FLOW-3D Version 9.4 Features

for the Water & Environmental Industry

Meshing & Geometry

- Structured finite difference/control volume meshes
- Multi-Block Gridding with:
  - Nested blocks
  - Linked blocks
- Fractional areas/volumes (FAVOR™) for efficient & accurate geometry definition
- Solids Modeler
- Imports STL CAD files
- Grid & geometry independence

Flow Type Options

- Internal, external & free-surface flows
- Three, two & one dimensional simulations
- Transient flows
- Cartesian or cylindrical meshes
- Inviscid, viscous, laminar & turbulent flows
- Multiple scalar species
- Multi-phase flows
- Evaporation
- Saturated & unsaturated porous media

Thermal Modeling Options

- Natural convection
- Forced convection
- Conduction in fluid & solid
- Fluid-solid heat transfer
  - Conduction
  - Specified heat flux
  - Specified solid temperature
- Heat transfer to voids from fluid/obstacles
- Distributed energy sources/sinks in fluids or solids
- Radiation by emissivity
- Temperature-dependent material properties

Numerical Modeling Options

- **TruVOF** – Volume-of-Fluid method for fluid interfaces
- First, second or third order advection
- Sharp fluid interface tracking
- Implicit & explicit numerical options
- Point, line relaxation & GMRES pressure solvers
- User-defined variables, subroutines & output
- On-the-fly simulation changes

Flow Definition Options

- General initial and boundary conditions
  - Symmetry
  - Rigid walls
  - Continuative
  - Periodic
  - Specified pressure
  - Specified velocity
  - Outflow
  - Grid overlay
  - Hydrostatic
  - Custom
  - Volume flow rate
  - Linear and non-linear surface waves
- Simulation restart options
  - Continuation of a simulation
  - Overlay boundary conditions from a previous simulation
  - Change mesh
  - Add, delete or change model parameters, numerical methods

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

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 programs
- PLOT3D output
- Neutral file output
- Extensive customization possibilities
- Topographic data

Supported Platforms

Processors

- x86-32 (Intel Pentium/Xeon, AMD Athlon/Opteron)
- x86-64 (Intel Pentium/Xeon/Core, AMD Athlon/Opteron)

Operating Systems

- 32-bit Windows XP/Vista/7
- 64-bit Windows XP/Vista & Server 2003/2008
- 32-bit Redhat Enterprise 3.0+
- 64-bit Redhat Enterprise 3.0+ & SUSE Enterprise 9.0+

Hardware Requirements

The hardware requirements to run ***FLOW-3D*** depend on the number of physical models active during the simulation. 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%.

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Water & Environmental Models

- Multi-sediment scour & bedload transport
- Scour potential
- Air entrainment
- Chemistry
- Scalar transport
- Screens
- Cavitation
- Melting, evaporation, freezing
- Wall roughness
- Vapor bubbles
- Chemical reactions
- Mass/momentum/energy sources
- Molecular & turbulent diffusion
- Particle/tracers

Results Analysis

- Automatic or custom graph requests
- Interactive OpenGL-based graphics (grid overlay optional)
- Color or B/W vector, contour, 3D surface & particle plots
- Moving history & probe data
- Force & moment computations
- Animation output
- PostScript, JPEG & Bitmap output
- Streamlines, streaklines & flow ribbons
- STL geometry viewer

Hydraulics Data Output

- Fluid residence time
- Fluid elevation
- Fluid depth
- Froude number
- Dynamic viscosity
- Distance travelled by fluid
- Fluid vorticity
- Depth-averaged velocity
- Velocity at an offset from the bottom
- Excess surface stress
- Total hydraulic head

Two-Phase & Two-Component Models

- Liquid/liquid & gas/liquid interfaces
- Two-fluid mixtures
- One compressible fluid with a dispersed incompressible component
- Two-component drift-flux
- Two-component, vapor/non-condensible gases
- Phase transformations for gas-liquid & liquid-solid
- Adiabatic bubbles
- Bubbles with phase change
- Continuum fluid with discrete particles

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

- Prandtl mixing length
- One-equation transport
- Two-equation κ–ε model
- RNG model
- Large eddy simulation

Porous Media Models

- Variable porosity
- Directional porosity
- General flow losses (linear & quadratic)
- Capillary pressure
- Unsaturated flow
- Porous baffles & filters with linear & quadratic flow losses

Fluid Structure Interaction

- General Moving Object model
  - 6 Degrees of Freedom–user specified motion
  - Fully-coupled with fluid flow
- Tainter gates
- Collision model
- Moving assemblies
- Tethered moving objects (springs & ropes)
- Flexible membranes and walls
- Wave generators/harvesters

Shallow Flow Models

- Shallow water model
- General topography
- Wind shear
- Surface roughness effects

User Conveniences

- Mesh & initial condition generators
- Automatic time-step control for accuracy & stability
- Automatic limited compressibility
- Convergence control
- Simulation mentor optimizes efficiency
- Change solution parameters as solver runs
- Manage & run multiple simulations
- Automatic termination of simulations based on user-defined criteria

Chemistry Models

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