

BioMEMS & Microfluidics

Micro Total Analysis System (μ TAS) applications

A brave new world



Recent advances in BioMEMS and Microfluidics devices are set to foster a brave new world of nano-biology. As the field of bioMEMS and the development of microfluidic devices continue to expand so too does the physical and geometric complexity of these devices.

Developing cutting-edge technologies requires cutting-edge tools.

Unfortunately, most Computational Fluid Dynamics (CFD) tools available on the market were designed for either aircrafts or automobiles, or for flow in pipes. Designing a bioMEMS chip is tad different from designing plumbing. So why use code that is not optimized for bioMEMS and microfluidics?

Not your fathers' fluidics engine

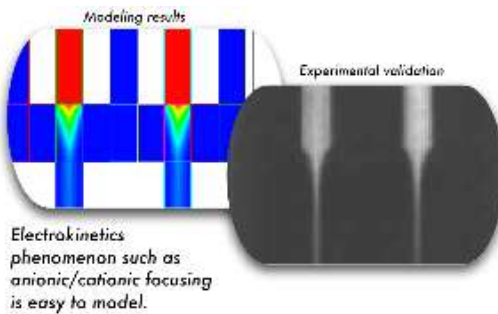
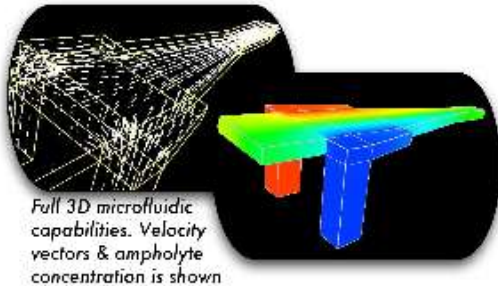
We created a full 3D Navier-Stokes solver optimized for microfluidic applications from the ground up. At the same time, we went way beyond the existing code bases by adding support for electrokinetic phenomena, Red-Ox reactions, acids, bases, ampholytes, and fluid-structure interaction.

To top it off, we added advanced visualization algorithms to look at cross sectional profiles, velocity vectors, and transient results. Our code base is not only faster at solving microfluidics problems but is the only MEMS tool for problems ranging from electrophoresis to isoelectric focusing. This module is fine tuned for real world bioMEMS.

What people are saying...

Network Biosystems is a Boston based company that develops large-scale bioMEMS systems. It's first product, BioMEMS 768, is an ultra-high throughput DNA sequencing system. Paul Pyzowski, the CEO of Network Biosystems remarked, "Fluidics code available on the market is not designed for bioMEMS. Correctly modeling nano-liter level reagent flow is incredibly difficult. IntelliSuite gets bioMEMS analysis right."

Dr. Vijay Mohan of **BigTec**, a company developing micro-scale assays for disease detection remarked, "We used IntelliSuite's microfluidics module for characterizing flow velocities, pressure distributions and mass transport phenomenon. It is stable, fast and simple to use, models can be modified and re-analyzed with just a few clicks. The exemplary performance of its tools resulted in accurate device simulations."



Application portfolio

Microfluidics

• Microvalves • Nozzles • Mixers • Fluid membrane interactions • Flapper valves • Membrane pumps

BioMEMS and Total Analysis Systems (μ TAS)

Capillary electroseparation
 μ -capillary zone electrophoresis (μ CZE)
 Dielectrophoresis
 Flow cyclometry
 μ -capillary iso-electric focusing (μ CIE)
 μ -capillary isotachophoresis (μ CI)
 Micromixers, T-sensors
 Reaction chambers
 Drug delivery systems
 Mixing in serpentine chambers
 Potentiostatic and galvanostatic applications

Array devices such as:

- DNA hybridization chips
- Proteomics on a chip
- Diffusion systems.

Feature highlights

Geometry creation and meshing

- Powerful, easy to use builder
- Structured computationally efficient bodyfitted-coordinate mesh
- Flexible mesh generation for complex geometries
- Flexible, hexahedral finite element mesh for fluid-structure interaction

Microfluidic solvers

- Multi-block finite volume solver for open/closed boundary flow incorporating multi-physics transport conservation.
- Finite element solver with deformable boundary tracking for fluid-structure interaction

Microfluidics and electrokinetics features

- Newtonian and non-newtonian fluids
- Steady state or transient analysis
- Generalized formulations for potentiostatic and galvanostatic scenarios
- Electrokinetics (including electroosmosis, electrophoresis and dielectrophoresis)
- Support for Acids, bases, and ampholytes
- Reaction kinetics of multi-valent analytes
- Fully coupled transport stoichiometry
- Strong and weak analytes
- Distributions solved exactly with no a priori approximations (pH, current, voltage, conductivity, ionic strength)
- Unique boundary conditions such as
 - Adsorption
 - Redox reactions at electrodes (Galvanostatic or potentiostatic formulations)
 - Specification of port voltages and zeta voltages.



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