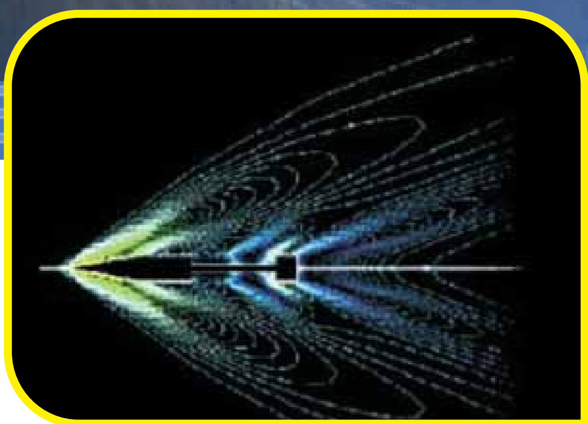
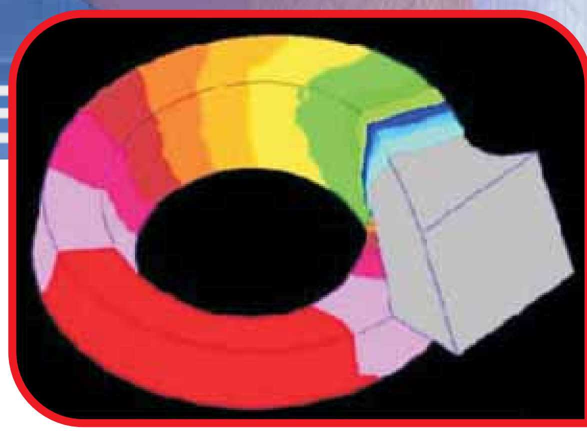
NISA - 3D-FLUID

Compressible and Incompressible





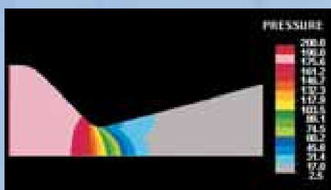
NISA/3D-FLUID is a general purpose finite element-based, computational fluid dynamics computer code for analyzing fluid flow and heat transfer problems.

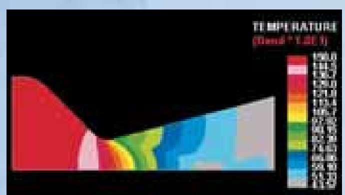
NISA - 3D-FLUID

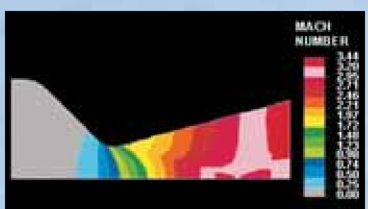
Compressible

FLOW SPEED RANGE

Gas flow from the low Mach number up to hypersonic speed can be easily analyzed using NISA/3D-FLUID. Problems involving hypersonic flows should be solved using multiple component gas flow equations to account for the real gas effect.







Compressible flow through a convergent - divergent nozel

ANALYSIS CAPABILITIES AND DOMAIN

Inviscid and viscous flow problems with or without chemical reactions can be simulated in 2D, axisymmetric and 3D arbitrary geometries. Quadrilateral and triangular elements can be combined in a planar domain whereas 3D domain can consist of a combination of hexahedron and wedge elements.

BOUNDARY CONDITIONS

NISA/3D-FLUID allows specification of two types of boundary conditions. The zero normal velocities at solid boundary are enforced internally for inviscid flow and for viscous, multicomponent flow problems, non-slip, non-catalytic boundary conditions at solid surface are imposed. The user can also specify flow variables such as density, temperature and its derivative, species mass fractions, and x, y, z momentums at any location in the computational domain.

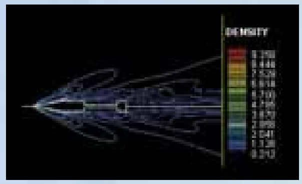
SOLUTION TECHNIQUE

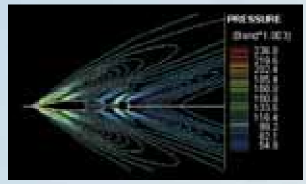
A two step Taylor Galerkin finite element method is employed. Matrix lumping technique is used to shift the numerical scheme into explicit form such that no matrix operations are involved during calculations. A local time step method is utilized for solving steady state problems.

through Navier-Stokes equations.

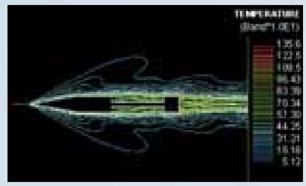
HEAT TRANSFER ANALYSIS

The solution of compressible flow equations always contains temperature as a variable and its value is obtained through the equation of state for gas or gas mixtures. Three sets of equations previously described solve convective heat transfer problems whereas the solution of heat conduction problems is obtained through Navier-Stokes equations.





Supersonic flow past a conical flying body with cavity at clyndrical section



STEADY STATE AND TRANSIENT ANALYSIS

The compressible flow program always solves the unsteady state governing equations. A constant time step size is used during numerical calculations for transient problems. A local time step technique can be used to accelerate convergence for steady state processes in which only the final steady state solutions have physical meaning.

MULTICOMPONENT MIXING AND CHEMICAL REACTION/ COMBUSTION

Mixing and combustion problems with multicomponents, multiple elementary reversible or irreversible chemical reactions are simulated by solving full Navier-Stokes equations and species continuity equations. The individual species mass fractions are determined in addition to the velocity, pressure and density of gas mixture to describe the flow field completely. A chemical kinetics program, CHEMKIN, and a transport property program, TRANSPORT, are used to assemble the chemical reaction mechanism and to evaluate the thermodynamic and transport properties of individual species and gas mixture accurately. Besides the solution for the standard Arrhenius form reaction, the solution for third body reactions, pressure-dependent fall-off reactions, and Landan-Teller reactions are also possible.

EQUATIONS SOLVED

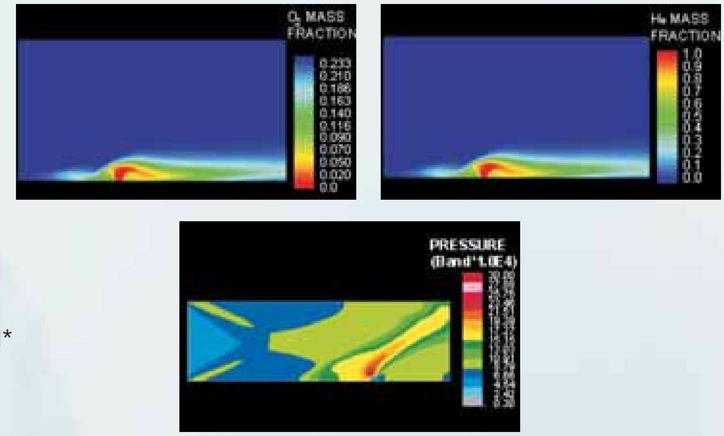
The compressible flow program solves three sets of equations:

- The Navier Stokes equation plus species continuity equations with or without chemical reactions for the mixing or the combustion of multiple species gas problems
- The compressible Navier Stokes equations for single component gas flow problems with viscous effects
- The Compressible Euler equations for single component inviscid gas flow problems

SUMMARY OF CAPABILITIES

- Subsonic, Transonic, Supersonic, and Hypersonic Flows
- Inviscid/Viscous Flow
- Steady/Transient Flow with Convective Heat Transfer
- Internal and External Flow
- Structured and Unstructured Grid
- Shock Wave Simulation
- Multicomponent, Chemically Reacting Flows with Mixing
- Combustion Simulations
- Chemical Kinetics and Thermodynamic Properties via CHEMKIN* Package
- Transport Properties via TRANSPOR* Package

* CHEMKIN and TRANSPOR and public domain programs developed by SANDIA National Laboratories, USA.



Transverse helium injection

NISA - 3D-FLUID

Incompressible

ANALYSIS CAPABILITIES AND DOMAINS

Laminar and turbulent flows with/without heat transfer analysis in internal and external domains can be conducted in 2D, 3D, and axisymmetric geometries. A choice of linear and higher order finite elements is available.

EQUATIONS SOLVED

3D-FLUID solves full Navier-Stokes, Continuity, and Energy equations using the finite element method. In addition, k-E equations are solved for turbulent flow and streamline upwind method is used to obtain stable solution at high Reynolds (or Peclet) numbers.

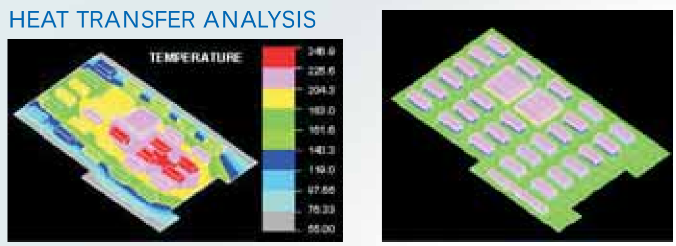
BOUNDARY CONDITIONS

Prescribed flow variable values or their gradients may be applied as boundary conditions. Spatially periodic boundary conditions can be applied to analyze flow fields with cyclic symmetry. No-slip boundary conditions at flow boundaries and at the fluid-solid interface, and the wall functions for turbulent flow can be included automatically.

SOLUTION TECHNIQUES

A choice of efficient direct (Frontal) and iterative solver is currently available. Iterative solver is being updated to reflect state-of-the-art methodology.

HEAT TRANSFER ANALYSIS



Cooling of a PCB

- Forced convective heat transfer in the presence of fluid flow in a weakly coupled analysis
- Free convective heat transfer and fluid flow resulting in a strongly coupled analysis
- Conduction heat transfer analysis
- Heat transfer due to surface radiation and view factors computed internally
- Specification of heat flux, convective and radiative boundary conditions on the domain boundaries
- Heat sources (sinks) specified within the domain

VARIABLE MATERIAL PROPERTIES

Temperature dependent material properties can be given in tabular and/or polynomial form.

CHOICE OF STEADY STATE OR TRANSIENT ANALYSIS

Transient and steady state analyses can be performed by choosing time step sizes and relaxation parameters, respectively.

NISA - 3D-FLUID

TIME DEPENDENT BOUNDARY CONDITIONS

Time dependent boundary conditions for flow variables can be prescribed to model truly transient phenomena.

ROTATING FRAME OF REFERENCE

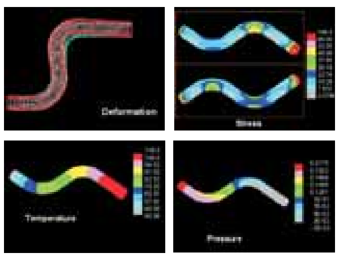
Rotating frame of reference can be invoked to study the fluid flow in pumps, turbines and other hydraulic machines.

RESTART OPTIONS

The solution can be restarted from the last time step (or iteration) in transient (or steady) problems. At restarts, the user can change material properties and/or boundary conditions.

FLUID-SOLID INTERACTION

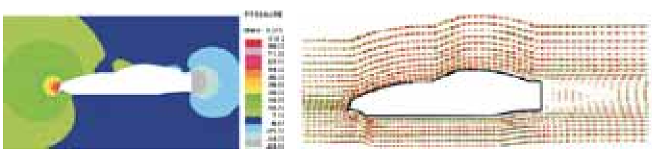
Fluid-Solid interaction involving flow and conjugate heat transfer is available. Pressure loading due to fluid flow can be applied for stress analysis in solids. A direct interface between NISA/3D-FLUID and NISA II (structures) is also available.



Fluid Structure Interaction

STREAM FUNCTION AND VORTICITY

Calculation of stream function and vorticity is possible as post-processed quantities.

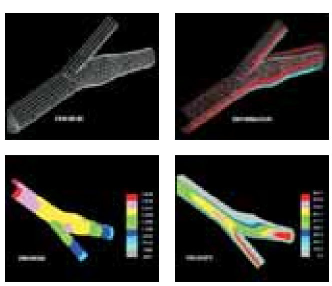

Turbulent flow over a car

MISCELLANEOUS POST-PROCESSING CAPABILITIES

- Mass flow rates and heat transfer rates computed along planes of flow domains
- Integration of pressure to obtain drag and lift forces
- Tracking of solid particles in fluid

NON-NEWTONIAN FLUIDS

Non-Newtonian fluids with Power law and Bingham type fluids can be modeled. Casson's fluid


Blood flow through an artery

FREE SURFACE FLOWS

Flows with free surfaces can be modeled with ALE (Arbitrary Lagrangian Eulerian) approach

DISTRIBUTED BODY FORCES

Body forces can be included to represent distributed forces due to the weight of the fluid, chemical, magnetic, and electrical forces.

POTENTIAL FLOW

Velocity potential and stream function formulations are available to analyze inviscid fluid flow.

SUMMARY OF CAPABILITIES

- Steady state and transient analysis
- 2D, 3D and axisymmetric domains
- Laminar and turbulent analysis
- Non-Newtonian fluids
  - Power law
  - Bingham
  - Cross
- Flow through porous media
- Rotating frame of reference
- Free surface flow
- Potential flow
- Boundary conditions
  - in global or local coordinate systems
  - coupled boundary conditions in global or local coordinate systems
  - time dependent boundary conditions
  - temperature dependent boundary conditions
  - Temperature dependent material properties
  - Conjugate heat transfer analysis
  - Forced & mixed and free convective heat transfer
  - Surface radiation heat transfer with view factor calculation
  - Phase change effects
  - Fluid-Structure interaction
  - Fluid-Electro-magnetics interaction
  - Stress analysis
  - Particle tracking

About us

Starcom Information Technology Limited is a leading provider of Computer Aided Engineering (CAE) services to the Automotive, Aerospace, Energy & Power, Civil, Electronics and Sporting Goods industries. Over 70 dedicated scientists, technology architects and software engineers providing NISA based solutions have helped major engineering companies reduce analysis turnaround time, improve user productivity, and ensure faster return on investments.

With a mission statement to provide its customers the best in scientific technology and to enable its customers to define new limits, Starcom is setting new standards in the scientific and engineering field. *For more information, please Email:* ***info@starcominfotech.com***

STARCOM

INDIA
Starcom Information Technology Limited
"Times Square", 88, MG Road,
Bangalore - 560 001, Karnataka, India.
Phone: +91 80 6765 0000
Email: info@starcominfotech.com