

Robust Solution

AcuSolve typically solves a given problem in the first attempt. Fully converged solutions are reliably obtained using AcuSolve's efficient steady-state solver. Nonlinear convergence remains strong even as solutions approach their final result.

Two key components contribute to this robustness: the GLS finite element formulation, and a novel iterative linear equation solver for the fully coupled pressure/velocity equation system.

This powerful iterative solver is highly stable and is capable of efficiently handling unstructured meshes with high aspect ratios and badly distorted elements commonly produced by fully automatic mesh generators. This linear solver yields significant stability and convergence advantages over the segregated solution procedures commonly found in many commercial incompressible flow solvers.

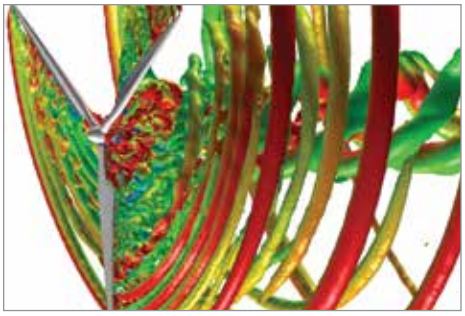
High Speed, Parallel Performance

AcuSolve achieves fast solutions via three mechanisms:

- Solution of the fully-coupled pressure/velocity equation system, which yields significant linear and nonlinear convergence speed.
- Architected from the ground up for vector and cache-based super-scalar computers.
- All algorithms are designed for multi-core parallel clusters, using a hybrid distributed/shared-memory (MPI/OpenMP) parallel model. The parallelization is completely transparent to end users.

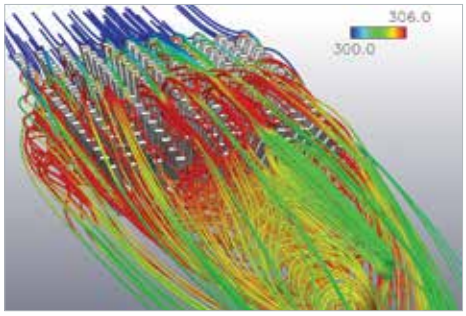
AcuSolve Simulation Features and Functionality

- **Conservative Equations in 3D**
  - Incompressible & weakly compressible Stokes and Navier-Stokes equations
  - Thermal analysis and conjugate heat transfer
  - Multi-layered thermal shell equations
  - Multi-species transport equations
  - Viscoelastic material modeling



Wind Energy: Turbulent Flow in the Wake of a Three-bladed Wind Turbine Rotor

Automotive: Fluctuating Pressure on Automotive Exterior



Electronic Cooling: Thermal Flow Solution of a Diverging Fin Heat Sink

- **Radiation**
  - Gray body enclosure radiation
  - View-factor computation (in parallel)
  - Solar radiation model
- **Turbulence Models**
  - Direct Numerical Simulation (DNS)
  - Large Eddy Simulation Models (Smagorinsky and Dynamic sub-grid scale)
  - Hybrid RANS/LES (DES, DDES, IDDES and SST-DES) models
  - One- and two-equation RANS model (Spalart-Allmaras, SST & k-omega)
- **Moving Mesh Simulation Technology**
  - Arbitrary Lagrangian Eulerian (ALE) technology
  - Flexible mesh movement
  - Free surface simulation
  - Guide surface technology
  - Sliding mesh technology
  - Specified mesh motion
  - Non-conformal mesh interfaces
- **Powerful User-Defined Function (UDF) Capability**
  - Allows definition of material models, source terms, boundary conditions, etc.
  - Client-server interface with external programs
- **Component Technology**
  - Fan component
  - Heat exchange component
- **Multiphysics Capabilities**
  - Rigid body dynamics coupling
  - Practical Fluid/Structure Interaction (P-FSI)
  - Direct-Coupled Fluid/Structure Interaction (DC-FSI)
  - Direct-Coupled with Multi-body dynamics software MotionSolve®
- **Computational Aero Acoustics (CAA) Simulations**
  - Integrated Ffowcs-Williams-Hawkings acoustic solver
  - Support for 3rd party acoustics solver
- **Unstructured Mesh Support**
  - 4-node tetrahedron, 5-node pyramid, 6-node wedge, 8-node brick, and 10-node tetrahedron elements
- **Highly Effective Solver Technology**
  - Novel and highly efficient iterative solver for fully coupled pressure/velocity equation systems
  - Fully coupled temperature/flow iterative equation solver
  - Fully parallel on shared and distributed memory machines, transparent to the user
- **Particle Tracer**
  - Fast and accurate parallelized particle tracer
  - Laminar and turbulent diffusion
  - Finite mass and massless particle tracing
  - Bi-directionally coupled

AcuConsole Features and Functionality

- **Build Simulations from CAD or Mesh**
  - Import geometry from PTC Pro/ENGINEER, Parasolid, ACIS, Discrete, Dassault Catia V5
  - Import mesh from Altair HyperMesh, ANSYS ICEM-CFD, MSC FluidConnection, Pointwise
- **Generate Mesh from CAD**
  - Automatic tet mesher
  - Robust boundary layer meshing capabilities
  - Full mesh size control on surfaces, volumes and arbitrary zones
  - Advanced extrusion and periodic meshing capabilities
- **Set up Entire Problem within GUI Environment**
  - Intelligent default settings simplify user set-up
- **Launch Solver**
  - Interactive or batch processing
  - Progress monitors provide real-time feed back
- **Interface Directly with Visualization Packages**
  - AcuFieldview, FieldView and EnSight
- **Customize for Easy Deployment**
  - CAE automation

AcuFieldView

Industrial Strength and World Class Post-Processor

AcuSolve comes equipped with a powerful post-processing solution AcuFieldView. AcuFieldView is an OEM version of Intelligent Light's class-leading FieldView CFD post-processor that furnishes the ability to manage large and complex CFD data visualization requirements. It incorporates Intelligent Light's most recent advancements in FieldView, including a new codebase that produces optimized graphics performance and a common graphical user interface (GUI) on all platforms.

Supported Platforms

- Windows XP/Vista/Windows 7 (32 & 64 bit)
- Windows HPC Server 2008
- Linux (x86-64, NVIDIA Tesla GPGPUs)

Altair

1820 E. Big Beaver Rd., Troy, MI 48083-2031 USA
Phone: +1.248.614.2400 • Fax: +1.248.614.2411
www.altair.com • info@altair.com

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