# Staying Cool with **ANSYS Icepak**

Thermal management solution predicts air flow and heat transfer in electronic designs so engineers can protect heat-sensitive components.

*By Stephen Scampoli, Lead Product Manager, ANSYS Inc.*

ANSYS Icepak technology is aimed at one of the most significant challenges facing engineers designing electronic assemblies: dissipating thermal energy from electronic components to prevent premature component failure due to overheating. This fully interactive software is used to evaluate the thermal management of electronic systems in a wide range of applications, including simulation of air flow in enclosures, analysis of temperature distributions in chip and board-level packages, and detailed thermal modeling of complex systems such as telecommunications equipment and consumer electronics. By predicting air flow and heat transfer at the component, board or system level, the software improves design performance, reduces the need for physical prototypes and shortens time to market in the highly competitive electronics industry.

Based on powerful computational fluid dynamics (CFD) simulation, ANSYS Icepak technology has a specialized user interface that speaks the language of electronics design engineers. Models are created by simply dragging and dropping icons of familiar predefined elements including cabinets, fans, circuit boards, racks, vents, openings, plates, walls, ducts, heat sources, resistances and heat sinks. These "smart objects" capture geometric information, material properties and boundary conditions — all of which can be fully parametric so a user can easily enter values to precisely match application requirements or to study what-if scenarios. The software also includes extensive libraries for standard materials, packages and electronic components such as fans — including fan geometry and operating curves.

As a further modeling aide, the software can import both electronic CAD (ECAD) and mechanical CAD (MCAD) data from a variety of sources. Geometry from ECAD and MCAD data sources can be combined with smart objects to quickly and efficiently create models of electronic assemblies. For instance, a system
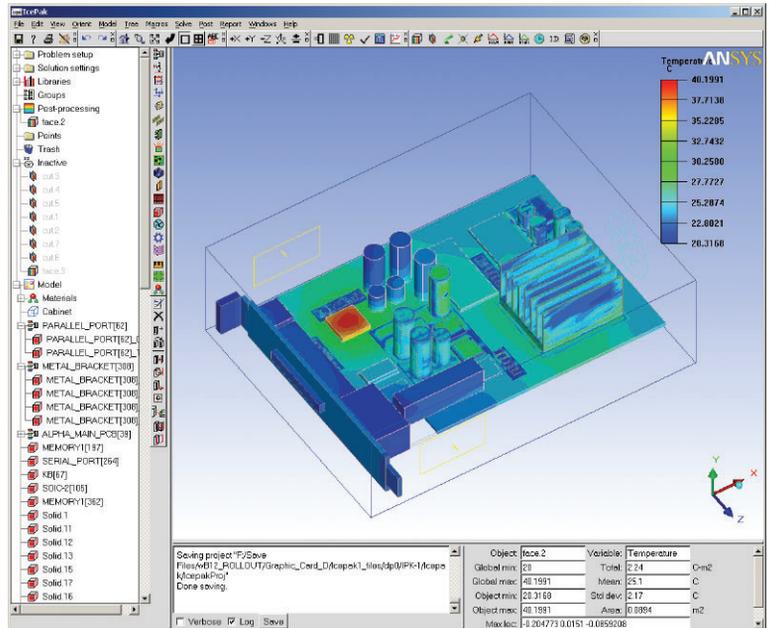
ANSYS Icepak software predicts the temperature profile in a computer graphics card.
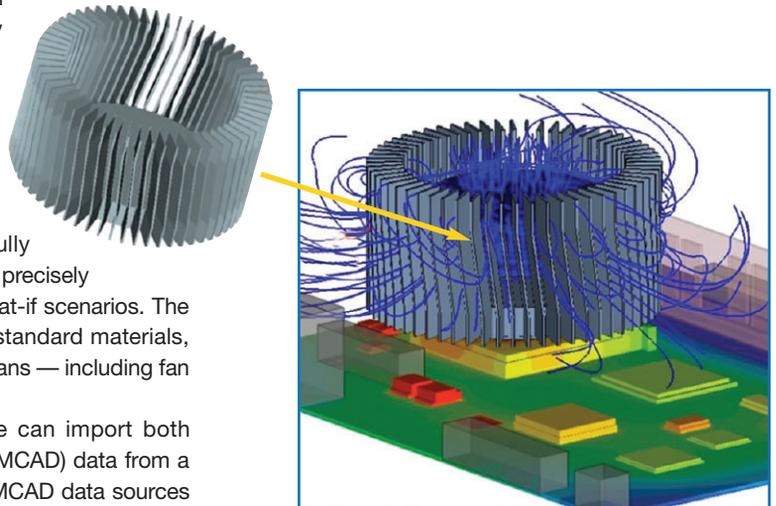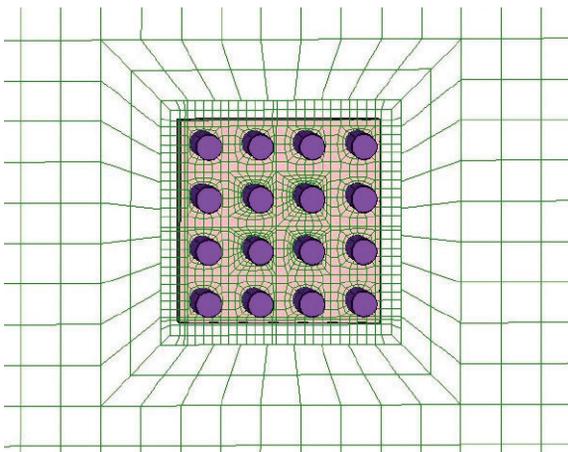

Simulation results of a fan-cooled processor heat sink attached to a printed circuit board

Thermal simulation of a PCB using the power map data imported from SIwave

model of a computer enclosure could easily be generated by combining MCAD data for the enclosure, ECAD data for the printed circuit boards (PBCs) and electronic packages, and smart objects for other components. In addition, the ANSYS Icepak solution includes many macros to automate the creation of geometry including different types of packages, heat sinks, thermo-electric coolers and industry-standard test configurations.
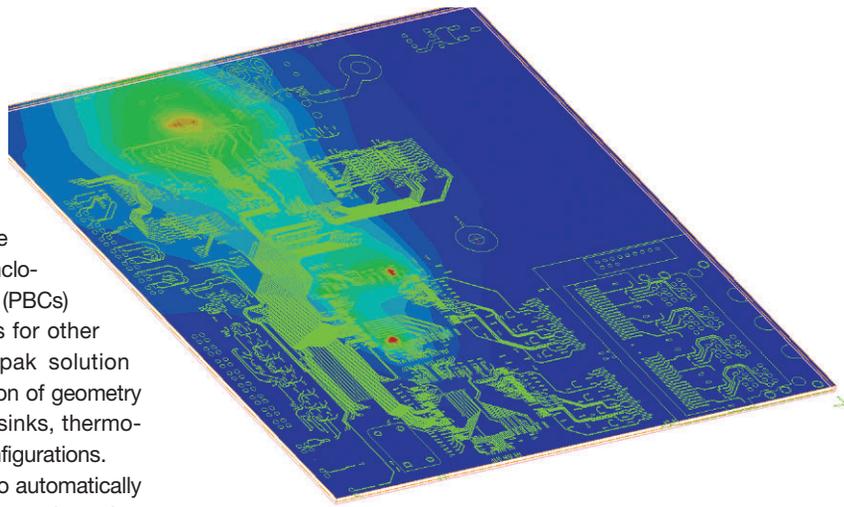
Another productivity feature is the ability to automatically generate highly accurate body-conformal meshes that represent the true shape of components rather than a rough stair-step approximation. Meshing algorithms can generate both multi-block and unstructured hex-dominant meshes. Algorithms also distribute the mesh appropriately to resolve the fluid boundary layer. While the meshing process is fully automated, users can customize the meshing parameters to refine the mesh and optimize the trade-off between computational cost and solution accuracy. By grouping objects into assemblies, the mesh count can be further optimized by meshing each assembly separately and automatically combining them before running the solution. This meshing flexibility results in the fastest solution times possible without compromising accuracy.

ANSYS Icepak uses the state-of-the-art ANSYS FLUENT computational fluid dynamics solver for the thermal and fluid flow calculations. The CFD solver solves the fluid flow and includes all modes of heat transfer — conduction, convection and radiation — for both steady-state and transient thermal-flow simulations. The solver also provides complete mesh flexibility, and this allows the user to solve even the most complex electronic assemblies using unstructured meshes, providing robust and extremely fast solution times.

Once the solution is complete, ANSYS Icepak software provides a number of different methods for visualizing and interpreting results. Visualization of velocity vectors, temperature contours, fluid particle traces, iso-surfaces, cut-planes and two-dimensional XY plots of results data are

all available. The software also offers customized reports that allow users to identify trends in the simulation along with the ability to report fan and blower operating points. Reports including images can be created in HTML format for distributing the results data.

ANSYS Icepak tools can interface with other products in the software portfolio from ANSYS to allow comprehensive multiphysics simulation of electronic components. One option is the ability to import a power distribution map from SIwave; this simulation software from Ansoft extracts frequency-dependent electronic circuit models of signal and power distribution networks from device layout data-bases for modeling integrated circuit packages and printed circuit boards. Based on the results from an SIwave simulation, users can import the DC power distribution profile of printed circuit board layers into ANSYS Icepak software for a thermal analysis of the board. The coupling between the two packages allows users to predict both internal temperatures and accurate component junction temperatures for printed circuit boards and packages.

ANSYS Icepak software can export temperature data from a thermal simulation to a structural mechanics model to calculate thermal stresses of electronic components. With the demands of today's high-performance electronic devices, electronic components are becoming more complex and using more exotic materials. These newer materials have widely varying thermal and mechanical properties and are being subjected to higher temperatures during both manufacturing and usage. These varying material properties and temperatures can result in significant thermal stresses, which can bring about fatigue-based failure of the components. ANSYS Icepak software, together with ANSYS Mechanical technology, allows users to evaluate both the thermal and mechanical aspects of the design.

ANSYS Icepak technology in conjunction with SIwave and ANSYS Mechanical products provide a full portfolio of software to meet the simulation requirements of the electronics design engineer. ANSYS continues to be a leader in providing solutions to the electronics industry — solutions that provide the high-fidelity electrical, thermal and structural simulations required to meet the challenges of today's product development demands. ■

Mesh around a pin fin heat sink follows the geometry of the part without any approximation.