I-DEAS® Electronic System Cooling™

for 3D flow and thermal simulation of electronic, automotive, and industrial systems

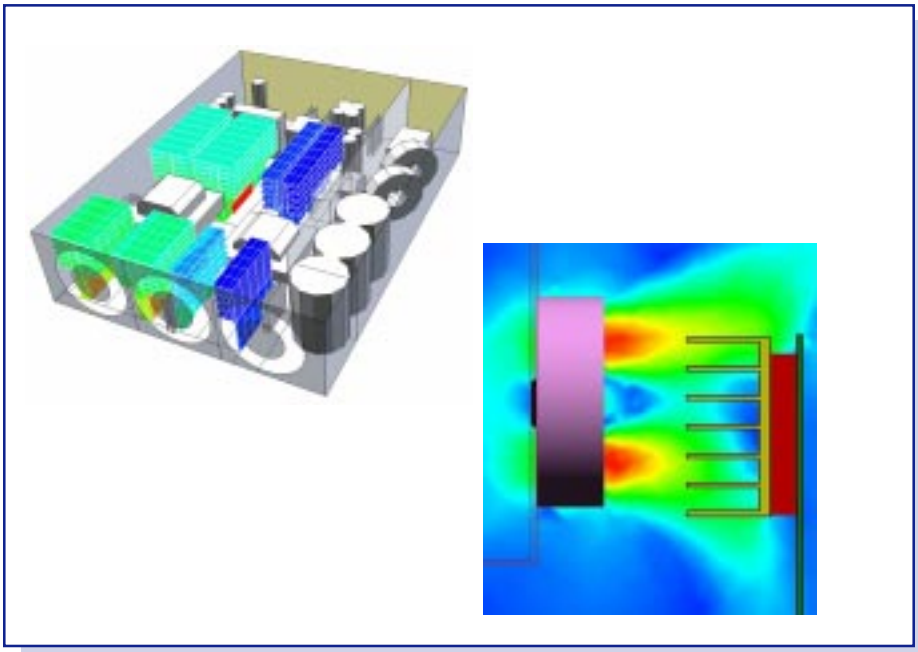
Electronic Cooling Simulation

I-DEAS® Electronic System Cooling™ software provides you with a comprehensive set of tools to simulate 3D air flow and thermal behavior in electronic systems. With its powerful computational fluid dynamics capabilities, it is also ideal for many automotive, heating and ventilation, and industrial applications. As an integrated part of the I-DEAS software package, models are created with 3D-design geometry using a simple and intuitive graphical interface. With I-DEAS Electronic System Cooling, you can effectively model individual components, multi-chip modules, heat sinks, and PC boards, as well as complete electronic systems. This allows you to perform digital thermal simulation early in the design process and reduces the need for building and testing physical prototypes.

Unstructured free meshing and powerful mesh coupling technology allow you to use a single model for both system level and component level analyses. The software helps you quickly perform a detailed thermal analysis and pinpoint design problems. It assists with practical thermal engineering challenges including:

•Optimizing the placement of critical components.
•Predicting the fan operating point from the manufacturer's fan curve data.
•Investigating both forced and natural convection cooling schemes.
•Positioning and sizing of fans and vents.
•Spacing requirements between boards and assemblies.
•Optimizing the size and shape of heat sinks to maximize convection.
•Investigating conductive heat transfer using thermal vias, heat pipes, and heat spreaders.

I-DEAS Electronic System Cooling helps you to resolve thermal engineering challenges early in the design process. It is a valuable aid to understanding the physics of fluid flow and heat transfer in enclosures.



I-DEAS Electronic System Cooling simulates 3D airflow, convection, conduction, and radiation to predict PC board and component temperatures.

Mechanical Design Integration

Integration with I-DEAS mechanical engineering design enables you to effectively use simulation to provide design guidance, not just verification. As an integral part of I-DEAS, no additional input files or geometry conversions are needed to build thermal and flow models. The software responds to the needs of non-specialists and specialists alike. It provides rapid turn-around since modeling and analysis time is reduced. Integrity is assured by maintaining data associativity between model building, solving, and results interpretation.

I-DEAS provides the ability to model, catalogue, and share parts and material libraries among the entire design team. I-DEAS interfaces with EDA design systems for direct data exchange with PCB layout programs using I-DEAS PCB.xchange - minimizing tedious rework and modeling errors. I-DEAS Electronic System Cooling is fully coupled to I-DEAS TMG Thermal Analysis software offering both advanced conduction and advanced radiation modeling. Flow and thermal results can be used as boundary conditions for thermal stress and deflection analysis with I-DEAS Model Solution™ software.

Easy to Learn and Use

I-DEAS Electronic System Cooling uses a simple and intuitive interface. All functions are performed using icons and forms. Modeling is performed directly on design geometry. The software uses terminology familiar to electronics packaging engineers and offers intelligent defaults for all options. Input is verified as it is entered on the form and modeling units are shown.

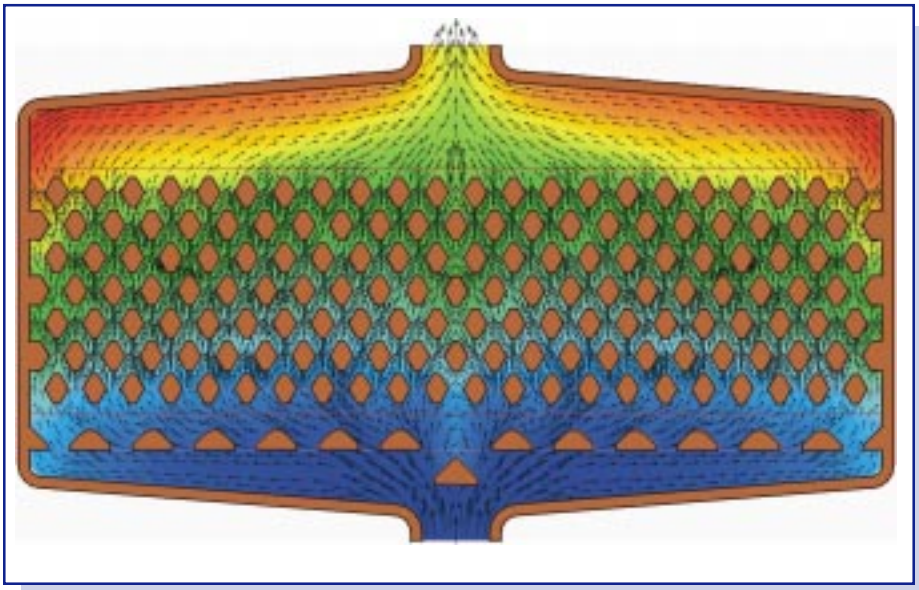
Model checks and diagnostics alert you to modeling mistakes and provide quick solution summaries to help you verify your results. I-DEAS online help and reference materials are always available to guide you through all modeling operations. I-DEAS Electronic System Cooling provides you with simple and reliable tools to meet the most demanding analysis requirements.

Modeling with Complex Geometry

I-DEAS provides an extensive set of tools for creating analysis geometry. The modeling of complex assemblies is made easy with I-DEAS Finite Element Modeling™ software. Automated free meshing tools allow you to quickly model parts using precise wireframe, surface, and solid geometry. You can refine the mesh in critical areas and selectively control mesh density minimizing model size for rapid solution turnaround. Full associativity with design geometry means the mesh is automatically updated when your design is modified.

Unique Modeling Approach

Analysis time is significantly reduced through the use of powerful I-DEAS Electronic System Cooling modeling tools. The fluid flow mesh does not need to be aligned to the solid thermal mesh. The fluid flow model adapts around convecting surfaces and flow obstructions. Convection heat transfer from the components, boards, and enclosures is calculated using local flow conditions and geometry. The simulation can be tuned for modeling convection from PC boards and the drag due to components. Heat transfer coefficients and surface roughness can be automatically calculated or specified.



I-DEAS ESC is ideally suited to modeling applications with complex geometric detail and can be applied from system level to component level simulation.

Dissimilar meshes are automatically coupled, greatly simplifying meshing and dramatically reducing mesh density. Thermal couplings are automatically established based on proximity, and are distributed to account for overlap and mismatch between dissimilar meshes.

This is a powerful tool for modeling junction-to-case thermal resistances, component to PCB interfaces, card edge guides, bolted or bonded connections, multi-layer materials, and free convection from exterior surfaces. Isotropoic and orthotropic conduction can be modeled using 3D solid, 2D shell and beam elements.

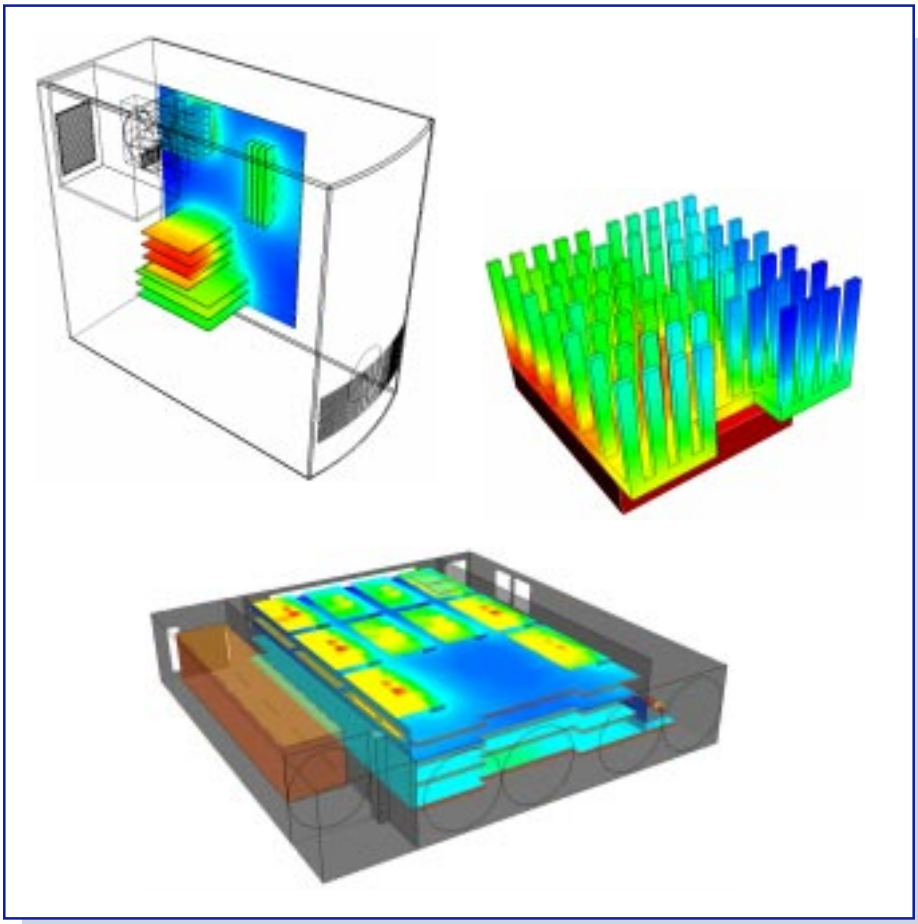
Powerful Hybrid CFD and Thermal Simulation

Electronic component level, board level, and system analysis is performed by seamlessly coupling computational fluid dynamics (CFD) solver technology with thermal solver technology. Together this hybrid coupled-solver can accurately predict fluid flow, convection, conduction, and radiation.

An element-based finite volume method is used to model 3D fluid velocity, temperature, and pressure by solving the Navier-Stokes equations. The analysis models incompressible flow in enclosures, flow turbulence, surface convection, and fluid advection. Calculation points for momentum, mass, and energy are co-located and the momentum and mass equations are solved together. Flow turbulence can be modeled using fixed turbulent viscosity or k-e turbulence models. This physically based approach is both robust and reliable.

I-DEAS Electronic System Cooling software combines the versatility of finite element-based analysis with the power and accuracy of a control volume-based formulation. The fluid flow and thermal models are solved iteratively. Algebraic multi-grid solver technology is used to ensure efficient solution convergence; solution time is linear with model size. During analysis execution, a solver monitor dynamically plots solution convergence and displays intermediate results to monitor progress. You can stop the solution, display intermediate results, or change solution parameters and restart at any time.

The combination of 3-dimensional CFD and thermal solver technology allows you to simulate complex situations including:
•3D air flow across boards, around components, and within enclosures.
•Component heat loads and operating temperatures.
•Forced, natural, and mixed convection on arbitrary geometry.
•Incompressible Newtonian fluid flow within multiple enclosures or both internal and external flows.
•Orthotropic and isotropic conduction, surface radiation, and fluid advection.
•Thermal characterization of component packages and heat sinks.
•Buoyancy effects and flow turbulence.
•Internal and external fans as well as recirculating fans.
•Predicting the fan operating point with manufacturer's fan curve data.
•Losses due to screens, filters, and other obstructions to fluid flow.
•Convection to the surrounding environment and solar heat loads.
•Moving or rotating surfaces.
•Slip and symmetry conditions.



I-DEAS ESC can help you engineer reliable products by simulating the thermal performance of your product early in the design process.

Simulation Results

Simulation results can be displayed with graphical plots, charts, and reports. This will help you understand and gain physical insight as well as improve or optimize your design. Results can be displayed using 3D vector, particle path, contour, criterion, and carpet plots. You can dynamically rotate result displays and interactively probe for specific data. It is easy to generate tabular reports, XY or XYZ graphs to communicate your results to the design team.

The following simulation results are available for post processing:
•Fluid velocity
•Fluid and solid temperatures
•Fan, vent, and screen mass flux
•Heat flux
•Fluid pressure
•Heat transfer coefficients
•K-E turbulence data
•Fluid density
•Surface shear stresses
•Error and local dimensionless values

Applications

I-DEAS Electronic System Cooling is capable of modeling more than simple electronic enclosures. It can be applied to a broad range of industries and products:

•Computers and Peripherals: individual components such as disk drives, large rack mounted systems, and printers.
•Consumer Electronics: ideally suited to complex geometry and compact packaging challenges.
•Medical and Instrumentation: electronic systems and instrument sensors and control systems.
•Automotive Electronics: individual electronic modules and electrical systems exposed to extreme environments.
•Automotive Cooling and Heating Systems: heating and ventilation systems, under-hood and under-car cooling as well as headlamps.
•Communication: Rack-mounted systems in climate-controlled rooms and outdoor equipment in extreme environments.
•Aerospace and Avionics: electrical and electronic systems on aircraft as well as lighting systems.
•Building HVAC and Clean Room Ventilation: duct systems, ventilation diffusers and investigating flow in large spaces or controlled environments.
•Component and Electronic Packages: detailed modeling of wire-bonded, flip-chip, MCM, BGA packages. This can be used in combination with I-DEAS Model Solution Nonlinear software to solve thermal stress and distortion problems.

Quality Assurance

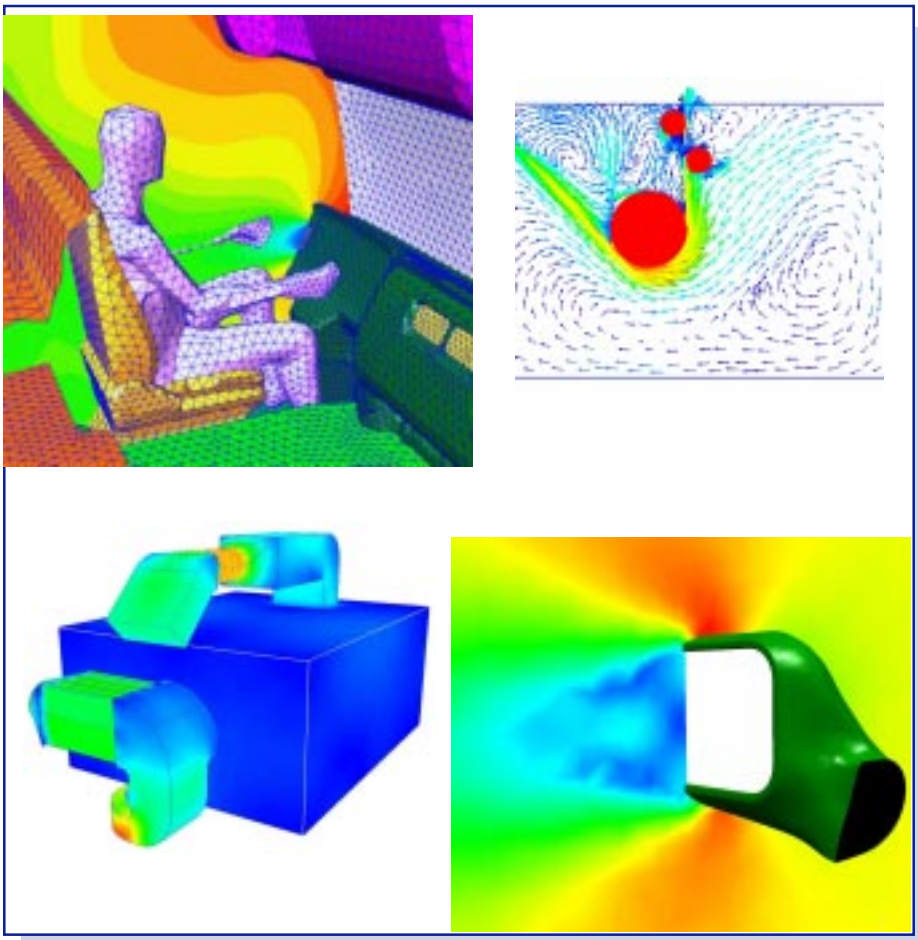
I-DEAS Electronic System Cooling is rigorously tested using an extensive suite of verification test problems.

Prerequisite

Core Simulation

For More Information

For more information, contact your local SDRC representative or call 1-800-848-7372.



I-DEAS ESC CFD and thermal simulation technology can be applied to a broad range of industries and products such as automotive and manufacturing indusry.