FLOW-3D Version 10.0 Features

Meshing & Geometry

- Finite element meshes for solids
- Structured finite difference/control volume meshes
- Multi-Block gridding with nested & linked blocks
- Fractional areas/volumes (FAVOR™) for efficient & accurate geometry definition
- Basic Solids Modeler
- Import CAD data
- Grid & geometry independence
- Cartesian or cylindrical coordinates
- Unstructured Memory Allocation

Flow Type Options

- Internal, external & free-surface flows
- 3D, 2D & 1D problems
- Transient flows
- Inviscid, viscous laminar & turbulent flows
- Non-inertial reference frames
- Multiple scalar species
- Two-phase flows
- Heat transfer with phase change
- Saturated & unsaturated porous media

Flow Definition Options

- General initial and boundary conditions
  - Symmetry
  - Rigid and flexible walls
  - Continuative
  - Periodic
  - Specified pressure
  - Specified velocity
  - Outflow
  - Grid overlay
  - Hydrostatic pressure
  - Volume flow rate
  - Non-linear periodic and solitary surface waves
- Restart from previous simulation
  - Continuation of a simulation
  - Overlay boundary conditions
  - Change mesh
  - Change model parameters

Thermal Modeling Options

- Natural convection
- Forced convection
- Conduction in fluid & solid
- Fluid-solid heat transfer
  - Conduction
  - Specified heat flux
  - Specified solid temperature
- Distributed energy sources/sinks in fluids and solids
- Radiation
- Viscous heating

Numerical Modeling Options

- TruVOF Volume-of-Fluid (VOF) method for fluid interfaces
- First and second order advection
- Sharp and diffuse interface tracking
- Implicit & explicit numerical methods
- GMRES, point and line relaxation pressure solvers
- User-defined variables, subroutines & output
- Utilities for runtime interaction during execution

Fluid Modeling Options

- One incompressible fluid – confined or with free surfaces
- Two incompressible fluids – miscible or with sharp interfaces
- Compressible fluid – subsonic, transonic, supersonic
- Stratified fluid
- Acoustic phenomena
- Mass particles with variable density or diameter

Shallow Flow Models

- Shallow water model
- General topography
- Wetting & drying
- Wind shear
- Ground roughness effects
- Laminar & turbulent flow

Physical Modeling Options

- Fluid structure interaction
- Thermal stress evolution
- Sediment scour deposition & bedload transport
- Cavitation
- Phase change (liquid-vapor, liquid-solid)
- Surface tension
- Thermocapillary effects
- Wall adhesion
- Wall roughness
- Vapor & gas bubbles
- Solidification & melting
- Mass/momentum/energy sources
- Shear, density & temperature-dependent viscosity
- Thixotropic viscosity
- Visco-elastic-plastic fluids
- Elastic membranes & walls
- Evaporation residue
- Electric field
- Dielectric phenomena
- Electro-osmosis
- Electrostatic particles
- Electro-mechanical effects
- Joule heating
- Air entrainment
- Molecular & turbulent diffusion
- Temperature-dependent material properties
- Granular flow
- Moisture drying
- Solid solute dissolution

Advanced Physical Models

- General Moving Object model with 6 DOF–prescribed and fully-coupled motion
- Rotating/spinning objects
- Collision model
- Tethered moving objects
- Flexing membranes and walls

Chemistry Models

- Stiff equation solver for chemical rate equations
- Stationary or advected species

FLOW-3D Version 10.0 Features

Metal Casting Models

- Solidification & melting
- Solidification shrinkage with interdendritic feeding
- Micro & macro porosity
- Binary alloy segregation
- Thermal die cycling
- Thermal stress & deformations
- Surface oxide defects
- Cavitation potential
- Lost-foam casting
- Semi-solid material
- Iron solidification
- Sand core blowing
- Sand core drying
- Permeable molds
- Core gas generation
- Back pressure & vents
- Shot sleeves
- Air entrainment
- Temperature-dependent material properties

Porous Media Models

- Saturated and unsaturated flow
- Variable porosity
- Directional porosity
- General flow losses (linear & quadratic)
- Capillary pressure
- Heat transfer in porous media
- Linear & quadratic flow losses
- Van Genunchten model for unsaturated flow

Discrete Particle Models

- Massless marker particles
- Mass particles of variable size/mass
- Linear & quadratic fluid-dynamic drag
- Monte-Carlo diffusion
- Particle-Fluid momentum coupling
- Coefficient of restitution or sticky particles
- Point or volumetric particle sources
- Charged particles
- Probe particles

Turbulence Models

- RNG model
- Two-equation $\kappa-\varepsilon$ model
- Large eddy simulation

Two-Phase & Two-Component Models

- Liquid/liquid & gas/liquid interfaces
- Variable density mixtures
- One compressible fluid with a dispersed incompressible component
- Drift flux
- Two-component, vapor/non-condensable gases
- Phase transformations for gas-liquid & liquid-solid
- Adiabatic bubbles
- Bubbles with phase change
- Continuum fluid with discrete particles
- Scalar transport
- Homogeneous bubbles

Coupling with Other Programs

- Geometry input from Stereolithography (STL) files – binary or ASCII
- Geometry input from ANSYS or I'DEAS tetrahedral data
- Direct interfaces with EnSight®, FIELDVIEW® & Tecplot® visualization software
- PLOT3D output
- Neutral file output
- Extensive customization possibilities
- Topographic data input
- Solid Properties Materials Database

Data Processing Options

- Automatic or custom results analysis
- High-quality OpenGL-based graphics
- Color or B/W vector, contour, 3D surface & particle plots
- Moving history & probe data
- Force & moment computations
- Animation output
- PostScript, JPEG & Bitmap output
- Streamlines
- Flow tracers

User Conveniences

- Mesh & initial condition generators
- Automatic time-step control for accuracy & stability
- Automatic convergence control
- Mentor help to optimize efficiency
- Change simulation parameters while solver runs
- Manage & launch multiple simulations
- Automatic simulation termination based on user-defined criteria

Supported Platforms

Processors

- x86-64 (Intel/AMD)

Operating Systems

- 32-bit Windows XP/Vista/7
- 64-bit Windows XP/Vista/7 & Server 2003/2008
- 32-bit Redhat Enterprise 4 and 5
- 64-bit Redhat Enterprise 4 and 5 & SUSE Enterprise 10 and 11

Hardware Requirements

The hardware requirements to run ***FLOW-3D*** depend on the size of the computational grid and number of active physical models. An iso-thermal, inviscid simulation requires roughly 1GB of memory for 2.5 million computational cells in double precision. Activating turbulence & heat transfer increases the memory requirements by about 30%. A single precision solver reduces the memory requirements by roughly 40%.