DESIGNING HOT PRODUCTS

When developing a new product, managing its thermal signature — the thermal energy that it releases/absorbs in its operating environment — is important for aesthetic and economic reasons. Engineering simulation can help you to find this optimum value and create a long-lasting product that performs well.

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Designing cutting-edge products today often means getting them to work under extreme conditions, which can make it challenging to manage the energy generated by the product.

My most vivid experience of this occurred when engineers from Goodrich Aerostructures (now UTC Aerospace Systems) described how they design and test commercial aircraft landing brakes. If the pilot of a wide-body jet decides to abort takeoff at any time while accelerating down the runway, the FAA mandates that the brakes must stop the aircraft, completely and safely, without endangering the passengers. This requires converting the kinetic energy of an 850-ton aircraft racing at 170+ mph to frictional heat and dissipating it to the surroundings in just minutes! Watching this process in action during testing reveals mechanical engineering at its best — the brakes glow white-hot while bringing the massive, speeding vehicle to a halt.

In this instance and many more, heat must be controlled for optimal system operation. Running a chemical reactor at less-than-ideal temperatures will reduce the product yield, while too high a temperature might cause a dangerous runaway reaction, or damage the reactor. Overheating integrated circuits (IC) can cause stress and IC package delamination, but excessive cooling means consuming more electricity than is necessary to power fans. Designers of electronic systems must strike a balance between electrical performance and physical size. A rich user experience requires significant IC computations, which burn power and create heat, so the design must allow for sufficient cooling without compromising user preferences for size, weight, noise and portability.

Clearly, economics and aesthetics figure greatly in the thermal management of industrial and consumer products and processes. Simulation can eliminate waste by preventing over-design — using too much of a material, or using a more expensive material when a cheaper one would suffice. Simulation can also prevent under-design, which might compromise your product's safety or reduce its lifetime. In addition, understanding how long your product can work effectively at its operating temperature helps you to set reasonable warranty periods.

Engineering simulation using reliable computational physics and multiphysics can minimize thermal management concerns for your product or process. You can model your product and simulate its operation virtually, using parametric studies to explore the design space more thoroughly than would ever have been possible using the old build-and-test method. You can see how your model responds to changes in temperature, delineate the optimal range of operation, and choose the best materials for your application. The result will be the best product possible, both technologically and economically.

ANSYS products enable you to study the effects of conjugate flow and heat transfer, Joule heating, chemical reactions, thermal dissipation and electronics cooling, to mention just a few areas. ANSYS Mechanical, ANSYS Fluent and ANSYS Icepak are routinely used today by engineers worldwide to address product design challenges.

In this issue, a few of our most creative customers relate how they used ANSYS engineering simulations to solve their toughest thermal management challenges in many industries. I think you will find their stories insightful.

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