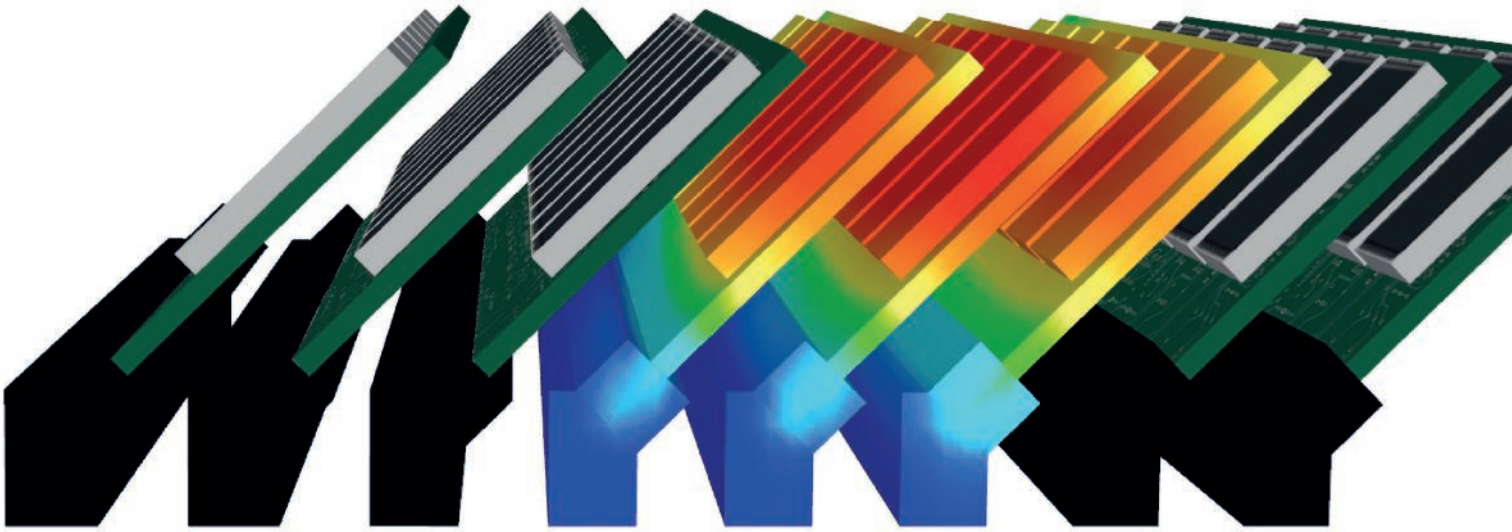


Keeping your cool

As thermal design challenges get more complex, future solutions are likely to be cloud based. By **Graham Pitcher**.

Electronic devices get hot, but how hot depends upon a range of factors. However, the move to smaller devices offering more functionality has increased the challenges of keeping them running at sensible temperatures.

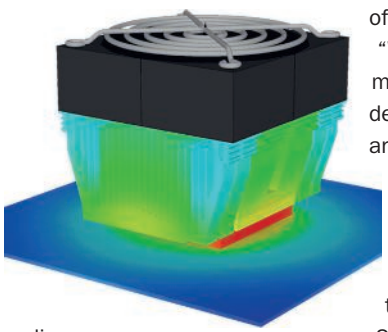
But it's not just small consumer devices that provide challenges; even products targeted at industrial applications – with large enclosures and forced cooling – require careful thermal design.

What was a specialist task is now available to all, courtesy of software which first appeared in the early 1980s. Chris Aldham, product manager with 6SigmaET, noted that early users of these systems included the nuclear and aerospace sectors, with electronics catching up quickly. "IBM, for example, signed a large contract for general purpose fluid dynamics software."

One thermal analysis software pioneer was UK based CHAM, but a group of engineers split away to form Flomerics, where they focused on developing solving algorithms. "Electronics cooling software in those days was a 'missionary sell'," Aldham reflected. "You had to tell people they could simulate thermal effects in order to help electronics design. Until then, the approach was 'build, measure, repeat'."

In the early days, lack of computing power was a drawback. "The art then was how to simplify modelling in order to get something useful. But, as computers have become more powerful, the software has become more complex."

One of the challenges with earlier software packages was the way in which analysis was undertaken. "Most early software was based on Cartesian coordinates," Aldham said. "It was very rectilinear; much like building models using Lego blocks. But the technology has moved on to the point where curved shapes can be analysed – consumer products, for example – and that has seen greater interaction with CAD packages in building models."



6SigmaET has been used to model a range of electronic designs, including DIMM arrays (top) and a processor heatsink

Future Facilities, which develops 6SigmaET, span out of Flomerics in 2004; initially to focus on the cooling issues associated with data centres. "The challenge was to deal with very large 'boxes' of electronics," Aldham said. "The level of detail was huge." However, the company started addressing the thermal challenges of electronics design in 2008.

"We wanted to make the software more specific to electronics design, bringing more intelligence and more automation," he continued. "While you no longer needed to be a CFD expert, you still needed to understand modelling; how you put things together to represent devices."

So what are the challenges facing companies developing thermal management software? "There are a couple of important challenges," Aldham asserted. "One is the price of the equipment being developed. At one time, people thought about the 'engineering margin' – products were over designed, but engineers knew they would work. Today, people want to work on the limit, producing

something that 'just works', rather than over engineering. Today's products don't have to last 20 years, but they still have to work.

"That means designers need to be more accurate because the power going into electronics has grown, more heat is generated and the packages are smaller.

"The other challenge is the use of CAD data," he noted. "Most engineers have fully detailed CAD models – often down to the screws being used – and they want to use that data in their thermal model. It's a similar problem to the early days; there is still the need to simplify the extreme details of a CAD model."

In Aldham's view, the challenge can be addressed in two ways; one is to embed thermal analysis functionality into CAD packages. "You can put a CFD solver into the CAD package, but that means it's a CAD driven solution, even though it's targeted at electronics."

The other way is to make data import as seamless as possible. "We can then read the CAD model and migrate it in a way that makes it easier to handle."

Meanwhile, the granularity of analysis software is becoming ever finer. "We are using smaller and smaller grids," he pointed out. "The question then is how many grid cells the system can handle. Our software can support up to 700million, but a model like that would probably take a week to run. The biggest models we see are around 100m cells, but most designers try to run models featuring tens of millions."

Yet, despite thermal analysis software becoming more widely available, Aldham suggests most users are full time thermal engineers. "They're mechanicals responsible for signing off thermal designs or in a mechanical design team working alongside an electronic engineer. Full time thermals understand where heat is coming from and the techniques that need to be used."

Implicit is an understanding of how heat moves around a product. "Heat can spread, it can be moved by airflow and there's radiation. All three approaches need to be considered."

Thermal analysis software is also good for a 'what if?' approach. "If it runs at 50W," Aldham noted, "what size fan do I need? If it increases to 70W, do I need a bigger fan? What about heat sinks?"

So what will the thermal analysis package of the future look like? "In some respects," Aldham said, "it will be 'more of the same'. Packages will be more powerful, more detailed and faster, with closer integration with CAD and EDA systems."

But faster, more detailed software needs more computing power and Aldham believes that, while thermal analysis today is desktop based, that will change. "If you want more detail, you need faster processors and that could mean cloud based solutions."

"Designers need to be more accurate because the power going into electronics has grown, more heat is generated and the packages are smaller."
Chris Aldham

There is also a growing need to move beyond steady state analysis. "Particularly in devices like mobile phones, static analysis has little value because devices are rarely in a steady state; they're playing a video, making a call and so on," Aldham explained. "Thermal design strategies are often based on controlling a processor as it gets hot. This needs to be simulated and that's difficult in terms of the amount of computation needed."

In the end, however, Aldham knows that thermal analysis needs to get closer to electronic engineers. "They are the ones creating the problems and it's something we have on the back burner," he concluded.

FloTHERM XT updated

Mentor has updated its FloTHERM XT software package, adding advanced thermal management capabilities that allow designers to effectively simulate thermal effects of complex geometries.

"The latest release of FloTHERM XT is based on listening to our customers and delivering the optimum thermal simulation solution to address their thermal design challenges," said Roland Feldhinkel, general manager of the Mentor Mechanical Analysis Division. "Our continued investment in FloTHERM XT will allow our customers to verify and prototype their designs with greater ease and confidence. These new features are vital for electronics systems designers who are creating innovative, high-performance products for the transportation, mil-aero and automotive industries."

Features available in the latest FloTHERM XT release include: simulation of spinning parts in electronic enclosures; temperature-dependent power simulation; enhanced 'Design of Experiments' parametric studies to determine best design coverage; and thermal territory simulation when using various component materials. Also featured are explicit models for: spinning parts; temperature-dependent power simulation; thermal territory simulation; and enhanced parametric study functionality.