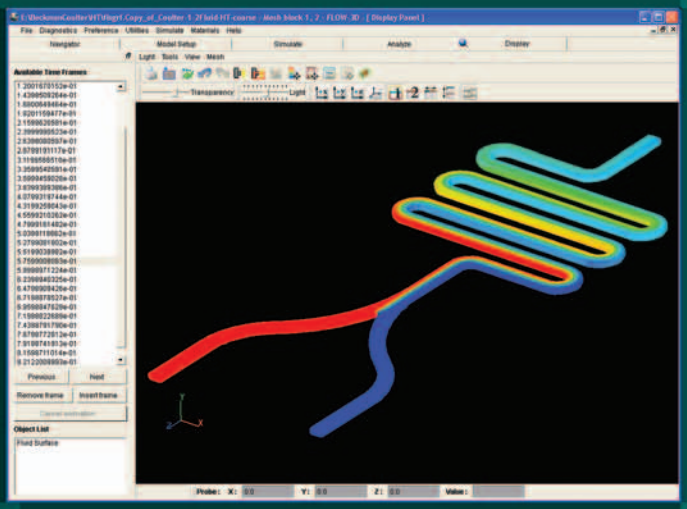
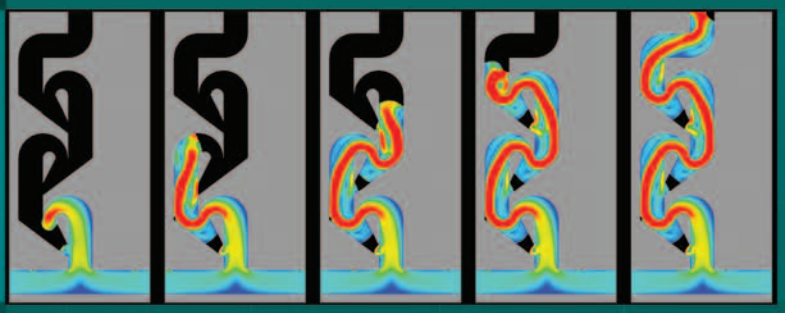


FLOW-3D

Powerful computational fluid dynamics software for accurate fluid modeling



MICROFLUIDICS

Easy-to-use CFD sofware to design and optimize your microfluidics projects

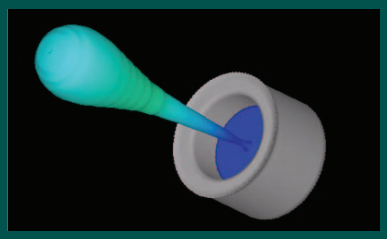
- **Design using a robust multi-physics package**
- **Accurately track free-surface flows**
- **Model a wide range of microfluidic processes**
- **Set up simulations quickly**
- **Make iterative design modifications**
- **Reduce R&D and production costs**

FLOW Science
1980 - 2010

Improving the world through accurate flow modeling

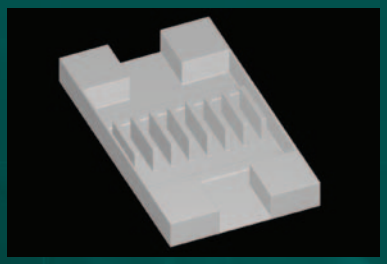
Advanced Modeling Features

TruVOF



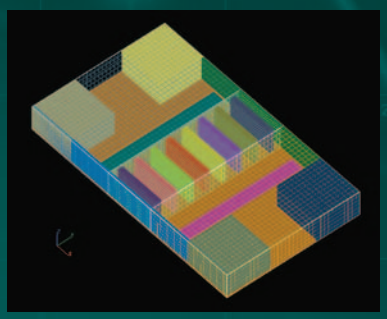
FLOW-3D's **TruVOF** technique allows for accurate representation of moving liquid fronts.

FAVOR™



With **FAVOR™**, a simple structured grid results in a well-resolved geometry. ***FLOW-3D*** can be used to accurately and efficiently simulate flow in complex microchannels, chambers and other devices.

Multi-Block



With Multi-Block meshing capabilities in ***FLOW-3D***, you can easily and efficiently capture complex geometries and apply varying degrees of resolution for sharper modeling.

FLOW-3D
from
FLOW Science

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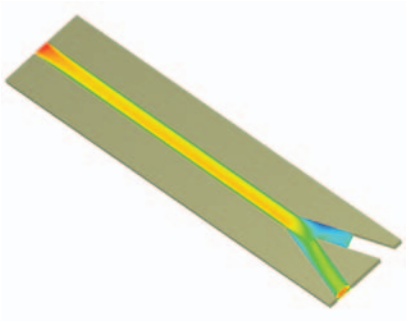
More Precise Simulation

Optimize and easily vary your designs with ***FLOW-3D***, a powerful computational fluid dynamics software for highly accurate flow modeling. This easy-to-use software takes the trial and error out of microfluidic designs with advanced small-scale modeling techniques.

FLOW-3D applies unique modeling principles that differentiate it from other applications and provides accurate results.

Microswitch

Centrifugal microfluidic devices like micro-switches make use of centrifugal and Coriolis effects to manipulate fluids at the micro-scale. ***FLOW-3D***, with its non-inertial reference frame and surface tracking algorithms, can help optimize the design of such devices, including the capillary burst valve.

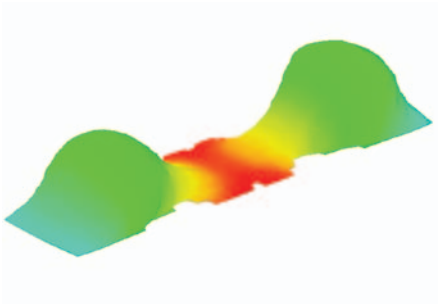


Taylor Cones

Electric fields can distort liquid drops and produce a thin liquid jet emanating from a drop. Referred to as Taylor cones, these jet flows are used for a wide variety of applications that require a stream of more-or-less uniform droplets having an electric charge.

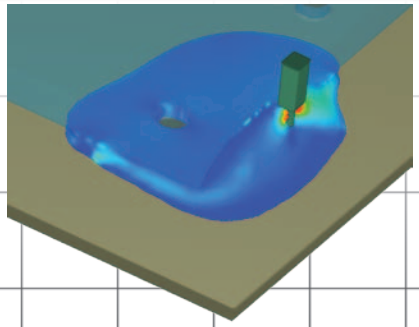
Lab-on-a-Chip

Droplet manipulation in lab-on-a-chip application can be simulated by defining the electrical characteristics of the fluids and surrounding solids and then manipulating the liquid flow through time-dependent electric fields.



Chip Packaging

Resins with complex rheologies are used to under fill a chip and bind it to a substrate. This process, along with the precise movement of dispensers, can be simulated using ***FLOW-3D***'s multiphysics models. This ensures good packing without voids and superior structural integrity.



Designed for Exceptional Accuracy

Dielectrophoresis & Electrophoresis

Microfluidic systems make use of electrical phenomenon such as electrophoresis and dielectrophoresis to manipulate small volumes of fluid. ***FLOW-3D***'s electro-mechanics model coupled with its Navier-stokes solver can accurately account for these electrical interactions on fluid and particles.

Joule Heating

FLOW-3D's joule heating model simulates heat generation in fluids or solids due to the resistance of a material to the flow of electric current. Many different solid materials can be created, each with distinct electrostatic properties, which allows complex systems to be designed.

Discrete Particle Dynamics

Massless tracer particles provide detailed information on fluid flow pattern without affecting fluid motion. The motion of dispersed particulate matter, coupled with fluid, such as dust, liquid droplets or gas bubbles, can be simulated using ***FLOW-3D***'s mass particle model, where particles can vary by size and material density.

Fluid-Structure Interaction

FLOW-3D's general moving objects (GMO) model allows users to simulate rigid body dynamics with six-degrees-of-freedom, fully coupled with fluid flow. A range of motion constraints, including fixed-axis translations and rotations, applied forces and torques, and prescribed velocities, provide the means to simulate flow in complex devices.

Non-Newtonian Fluid

FLOW-3D models fluids with non-Newtonian viscosities that are strain and/or temperature dependent. Shear and temperature dependent viscosities are described with either Carreau or the power law models. Time-dependent or thixotropic behavior, characteristic of some polymers and semi-solid metals, can also be simulated.

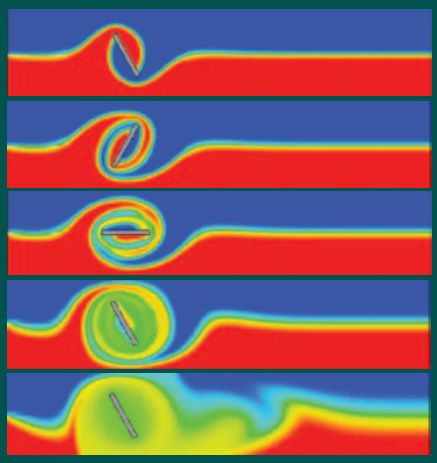
Flexing Wall Model

Fluid flow in long micro-channels can cause the channel walls to deform, which in turn can affect the fluid flow. The flexing wall model allows ***FLOW-3D*** users to efficiently simulate these interactions.

> "I have been using ***FLOW-3D*** for 15 years as the primary theoretical tool in design optimization work on drop-on demand type inkjet printheads. I have found its free-surface modeling capabilities ideally suited for simulating the ligament formation process, and for studying other important free-surface problems such as wetting and priming."
>
> ***Charlie Willus***, *Member, Technical Staff, Ricoh*

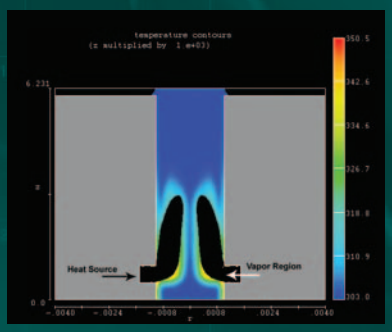
Advanced Modeling Features

Active Micromixer



Microscale fluid mixing is crucial and challenging for microfluidic system applications. Active and passive micromixers aim to achieve maximum mixing efficiency in the least amount of distance and time. ***FLOW-3D*** can model molecular and eddy diffusion for different complex mixer geometries to achieve efficient and optimal design.

Phase Change



FLOW-3D's interface and free-surface tracking technology allows users to simulate multi-phase flows quickly and easily without complicated meshing procedures. ***FLOW-3D*** can also simulate evaporation and condensation at these surfaces.

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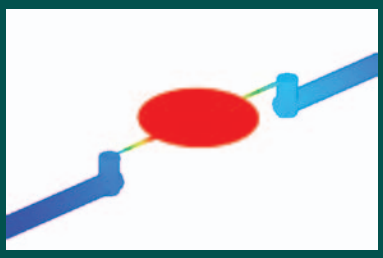
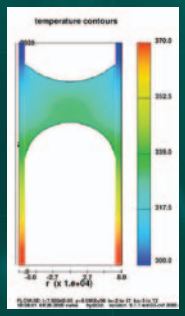
Elastic Membranes



An instantaneous pressure distribution of the piezoelectric pump system, which is calculated using the elastic membrane model.

Actuator controlled elastic membranes serve as flow driving elements in micro-flow applications such as inkjet printers and micropumps. ***FLOW-3D***'s elastic membrane model calculates the deformation of the elastic membrane in response to hydraulic and actuator forces.

The Marangoni Effect



Optical switch: A small mass of liquid moved in or out of the path of a light beam can redirect it by refraction or reflection into a different path. This simulation shows motion of a small drop of liquid placed in a micro-channel that intersects a fiber-optic light beam. The drop is moved by differentially heating its two sides. This causes changes in the surface tension in the menisci on either side of the drop, so that the drop is pulled (Marangoni effect) toward the cooler end of the channel.

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An All-Inclusive Application

From Model Setup to Simulation to Detailed Results Analysis

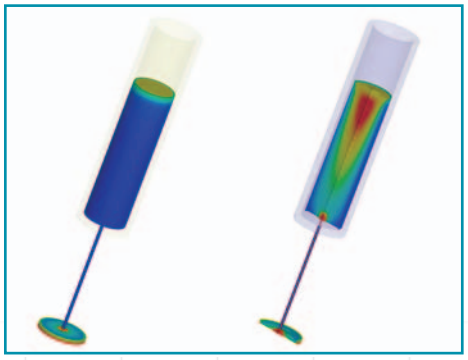
***FLOW-3D* includes all the functionality you need in one simple-to-use application, driven by an intuitive graphical user interface.** Easily set up a model and quickly mesh it through its graphical model builder, screen out model incompatibilities and configuration errors, and perform detailed analysis through extensive post-processing capabilities.

Flow Science, Inc.

For 30 years, Flow Science has been an innovator in flow modeling software, serving a global clientele of business, government and academic institutions.

Call **505-982-0088** or email **sales@flow3d.com** for more information about how ***FLOW-3D*** can enhance the reliability and quality of your microfluidics designs and help you reduce overall costs.

> "I would like to express my appreciation for the help that Flow Science's technical support team has provided to me over the last few years. They have promptly resolved all the issues that I have encountered, and their response has been both professional and insightful. They have saved me a great deal of time, and I cannot say enough good things about them."
>
> ***Edward P. Furlani, Ph.D****, Senior Principal Scientist, Eastman Kodak Research Laboratories*



Injection Modeling

*Velocity distribution of shear thinning fluid in an injection needle caused by plunger motion, which is simulated using **FLOW-3D**'s General Moving Object (GMO) model.*

FLOW Science 1980 2010 30 YEARS FLOW-3D

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