



ANSYS CFX-Flo 11.0

Using ANSYS CFX-Flo software, ANSYS customers achieve new heights in product innovation no matter what level of computational fluid dynamics (CFD) is required in their design processes.

ANSYS CFX-Flo software delivers:

- ▶ The power of the ANSYS® CFX® CFD software package
- ▶ A single environment for your simulation from start to finish
- ▶ Geometry modeling with bi-directional associative CAD
- ▶ Quick setup wizard
- ▶ Ability to perform fast design iterations
- ▶ Capabilities to help understand designs
- ▶ The means to share designs with others
- ▶ Scalable access to even more capabilities

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Simulation-Driven Design via ANSYS® Workbench™ Parameter Manager

- Enables setup of a series of simulations to study the operating range of the product or process
- Compare several alternative designs
- Vary geometry and physics description
- Automatic calculation of performance metrics

Automated Report Generation

- Report generation (comments, figures, charts, tables)
- Report templates can be established that include all charts, tables, figures and then re-used for each design to allow easy comparison of design alternatives.
- HTML report export

CFD Mesh Capabilities

- ▶ Automated mesh update with geometry updates
- ▶ Tetra and prism volume meshing
- ▶ Hex-dominant
- ▶ Sweep
- ▶ High-quality boundary layer meshing
- ▶ Body and part suppression for meshing
- ▶ Virtual topology
- ▶ Surface curvature sensitive meshing
- ▶ Automated 3-D proximity refinement
- ▶ Mesh morphing from prescribed surface or volume motion

CFD Physics Pre-Processor

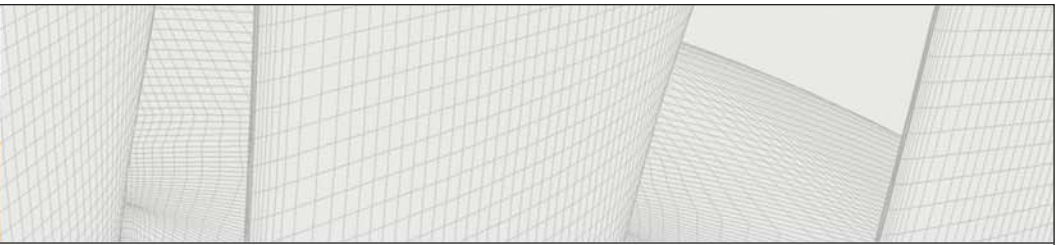
- ▶ Quick setup wizard
- ▶ Import of meshes from a wide variety of sources/formats, including: ANSYS, ANSYS® ICFM CFD™, I-DEAS® Universal, Patran Neutral, Nastran®, CGNS and others
- ▶ Transform and connect multiple meshes using the generalized grid interface
- ▶ Intuitive problem definition
- ▶ Flexible fluids editor, including common fluids library
- ▶ Visualization of boundary conditions
- ▶ Context sensitive online user documentation with hyperlinks

Boundary conditions

- Inlet: mass flow, velocity, static pressure, total pressure, supersonic, mixed sub/supersonic
- Outlet: mass flow, velocity, uniform pressure, average pressure, supersonic, meridional pressure profile, zero gradient condition
- Opening (mixed flow): velocity, static pressure, total/static pressure
- Wall: no slip, slip, rough, moving, adiabatic, temperature-specified, heat flux, heat transfer coefficient
- Symmetry, periodic pair, thin surfaces
- 1-D or 2-D profile specifications for any quantity

CFD Modeling Capabilities

- ▶ Solution on any mixture of tetrahedral, hexahedral, prism and/or pyramid elements
- ▶ Incompressible/compressible — subsonic, transonic, supersonic
- ▶ Steady state/transient
- ▶ Laminar/turbulent
- ▶ Rotating or stationary frame of reference
- ▶ Alternate rotation model to minimize false swirl in rotating components
- ▶ Turbulence models
 - Zero-equation turbulence
 - k - ϵ , RNG k - ϵ , k - ω
 - Shear stress transport
 - k - ω Reynolds stress
 - Scalable wall functions
 - Automatic near-wall treatment including integration to the wall
- ▶ Heat transfer
 - None, isothermal, thermal energy or total energy
 - Viscous heating
 - Conjugate heat transfer
 - Natural convection
 - Radiation
 - Discrete transfer radiation model
 - P1 (diffuse) radiation model
 - Rosseland radiation model
- ▶ Newtonian and non-Newtonian fluids
- ▶ User-defined equations and species transport
 - Advective/diffusive transport



- Poisson equation
- Scalar and vector algebraic additional variables
- Flexible properties
- Ideal gas equation of state
- Redlich–Kwong equation of state
- User-defined properties through expressions or user Fortran
- Antoine equation for vapor pressure curves of pure substances.
- Kinetic theory viscosity and thermal conductivity models including Sutherland's Law, modified Eucken and non-interacting sphere models
- Equilibrium real gas thermodynamics
- Real gas properties can be provided via tables or expressions for equation of state and Cp definition
- Wetness model
- Tables for steam and R134a provided
- Multi-component fluids
- Algebraic slip multiphase model
- ▶ Free surface modeling
 - Compressive discretization for sharp free surface interfaces
 - Surface tension
- ▶ Rayleigh–Plesset cavitation model
- ▶ Noise modeling: export of surface and rotating dipole sources for acoustics solvers
- ▶ Volumetric porosity with sharp interface capture
- ▶ Linear and quadratic resistance models
- ▶ User-defined volumetric sources of mass, momentum, energy and species
- ▶ User-defined boundary sources of mass, momentum, energy and species
- ▶ Solution-based mesh adaptation

Numerics

- ▶ Conservative finite element based control volume method
- ▶ Implicit, pressure-based algorithm for all flow speeds, incompressible to compressible
- ▶ Advection modeling
 - High-resolution bounded discretization
 - Upwind differencing scheme
 - 1st- and 2nd-order blend factor
- ▶ 1st- and 2nd-order transient discretization with adaptive transient time-stepping

Fluid Structure Interaction

- Transfer of force and thermal results to ANSYS stress analysis

CFD Post-Processing

The CFX post-processor provides a powerful and flexible analysis system for ANSYS CFX results. Its capabilities are summarized below.

Graphics Capabilities

- ▶ Reads results in ANSYS CFX or CGNS formats
- ▶ Data comparison over multiple results
- ▶ Interactive point picking for plane and point regions
- ▶ Multiple viewer windows
- ▶ Pre-defined and user-defined views
- ▶ Scene clipping
- ▶ Image output to postscript, jpeg, png, bmp, ppm and vrmf
- ▶ Regions
 - Points
 - Slice planes (unbounded and bounded)
 - Uniform point sampling
 - Circular and rectangular sample planes
 - Isosurfaces
 - Surface or revolution
 - Boundaries
 - Volumes from Iso-values, sphere, surface intersection.
 - Lines and polylines (2-point, external data or boundary/slice intersection)
 - Surface groups
 - Offset surfaces
 - User surfaces from external data
- ▶ Plots (on any region)
 - Coloring by variables
 - Contours/fringes
 - Streaklines and surface streaklines
 - Vectors
 - XY graphs
 - Rendering control of faces, lines, lighting, transparency and texture mapping
- ▶ Annotations
 - Legends
 - 2-D and 3-D text labels
- ▶ Animation
 - Quick animation of key graphics objects
 - Detailed key-frame animation
 - Automated MPEG creation
- ▶ Quantitative calculations
 - Node count, mass flow, length, area and volume evaluation
 - Length, area, volume and mass flow-based averaging and integration
 - Force and torque calculation

- Support of all above functions in expressions
- Expression evaluation
- User-defined variables
- Configurable units specification
- Data export
- Quantitative tables in a spreadsheet-like environment
- ▶ User Interface
 - Session recording and playback
 - State save and restore
 - Batch processing
 - Unlimited undo and redo
 - Automatic region recalculation after reload
 - Context-sensitive help
 - Object picking and dynamic highlighting
 - Detailed object control with context-sensitive viewer interaction
 - Interactive data probe

Platform support

UNIX® Workstations

- ▶ Hewlett-Packard PA-RISC
- ▶ SUN® UltraSPARC running Solaris™ 9 or 10

32- or 64-Bit Windows® and Linux®

- ▶ 32-bit Windows® 2000 or XP, Windows® XP64
- ▶ RedHat® Enterprise Linux® 3 or 4
- ▶ SuSE® Professional Linux® 9 or 10
- ▶ SLES 9