

DE

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TECHNOLOGY FOR DESIGN ENGINEERING

April 2011 / deskeng.com

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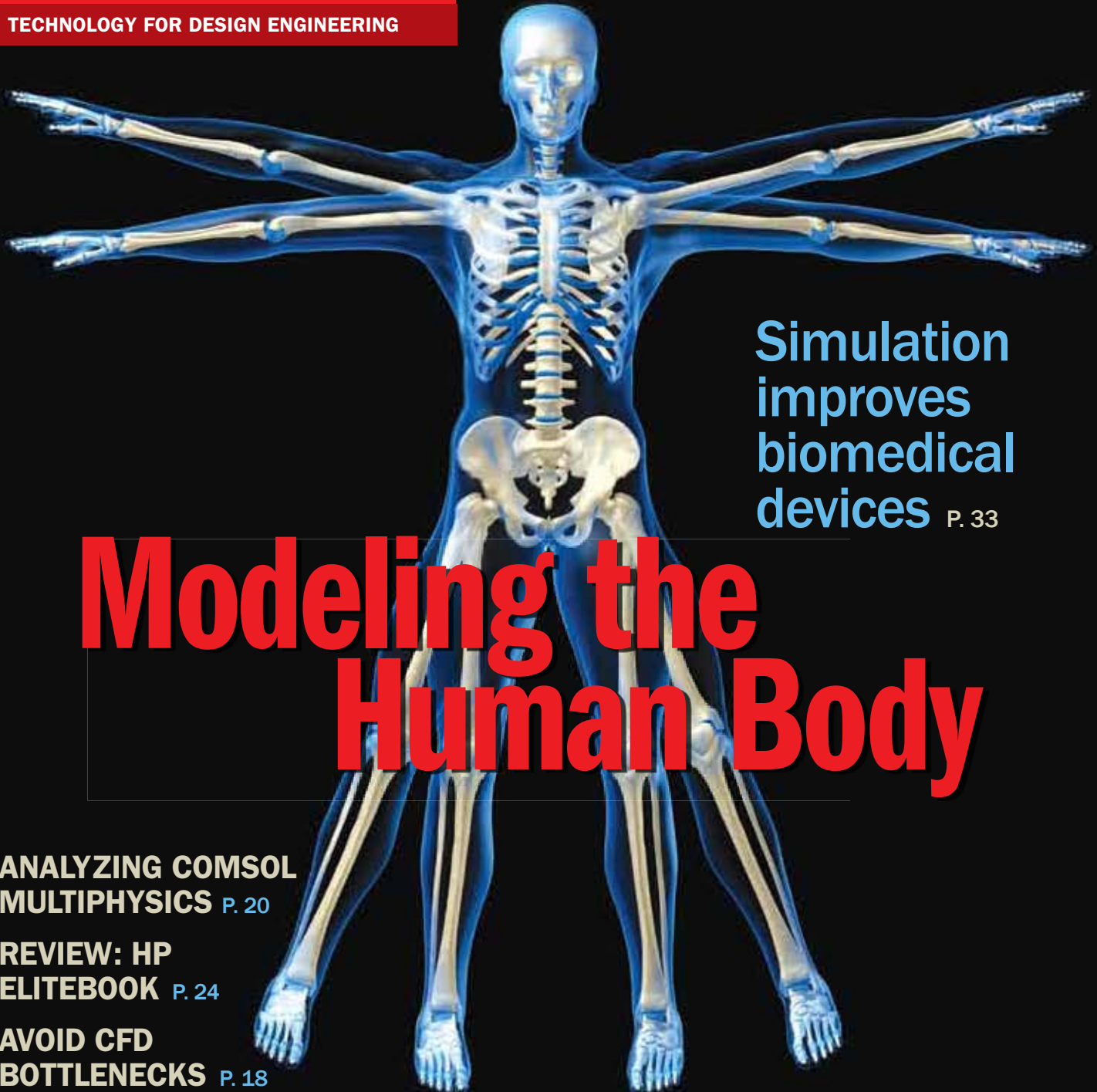
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Peter Simonsen

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Embedded Software*

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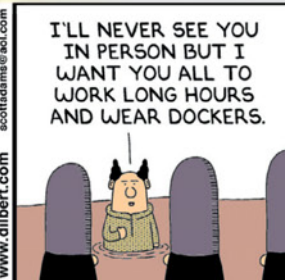
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Engineering Better Medical Care via Innovation

I'm always wowed by the innovative medical technologies being created by design engineers. As advances in medical imaging technology, computer hardware, 3D printing, and simulation software continue to become more sophisticated, the possibilities for medical breakthroughs seem endless.

A few years ago I had the privilege of listening to Dean Kamen, one of America's greatest entrepreneurs and innovators — as well as a huge advocate for First Robotics — deliver a keynote address at a PTC Users Group Meeting. He spoke about a major medical device manufacturer approaching him with a request to redesign its dialysis machine. There were a number of negatives the company wanted to address:

- Dialysis machines required a doctor and an assistant to run. It was a complicated procedure to perform, often taking place in a clinic or hospital.
- The procedure was disturbing and invasive to the patient, who watched his/her blood being pumped through tubing that was visible on the exterior of the device.
- The control and instrumentation on the machine was too complicated.

Prototypes are of the upmost importance when time is critical.

The medical device company wanted innovation. But it needed the machine quickly, and at a fixed price. Because of these limitations, the company suggested that Kamen start with the old design and improve upon it. Innovation on a budget, with time constraints and repurposing the existing design equals innovation? Kamen took the project, knowing what he was getting into, but warned the client they might not be able to meet the deadline. The project became the design that wouldn't die, with the engineering team working on its own time to finish the device.

The result was the HomeChoice peritoneal dialysis system, which has basic controls that can be operated in the home. It has two buttons: stop and go. It changed the lives of people needing dialysis, and was truly innovative.

Printing Prototypes and Organs

Design in the medical device industry has a lot of new tools to work with today. Simulation and analysis play a big role, with groundbreaking work going on in the fields of biomedical, surgery, prosthetics and orthopedics. 3D printing is bringing medical devices to market in record time. It's being used in medical centers to create functional medical models and custom-build medical devices. 3D printers are even being used to create human organs.

I came across a case study on the Seattle Children's Hospital, where 3D Systems' desktop 3D printers were being used for printing respiratory device interfaces for premature babies from CT data. Because of the rapid changes in the infants' developing nasal and oral passages, the interfaces had to be redesigned multiple times until the babies could breathe on their own. 3D printing could make that happen.

Speeding Care Delivery

Simulation software is being used on babies with skull disorders to assist in surgery to help separate fused bone structures, which happens in about 1 in 2,000 births. ANSYS multiphysics software has also helped improve patient outcomes through reduced surgery duration.

Using rapid prototyping, Honeywell/Logica has brought video endoscopes to military surgeons, allowing them to perform arthroscopic surgeries in the field. Stratasys rapid prototyping products enabled the endoscope design to move much faster through conception so it could be deployed faster.

Prototypes are of the upmost importance when time is critical. Whether a medical emergency, needing a custom-built part immediately, or bringing a product to market on time, the tools that design teams have today are able to produce better results and enable companies to compete in the global economy. They also enable innovation.

Every year *DE*'s staff is lucky enough to be on invited to report on the cutting edge of the technologies great designers create. Please, let us know the stories of how your designs will change the world. **DE**

Steve Robbins is the CEO of Level 5 Communications and executive editor of *DE*. Send comments about this subject to de-editors@deskeng.com.

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COVER STORY

Designing the Model Patient

33

To simulate any embedded device, engineers must first simulate the environment those devices will perform in. When it comes to medical devices, the environment is the human body. Using geometry derived from medical scan data is providing previously unparalleled understanding of device performance and patient safety via advanced simulations.

ON THE COVER: Simulating how medical devices interact with the human body is a challenge being tackled by today's advanced hardware and software. *Image courtesy of BigStock.com.*

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New GPU development tools makes porting engineering applications simpler.

By Peter Varhol

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There are advantages and disadvantages to working outside the office for everyone involved: the employee, the company and the community.

By Mike Hudspeth

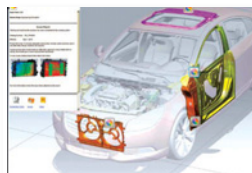
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By David Cohn



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Visual data management offers greater insight to projects.

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Autodesk releases its first native Macintosh version of AutoCAD in 18 years.

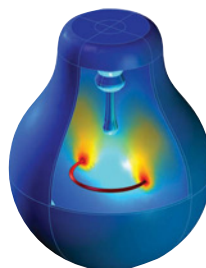
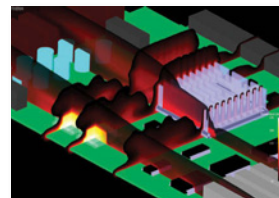
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How to use thermal bottlenecks and thermal shortcuts to drive design decisions.

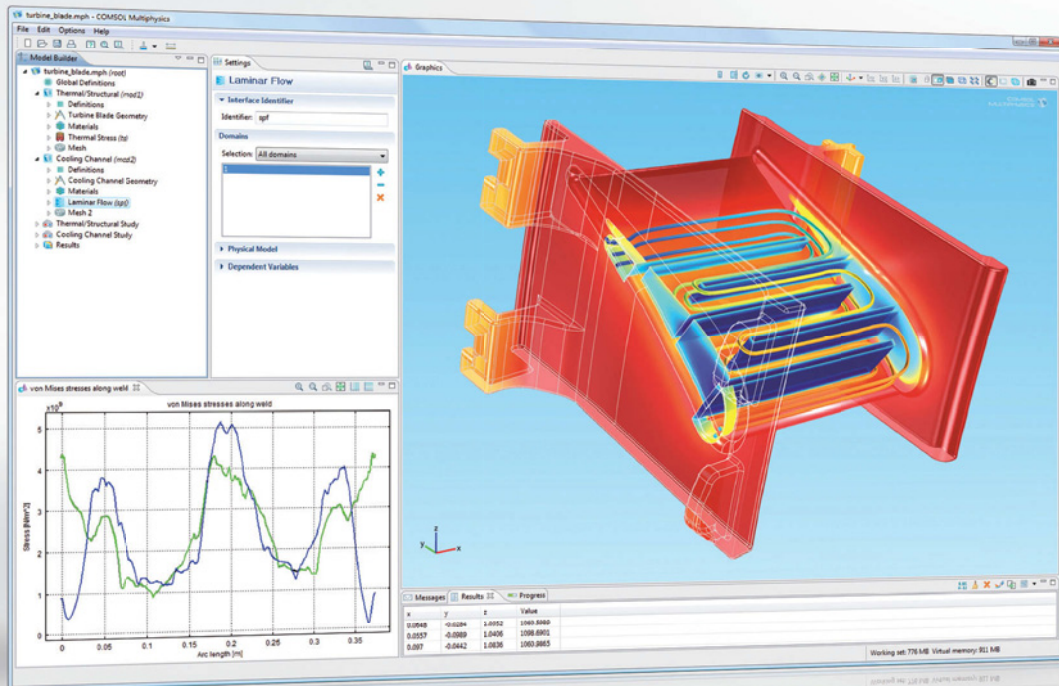
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20 An Introduction to Multiphysics

COMSOL Version 4.1 makes the concept easily accessible to design engineers.

By Vince Adams



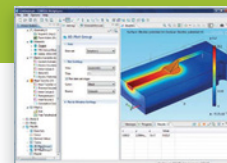
A stator blade in the turbine stage of a jet engine is heated by the combustion gases. To prevent the stator from melting, air is passed through a cooling duct in the blade.

Capture the Concept.

With COMSOL Multiphysics® you are empowered to build the simulations that accurately replicate the important characteristics of your designs. The key is the ability to include all physical effects that exist in the real world. This multiphysics approach delivers results—tangible results that save precious development time and spark innovation.

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Joule Heating of a Circuit Board Fuse
www.comsol.com/showcase



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Newslink; Editor's Pick of the Week; Check It Out; Virtual Desktop; Focus on Analysis and Simulation; Focus on Engineering IT & Computing; Focus on MCAD; and Focus on Rapid Technologies.

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A LEVEL 5 COMMUNICATIONS PUBLICATION

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Desktop Engineering® magazine
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1283D Main St., PO Box 1039 • Dublin, NH 03444
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Desktop Engineering® magazine
PO Box 677 • Northbrook, IL 60065-0677
847-559-7581 • Fax 847-564-9453
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Desktop Engineering® (ISSN 1085-0422) is published monthly by Level 5 Communications, Inc., 1283D Main Street, P.O. Box 1039, Dublin, NH 03444, 603-563-1631. Periodicals postage paid at Dublin, NH, and at additional mailing offices. Desktop Engineering® is distributed free to qualified U.S. subscribers.

SUBSCRIPTION RATES: for non-qualified; U.S. \$108 one year; Canada and Mexico \$126 one year; all other countries \$195 one year.

LIST RENTALS: For information on list rentals, contact Statistics, Danbury, CT: 203-778-8700.

POSTMASTER: Send all address changes to **Desktop Engineering**, P.O. Box 677, Northbrook, IL 60065-0677.

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MODEL PHYSICAL SYSTEMS

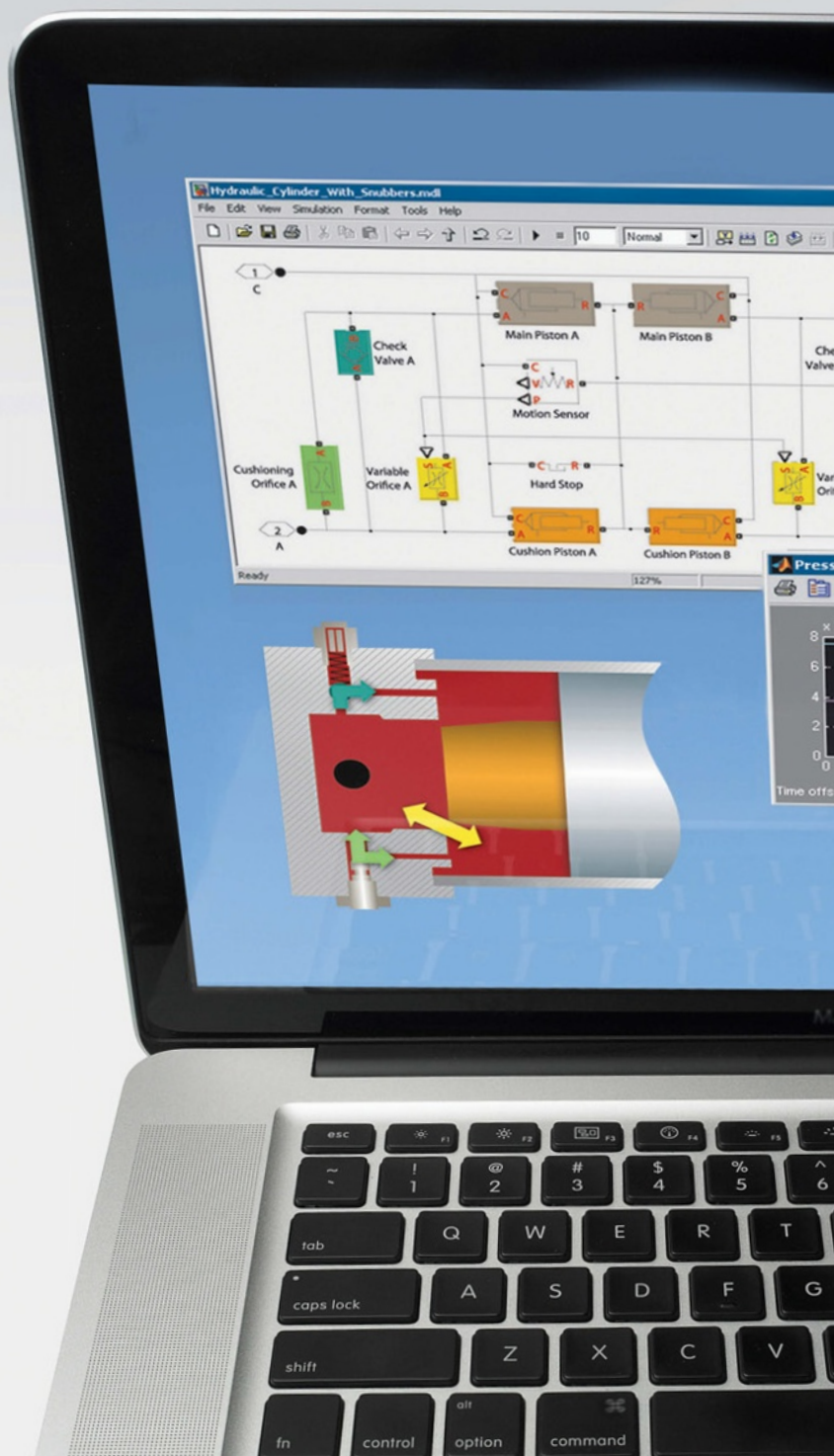
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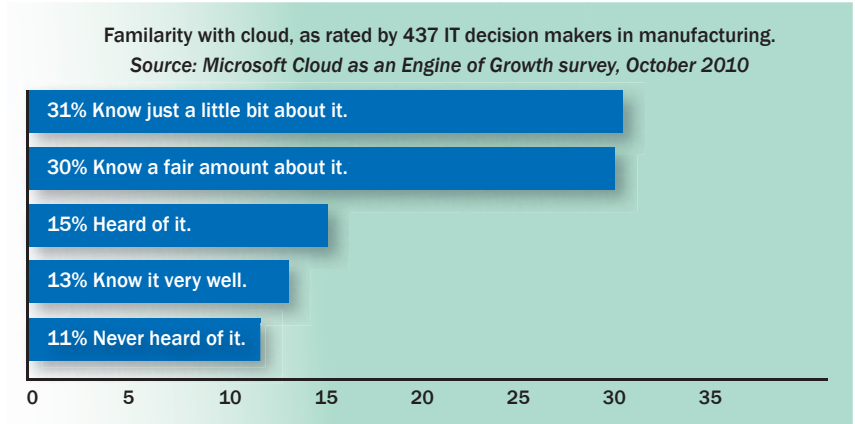
Cloud Computing: What the Numbers Tell Us

We have numbers—numbers that tell about your cloud-related curiosity, acceptance, reluctance, and reservations. The first set of numbers came from us, *Desktop Engineering*. When *DE* conducted a quick survey, we discovered there's an almost even split between those of you who are open to exploring cloud-hosted services and products, and those who are determined to shun them. More than 37% chose, "No [current cloud deployment], but we might in the future." More than 35% chose, "No, we're anti-cloud."

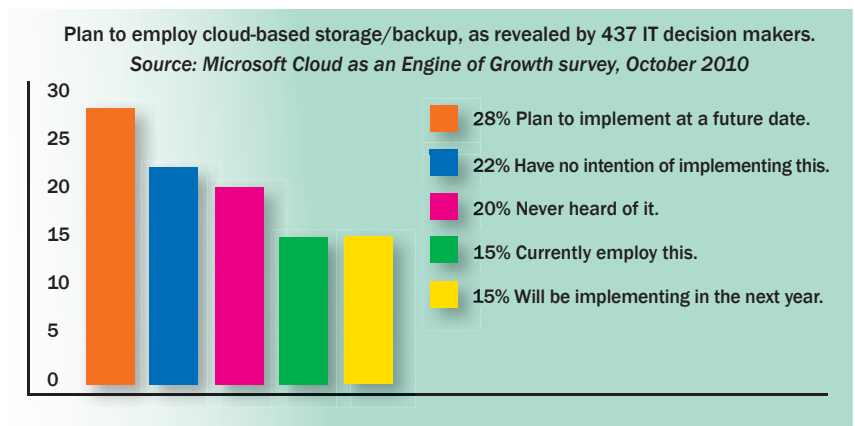
Coincidentally, when Microsoft conducted its own survey ("Cloud as an Engine of Growth," October 2010), they found a near even split between IT decision makers in manufacturing who "know just a little bit about [cloud]" (31%) and those who "know a fair amount about it" (30%). Microsoft's numbers, collected among 437 IT decision makers in manufacturing firms, also revealed that 26% of the respondents "plan to implement [cloud-hosted collaboration tools] at a future date," 11% "will be implementing in the next year," and 23% "have no intention of implementing this."

DE's numbers show that 9.85% of you haven't the foggiest idea what cloud computing is. Similarly, Microsoft's statistics revealed 11% have never heard of cloud computing. Also in Microsoft's numbers, those who have embraced the technology ranked low total cost of ownership, the need to support a remote workforce, and service level/high availability/up time as compelling reasons for adopting it.

In Microsoft's survey, 64% of IT decision makers in manufacturing revealed they invested in cloud services, spending anywhere from under \$1,000 to more than \$1 million. The other 36% chose to invest none. Of those who had



Results of Microsoft's Cloud Computing as an Engine of Growth Study.



What IT decision makers in manufacturing think of online data storage.

invested in cloud services, 59% reported saving money, from less than \$1,000 to more than \$1 million. So the glass is either half empty or half full of the promise of cloud-hosted services (well, nearly half empty but a little more than half full, if you want to nitpick).

The statistics, both ours and Microsoft's, tell us there's just as much enthusiasm for this emerging computing model as there is reticence. It also suggests, when the time is right, with affordable cloud-hosted services with a reliable track record, many decision makers and average CAD users would consider adopting them.

Some have argued that the rise of cloud computing means the death

of IT (that is, in-house IT management). Personally, I don't think that'll be the case. Most likely, on-demand computing services delivered over the web will become the preferred option for small- and mid-size businesses that don't have the resources to procure, maintain, and manage super-computing infrastructures. The pay-per-usage licensing model, a common characteristic of cloud services, lets you scale back or scale up computing services depending on workload and peak demands.

We're soliciting cloud-computing story ideas. Please join our brainstorm at deexchange.com/forum/topics/cloud-computing-story-ideas. **DE**



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Dell Braces for Consumerization

It's no secret that PCs, desktops and laptops in particular, have been facing mounting pressure from their smaller, nimbler competition: handheld tablets and smart phones, a market currently dominated by Apple's i-devices. PC maker Dell has been sizing up the competition. It singled out five top trends reshaping the future of business computing:

- The rise of social media as a business application;
- The blurring of work and home;
- The emergence of new mobile devices;
- Shifting business models that require tech-savvy employees; and
- Changing employee expectations of corporate IT.

"How data is stored, how computing is done is changing," notes Steve Lalla, Dell's vice president and general manager, Business Client Product Group. The five trends listed above attest to our desire "to be able to do what we do in our personal life in our professional life," as Lalla put it. More succinctly, Dell calls it "Consumerization."

Thinking about outlawing your employees' iPods, iPhones, and iPads in the name of security? You may end up doing more harm than good. "Corporate IT policies that ban the use of employee-owned devices in the name of security inadvertently create new, bigger security holes as users skirt IT restrictions," Dell points out in its Feb. 3 white paper: "CIO Strategies for Consumerization: The Future of Enterprise Mobile Computing."

Tech analyst firm Gartner notes, "Most organizations realize that they cannot stop the influx of personal devices and are looking to the post-consumerization era, seeking ways to stop managing the devices used by workers." ("Predicts 2011: Network Capacity and

Consumers Impact Mobile and Wireless Technologies," November 11, 2010).

Dell's white paper recommends "evolving security policies to protect data in a heterogeneous device environment." This could be an IT headache because managers would have to manage devices both inside and outside the firewall.

Social Work

Facebook's stats show that, "By the beginning of 2011, the average Facebook user spent 1,400 minutes, or 23.3 hours, on the site each month." Unisys, an IT firm, noted in its "Consumerization of IT Benchmark Study" that "Nearly half of all iWorkers (46%) surveyed give their employers extremely low marks for the integration of consumer devices and social networks with enterprise applications."

For hardware makers like Dell, the rise of social media demands incorporating high-quality audio-video features are a must-have in the era of Skype, WebEx, and remote communication. To resist social media is to stem the tide: You can't win. Dell's recommendation is to "launch enterprise applications that replicate the best aspects of consumer communication and social media within your worker community."

Among professional design software publishers, there's also widespread acknowledgment of the rise of mobile devices and social media. Since lightweight devices are not ideal for heavy-duty computing, companies like Autodesk looks to remote-computing functions and web-based viewing and markup applications as part of its strategy. Product lifecycle management software makers like Dassault



The Dell Streak 5, the computer maker's product to capture the mobile device market share.

Systèmes and PTC now offer community management, data management, and collaboration applications inspired by social media.

One behavioral change brought on by the popularity of portable devices: People have become more accustomed to multi-touch navigation. Apple's i-devices taught people a new way to interact with displays. We now instinctively drag on images and program windows to expand them, or tap on links to open them. The paradigm is not fully supported or exploited by desktop and laptop makers, but Dell has begun incorporating many such features into its latest machines.

Perhaps the Dell segment best-positioned to take advantage of Consumerization is the company's new smart phones and tablets (most of them running Android and Windows Mobile) and convertible PC tablets (running Windows 7). Dell's Streak 7, a camera-equipped mobile device with 7-in. multi-touch display, is powered by NVIDIA's ARM and Tegra T20 processors, running Google Android OS. Dell Venue, a slide phone with multi-touch enabled 4.1-in. display, runs Windows 7 and is equipped with a 5-Megapixel built-in camera. Dell Inspiron Duo, powered by dual-core Intel Atom N550, comes with a 10.1-in. HD display with multi-touch function. For photos of the products, visit the DE Exchange album titled "Feb 8, 2011: Dell Product Launch" at deexchange.com. **DE**

Mobile Engineering

Software manufacturers respond to an engineering workforce on the go.

The reality of anywhere, anytime computing is not being ignored by engineering software developers. It's easier than ever to share your work, either for collaboration or to sync it with your own mobile devices. Here are just a few examples of how you can take your data with you.

AutoCAD WS Supports Inventor

Can AutoCAD WS become Autodesk's own Acrobat-equivalent for DWG files? It certainly looks like the company is pushing it as its universal DWG viewer. Autodesk has given people one more reason to consider its mobile app as the de facto DWG viewer and editor for those on the go. AutoCAD WS now supports DWG files published from Autodesk Inventor.

A casual search for the keyword Autodesk on iTunes and Apple App Store reveals AutoCAD WS, Autodesk Inventor Publisher Viewer Mobile, and SketchBook Mobile, among others. Originally codenamed Project Butterfly, AutoCAD WS began as a web-hosted, browser-based DWG viewing and editing program on Autodesk Labs. Released alongside AutoCAD for Mac in August 2010 (read David Cohn's review on page 30), AutoCAD WS and AutoCAD make a formidable combo for rivals trying to unseat AutoCAD. With device-level support for iPhone and iPad via mobile apps (which is different from supporting mobile devices via web browsers), Autodesk made DWG markup a truly portable operation, allowing those in the field — manufacturing plants and construction sites, for instance — to interact with design data hosted online.

After publishing the DWG file from Autodesk Inventor, you can email the file to someone or post it somewhere online so iPad and iPhone users can

access it. To use AutoCAD WS, you need an Autodesk log in (the same credentials for Autodesk University or Autodesk Labs will work). If you receive your DWG file in your inbox in your mobile device with AutoCAD WS installed, you'll be prompted to use AutoCAD WS to launch the file.

The latest release, AutoCAD WS Mobile 1.2, marks the debut of certain new features:

- Setting line width for the free lines you use to sketch or scribble text;
- Tapping to select objects and text for copying and pasting;
- Magnified snap areas; and
- Displaying dimensions in inches and feet, as created in the original file.

Autodesk's rival, Dassault Systèmes,

develops and distributes, also for free, a 2D drafting program called DraftSight, but the software is not available for mobile devices. Dassault Systèmes offers 3DVIA Mobile, an application for viewing models published in common CAD and 3D formats, for \$1.99 on iTunes.

Analysis at Your Fingertips

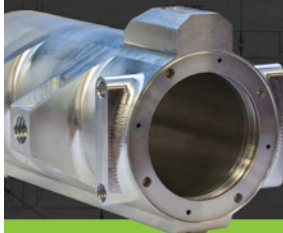
NEi Software's upcoming FEA application will put analysis at your fingertips, literally. Developed for iPad and iPhone, the software takes advantage of remote computing clusters and hosted software to let you conduct simple FEA tests on basic shapes, then retrieve the results in a combination of statistics and graphics — all done over the Internet.

In this debut release, you may select



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the basic shape you wish to analyze, enter its dimensions, specify force or pressure, specify the direction of the force (by selecting a surface or edge with your fingertip), specify material, and then let the application run.

It uses computing horsepower and solvers hosted elsewhere, allowing you to access and run it from an iPhone or an iPad. But the technology working behind the scene is the same NEi Nas-tran software you've come to know and respect. This could be the beginning of a new wave: FEA on demand, accessible from mobile devices previously considered unsuitable for analysis.

Mobile devices are still too lean and limited to run computing-intense applications like FEA or CFD. Nevertheless, using the web-enabled device as a portable terminal to communicate with remote servers, you may bypass the need to process FEA and CFD algorithms on your local hardware.

With this version from NEi, you cannot upload your own geometry or mesh model to solve in the cloud. But I'm willing to bet NEi—or someone else—is already working on such a solution.

When the application becomes available publicly may depend on Apple, the custodian of iPhone and iPad apps. The program must go through Apple's review process before it appears in the iTunes app store.

Autodesk Inventor Publisher Exports to Mobile

Autodesk Inventor Publisher is one of the CAD-related professional software packages that someone with limited exposure to CAD can pick up and begin using with almost no training. Most people would probably use it for producing animation sequences and interactive documents, using CAD models already in their possession as starting points.

Inventor Publisher's basic features—adding call outs, colors, and arrows—are intuitive and easy to understand. The drag handles it uses to reposition or resize these elements are nearly identical to the method you would use to format



With support for publishing to mobile devices, you can create animated instructions viewable on the iPod Touch, iPhone, or iPad.

2D images in Microsoft Word, PowerPoint, and Adobe Illustrator, so if you're marginally familiar with Office products and vector drawing programs, you'd be able to pick up Inventor Publisher in no time. The same may be said of Inventor Publisher's use of a color wheel to change your parts' colors.

To create animation sequences, you'll use snapshots to create interval steps along a timeline: for example, remove Bearing A in snapshot one, remove Bearing B in snapshot two, remove Shaft One in snapshot three, and so on. Inventor Publisher 2011 comes with a wide range of preset display styles (a much greater variety than the previous release offers).

By default, Inventor Publisher exports animations as AVI files. To publish to mobile devices, you need a few things. You'll need a mobile device (obviously), an Autodesk ID (the ID and password you use for Autodesk University or Autodesk Labs should work), and a mobile app called Inventor Publisher Mobile Viewer (free on iTunes app store). When you publish your document, by default it gets uploaded to your private folder on Autodesk's server.

Another alternative you have is to check the Share option (in the custom configuration dialog box available through Publish). This generates a clickable link, emailed to you so you can in turn forward it to your intended recipient.

I find this setup a bit daunting, as the link—not a browser-recognized URL but a link recognizable to Inventor Publisher Mobile Viewer app—is not easy to share without a chunk of footnote (otherwise, whoever receives your email would be at a loss as to what to do with it).

A more straightforward approach may be to allow MPEG-4 or QuickTime export, with presets that match typical iPod and iPad aspect ratios. This would make it possible for users to upload the video file to a site, recognizable by any mobile browsers, or forward the file itself to anyone with a mobile device.

If you do choose to publish your tech documents as Inventor Publisher Mobile files, there are some advantages. Unlike an animation file or a video file, you can pause an Inventor Publisher Mobile sequence, rotate it, zoom in, zoom out, and inspect each component from any given angle. Bear in mind, however, that the recipient would need the free viewer installed on his or her device to take advantage of these added functions. **DE**

Kenneth Wong writes about technology, its innovative use, and its implications. One of DE's MCAD/PLM experts, he has written for numerous technology magazines and writes DE's Virtual Desktop blog at deskeng.com/virtual_desktop/. You can follow him on Twitter at [KennethongSF](https://twitter.com/KennethongSF), or send e-mail to de-editors@deskeng.com.



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NVIDIA Launches its CUDA Toolkit 4.0

New GPU development tools makes porting engineering applications simpler.

BY PETER VARHOL

As graphics processing units (GPUs) move into mainstream computing for computationally intensive tasks, NVIDIA is supplementing the hardware with an increasingly comprehensive software development toolkit, the NVIDIA CUDA Toolkit 4.0. This toolkit provides capabilities to improve computational performance of parallel operations on multiple GPUs, speed porting of existing applications to the GPU, and provide software developers with more tools to enable them to produce fast and high-quality applications.

The CUDA Toolkit 4.0 was announced on February 28, and the release candidate was made available to registered developers on March 4. This new toolkit includes the ability of multiple GPUs to work together more seamlessly, without intervention of the workstation's CPU. It also provides for a unified addressing model for memory, which enables programmers to more easily port applications and use data that

"There are 250 million CUDA-capable GPUs deployed in systems."

resides in either CPU memory or GPU memory.

Lastly, this version also incorporates a greater range of developer tools. These tools include a performance analyzer, binary disassembler, and debugger for both PCs and the Mac OS. These are common for mainstream operating systems on CPUs, and are just starting to come into their own for GPUs.

Moving GPUs and CUDA into the Mainstream

According to Sanford Russell, director of CUDA Marketing at NVIDIA, the intent is to move GPU computing more toward commercial endeavors, such as mainstream design engineering, as well as fields such as finance, embedded systems, and even commercial business. "There are 250 million CUDA-capable GPUs deployed in systems," he explains. "This technology is established and ready to run a wide variety of software."

CUDA IN BRIEF

CUDA, which stands for Compute Unified Device Architecture, is NVIDIA's parallel computing architecture for use with the company's graphics processing units (GPUs). While these processors offer performance advantages over traditional CPUs for many engineering computations, they require software providers port their applications to run on these processors.

Russell also goes on to explain that as GPUs become more readily available on workstations, and the programming tools become better, many mainstream engineering applications are being ported to the GPU and CUDA.

"Structural mechanics applications are readily available to run on the GPU," he says. "GPU fluid dynamics applications are reaching the mainstream, which other areas in engineering computation are also making strides."

Russell notes that around 90% of the workstations sold to engineering groups either already come with one or more GPUs or offer GPUs as an option. This serves to make the technology increasingly available to engineering users.

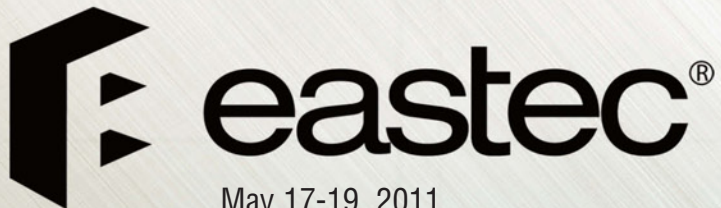
In addition to supporting C and C++, the most common languages used for commercial engineering applications, NVIDIA offers wrappers for Java, and has partners who support Fortran and Microsoft's .NET platform and languages.

Many design engineers' workstations probably already have GPUs installed. If you have your own source code, it's easier than ever to port it to run on CUDA GPUs. If you're looking toward commercial design and analysis applications, chances are your preferred vendor is supporting NVIDIA GPUs today, so ask if that software is available for your next upgrade. **DE**

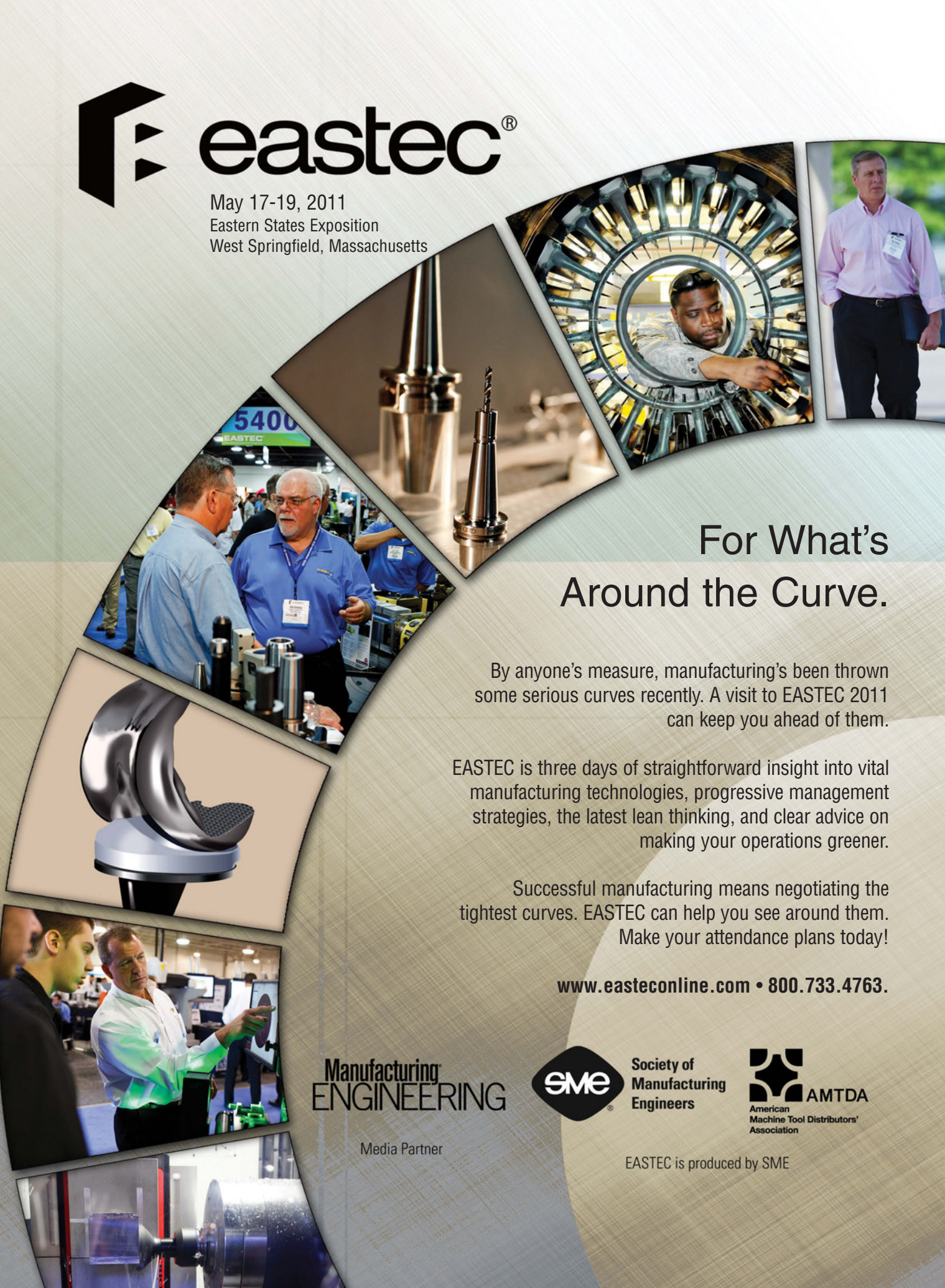
Contributing Editor Peter Varhol covers the HPC and IT beat for DE. His expertise is software development, math systems, and systems management. You can reach him at de-editors@deskeng.com.

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May 17-19, 2011
Eastern States Exposition
West Springfield, Massachusetts

A collage of images related to manufacturing and the EASTEC event. It includes: a man in a pink shirt standing; a man working on a large circular machine; a close-up of a drill bit; two men in blue shirts talking at a booth with a '5400 EASTEC' sign; a robotic arm; and two men looking at a computer screen.

For What's Around the Curve.

By anyone's measure, manufacturing's been thrown some serious curves recently. A visit to EASTEC 2011 can keep you ahead of them.

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Visualizing the Forest Beyond the Trees

Visual data management offers greater insight to projects.

BY KENNETH WONG

Allen Gager frequently goes hunting. He doesn't use a crossbow or a shotgun; instead, he fires up Autodesk Inventor. He's looking for what he calls "wild files," nesting somewhere deep within the assembly trees of his design files.

"We have a lot of data in (Autodesk Vault) that came from somewhere out in the wild," says Gager, a mechanical engineer for the global packing machine manufacturer KHS. "Basically the files were distributed across network drives. They're now in a single managed repository."

Many of these wild files have dubious provenance, with undetermined revision histories. "For example, everything housed in Vault (the data-management system for Inventor users) is now revision-controlled at the file level," he says. "But because there was no good way to manage revisions previously, Vault couldn't determine the revision level of some imported data."

Addressing those files via traditional means would involve:

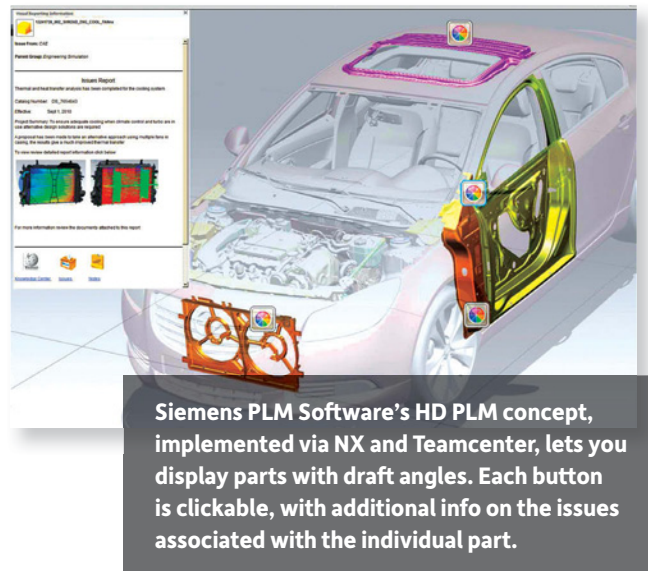
- 1** Identifying them in the data management software to obtain their part numbers.
- 2** Opening the assembly files where they're embedded in the CAD program to inspect them.
- 3** Declaring them safe to use in the data management system or fixing them in the CAD program.

"One of the things that (Autodesk Vault's) visual data mapping allows us to do is to quickly single out files that are not compliant," says Gager. "This lets me see which files are not, and then I can determine which have the proper revision, or which need more investigation."

Visual data mapping in Autodesk Vault lets you use part properties as filters and display different classes as color-coded clusters, right from the CAD modeling environment. A similar approach has been proposed by Siemens PLM Software, under the name HD PLM. It displays product data housed in TeamCenter data-management software within 3D assembly models constructed in NX. A significant departure from data-management solutions constructed in rows and columns, visual data management might yield new insights previously unavailable.

Visual Vault

Last April, Autodesk gave members of the trade press an early look at Autodesk Vault's visual data mapping, set to become part

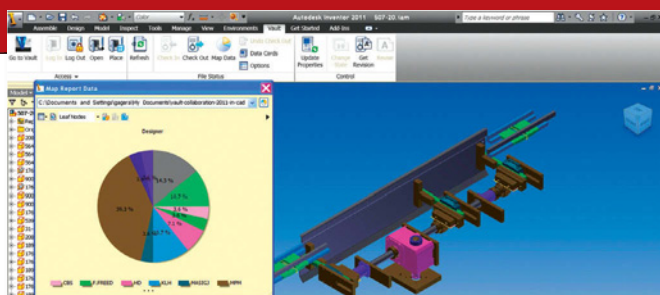


of Autodesk Vault 2011. Want to see which parts are overdue? Which ones are from overseas subcontractors? How about parts that have passed QA check? Whatever you'd like to see, you'll be able to display it right in your CAD modeling environment, Autodesk Inventor. Even though the data associated with each part—part number, check-in/check-out dates, ownership, revision history, and other properties—is stored and managed in the data-management environment, the CAD program becomes the environment to query, retrieve, filter, and view the data.

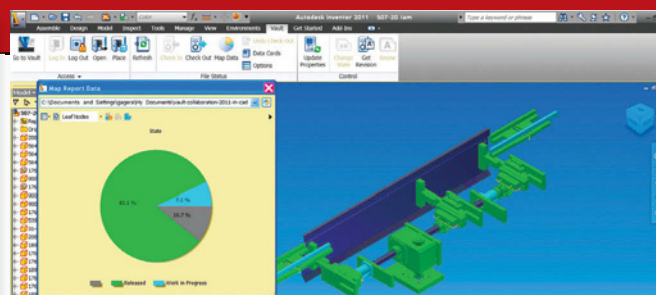
"I no longer have to manage my CAD data in a spreadsheet like an accountant, I don't have to focus on rows of data," says Gager. "(In Vault's data mapping), I can see the graphical picture, in the colors that are pleasing to me, right in my CAD model."

Color displays in Vault are not permanent designations in your CAD files. They're simply a method for you to quickly isolate and view parts with selected characteristics (for example, parts that have not been stress-tested or parts that are currently checked out). So, for project managers like Gager, the visual display is intuitive and reduces complexity to modeling workload.

"We offer our engineers flexibility, because individuals see colors differently," explains Gager. "The mapping technology uses a report that's easily configurable (in Vault). So I can set up the report, and let everyone see parts in the same color (for instance, blue for all parts that are checked out). My en-



The use of data mapping with Autodesk Vault lets engineers from packaging equipment manufacturer KHS to display different part clusters based on their attributes.



Using Autodesk Vault's data mapping, KHS identifies parts that have been released, and those that are in progress.

engineers may also see the data they want to see, in the manner they want to see it. In that case, it doesn't have an effect on anybody else."

For instance, Gager may choose to view all files below Revision B in Yellow, whereas a colleague of his may choose to view them in Red. If you prefer consistency, however, you may do what Gager is considering: Set up report templates so that there is company-wide agreement on what each color means.

From Data Overload to Filtered Views

Because most data management tools are designed for use by everyone, very few of them are designed for anyone in particular. Therefore, no matter what your priority is, you must sift through dozens of—or, in some cases, hundreds of—data fields to identify the ones you need. It is—and still remains—a major source of frustration for those who are forced to work within the confines of a rigid data management system. The configurable environment in Autodesk Vault, along with its graphical approach, is expected to make data-filtering a lot simpler.

Gager, for instance, is involved in identifying imported files and then migrating them into the "trusted" category. Consequently, when he opens assembly models, he's only interested in parts marked "wild files" and those marked "trusted." Promoting wild files to the "trusted" class after verification is as simple as right-clicking and changing its categorization—no need to launch a separate data-management program window.

By contrast, Gager's colleagues who are responsible for developing a new design might be more interested in parts manufactured in-house or parts from a certain vendor. Those in purchasing and acquisition may be more interested in cost. Whatever the desired fields, each user can isolate, view, and perform maintenance operations on them as a group, without paying attention to unconcerned fields.

"Any property you track in Vault can be used for visual mapping," says Gager. "If you have 1,500 parts, and five of them are classified 'wild,' I can just say, 'Show me those in Red.'"

At KHS, Gager and his colleagues often use visual data mapping to identify files checked out to themselves and files checked out to others, treating Vault as "a traffic cop, and providing true collaboration," according to Gager.

High-Definition Product Lifecycle

Siemens PLM Software first introduced HD PLM in November 2009, in a video clip that highlighted the possibility of using its NX CAD program to search, retrieve, and display product lifecycle data housed in TeamCenter.

"It's not a prerequisite that you need to have both NX and TeamCenter to take advantage of HD PLM," said Paul Brown, Siemens' senior marketing director of NX, in an interview at Siemens PLM Connection 2010 conference. "But the force multiplier is much bigger if you have both ... You can just use NX data, NX attributes, but the scale of what you can report on, what you can drill into is a lot smaller."

All the data housed in NX and TeamCenter are "HD-ready," as Brown puts it. "You don't need a separate file format, you don't need translation." If you'd like to use data from other PLM systems or ERP systems with NX in a similar fashion, however, you may need to do some additional integration work.

Many of us used to receive useful location data, such as bus stops and restaurants, in text. The information was there, right in your phone book, but you had to plot them out on a map in your own time. Then came online mapping applications, ushering in a whole new way of navigation.

The automatic correlation between CAD and data-management systems is a similar watershed moment, unleashing new ways of understanding projects and products. In the PLM industry, some are fond of saying, "PLM's biggest competition is Excel." For years, the spreadsheet was a good-enough tool for homegrown data management. But the emerging breed of visual-data management tools, as exemplified by Autodesk Vault's data mapping and Siemens PLM Software's HD PLM, suggests data-management is finally breaking out of its mold. **DE**

Kenneth Wong writes about technology, its innovative use, and its implications. One of DE's MCAD/PLM experts, he has written for numerous technology magazines and writes DE's *Virtual Desktop* blog at deskeng.com/virtual_desktop. Email him via de-editors@deskeng.com or follow him on Twitter @KennethwongSF.

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Don't Lose Your Cool

How to use thermal bottlenecks and thermal shortcuts to drive design decisions.

BY BYRON BLACKMORE

Computational fluid dynamic (CFD) techniques have been successfully applied to the realm of electronics cooling applications for about 20 years. Despite the powerful advances in solver techniques, parallelization, computer hardware, and ECAD and MCAD interfacing, CFD can still provide only snapshots of the thermal performance in a product. Usually this comes in the form of pictures or animations that display what the temperature field looks like at various locations in the model. This is useful information, of course, because it allows thermal engineers to confirm thermal compliance without building numerous expensive prototypes. Yet the question of what to do next still remains.

Case in Point

Let's say the initial thermal design for a product is put through a thermal simulation tool. The results demonstrate that several components are running too hot. All you really get from the temperature field in this case is an indication that you have a problem. The questions of how and why the design is failing remain unanswered, and it falls to the experience and intuition of the thermal engineer to invent a solution that will satisfactorily cool the product. This nearly always involves creating additional computational "what-if" scenarios and parametric simulations to locate a working solution, and—deadline permitting—the optimal design.

Simulating all possible design choices and selecting the best result is a proven technique, but it has two basic shortcomings:

- 1 The additional simulations required can number in the hundreds.
- 2 Thermal expertise is required to both avoid pursuing thermal design alternatives that have no chance of success, and to identify reasonable design limits for the parametric design space.

The state-of-the-art process for determining thermal design changes has been improved recently with the introduction of a means to visualize on screen two thermal post-processing aids: the "Bottleneck" and the "Shortcut" numbers. These two aids represent a step beyond simply observing the temperatures of a design, allowing an engineer for the first time to fully understand why a component within a product becomes hot, and how to go about fixing it efficiently. It's the on-screen indication of "why" and "how" that's important here, establishing a systematic means to troubleshoot thermal issues efficiently and reliably.

To understand why that is so, let's look at what the Bottleneck and Shortcut numbers are really showing us.

The Bottleneck Number

How easily the heat passes from the various sources to the ambient will determine the temperature rise at the sources and all points in between. The heat flow paths in an electronics product are many and complex, each one carrying portions of the heat with varying degrees of ease. Paths that carry a lot of heat and impede that heat flow significantly are thermal "bottlenecks."

Relieving the bottlenecks through a redesign would allow the heat to pass to the ambient more easily, thereby reducing temperature rises along the heat flow path all the way back to the source. Identifying the location and strength of these bottlenecks provides insight into the how and why of observed temperature behavior, and consequently can be used to guide thermal design decisions.

Typical methods used to relieve identified thermal bottlenecks in an electronics product include:

- Using a more thermally conductive material or adding copper pads or fills to sections of a printed circuit board (PCB).
- Increasing the cross-sectional area of a conduction path, such as by widening a heat sink base or fin.

The Shortcut Number

As a twist on the Bottleneck number, one can imagine that instead of relieving a thermal bottleneck, one might simply go around it by creating a new conduction path. The best areas in a design to build a new conduction path are called thermal Shortcut opportunities.

A large Shortcut number will appear when the heat flow is moving in the wrong direction. "Wrong," in this case, means it is not moving in a straight line toward the ambient (or locally cooler) area of the design. Like the Bottleneck number, the Shortcut number offers insight into how and where the thermal design can be improved.

So far, the Bottleneck and Shortcut parameters have been framed in the context of conduction within solid objects. But the Shortcut number has implications at a convective surface as well. The underlying mathematics of the Shortcut number provide a correlation with local Nusselt numbers—that is, both will have large values where convection heat transfer is efficient.

Evaluating a local Nusselt number outside of simplistic geometric and fluid conditions can be cumbersome. Thus, using the Shortcut-Nusselt number correlation is an efficient means to identify and visualize effective convective surfaces, offering additional insights into thermal design performance.

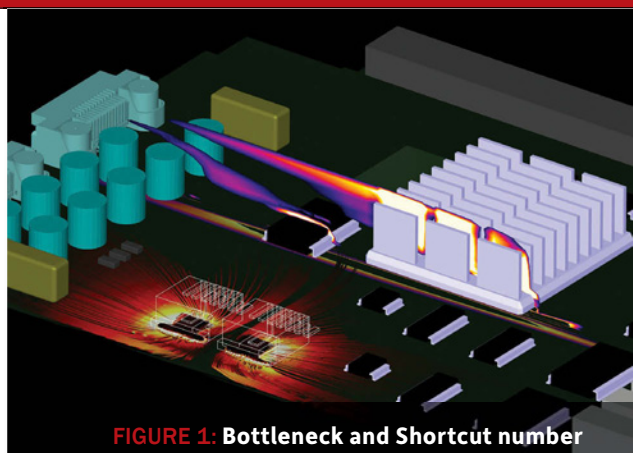


FIGURE 1: Bottleneck and Shortcut number distributions for a typical electronics printed circuit board.

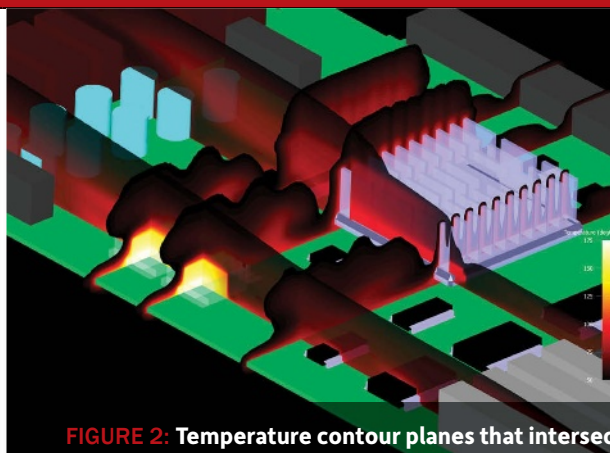


FIGURE 2: Temperature contour planes that intersect the TO devices and heat sink. Temperatures below 50°C have been hidden for clarity.

A Design Change Strategy

The general strategy is to perform a simulation and inspect both Bottleneck and Shortcut fields to determine which areas of the design should be prioritized when considering thermal design changes. Armed with information about Bottleneck and Shortcut opportunity locations, targeted design changes can be developed. The exact details of the changes will be determined by other design constraints (electrical, mechanical, cost) and how evolved the complete design is.

Generally speaking, Shortcut-inferred design changes should be considered first, as the creation of a new heat transfer path can completely change the heat flow topology for a design, and cause pre-change bottlenecks to greatly diminish in importance. After all, the new conduction path may bypass previously existing bottlenecks.

In Figure 1, we have the thermal simulation results for a PCB being cooled by forced convection. There are two types of information on display here:

1 The pair of TO-263s (shown in wireframe) is displaying heat flow lines that emanate from the die. These heat flow lines are colored by the Bottleneck number. In this case, the white color indicates a near-maximum level bottleneck, and black means a small Bottleneck number. The strongest bottlenecks for these components occur where the heat begins to enter the PCB from the copper spreaders. This area should be addressed first when considering a design change to reduce the TO-263 junction temperatures. As mentioned earlier, one possible way to relieve a thermal bottleneck is to introduce locally a material with a larger thermal conductivity. In this context, introducing a copper fill area to the PCB would be an excellent design change.

2 There is a contour plane showing the Shortcut number positioned such that it is near one line of heat sink fins. Again, we're using white to represent larger Shortcut values, and black to represent small values, although the color range differs from that of the Bottleneck scale. As the Shortcut number corresponds well to the Nusselt number, we can see that the top portion of the leading fin is not as efficient at moving

heat into the airstream as the ones behind it. If the design were under pressure to reduce cost, removing this section of the heat sink would be a reasonable place to start, as we would be reducing material costs in a location where the thermal performance hit will be minimized.

At this point, the designer would introduce either of the changes above and redo the simulation. The updated results would have a new set of bottleneck and shortcut targeted areas, from which a second design change can be derived.

Now let's compare the design work flow for the case where we have only temperature results to guide us, as shown in Figure 2. For the TO-263 devices, the practitioner would, by comparing the observed junction temperature values to the maximum rated values, recognize that a thermal problem exists. The workflow from this point involves drawing on the experience of the engineer to determine a course of action. This might include heat sink design or adding thermal vias, larger spreaders or copper fills, each of which will involve many additional what-if scenarios or parametric investigations.

Using the Bottleneck and Shortcut fields together provides valuable design insight as to why the temperature distribution for an electronics system is what it is. Application and interpretation of these post-processing parameters offers a methodology for determining the most promising thermal design improvements, without necessarily relying on thermal experience and intuition.

This is an important gain in simulation productivity: Rather than simulating potentially hundreds of thermal remedial actions and choosing the best one, engineers can now pinpoint on-screen where the best design changes are most likely to be found—and start designing. **DE**

Blackmore is electronics cooling product manager for Mentor Graphics Corp. Send e-mail about this article to de-editors@deskeng.com.

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An Introduction to Multiphysics

COMSOL Version 4.1 makes the concept easily accessible to design engineers.

BY VINCE ADAMS

“It’s a multiphysics world,” says David Kan, vice president of sales, Southwest USA for COMSOL, Inc.

But what is multiphysics, and why do engineers need to embrace it?

Finite element analysis (FEA)-based simulation of single-physics problem simplifications, such as stress or fluid flow, has become accepted practice in most industries. This growth has been accelerated by the availability of integrated FEA tools in CAD and solid modeling products. While there are many cases where single physics simulations are still satisfactory, increasing pressure to create more realistic virtual prototypes to accelerate the design process and reduce cost requires a more all-encompassing approach.

The most common types of multiphysics, or multi-domain, problems being explored at the design level include:

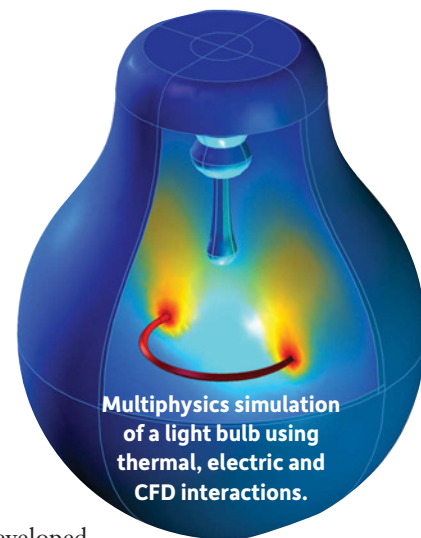
- flexible bodies in multi-body dynamics (mechanism) simulations;
- fluid-structure interactions;
- chemical reactions coupled with fluid flow;
- resistive heating created by electric current flow; and
- thermal stress.

Multiphysics as a Design Tool

COMSOL Multiphysics has now linked its simulation tools to the design process. Version 4 represents a major revision to the interface and usability of the product. Improvements include the COMSOL Desktop featuring the Model Builder and the Live Link suite of products that integrate COMSOL multiphysics model to standard CAD packages.

COMSOL also augmented its existing Parasolid-based CAD Import Module with geometry import and export capabilities that can ease the migration to multiphysics for engineers. This was enhanced in Version 4.1 to include helical sweeps, parametric 2D and 3D curves, and geometry sweeps along 3D curves.

Dr. Darrell Pepper, interim dean, College of Engineering, University of Nevada, Las Vegas, says he believes the new interface will enable a new generation of engineers to innovate by making multiphysics accessible to students and design-level users.



“My students have developed revolutionary concepts, from inflatable wind turbines to solar-powered aircraft,” he says.

The LiveLink suite of products, introduced in Version 4, establishes an associative connection between COMSOL and the solid modeling of CAD tools such as Creo Elements/Pro, Autodesk Inventor and SolidWorks. A change of a feature in the CAD model automatically updates the geometry in COMSOL Multiphysics, while retaining physics settings. Geometric parameters defined in CAD can be linked to the user’s simulation geometry. This enables multiphysics simulation involving parametric sweeps and design optimization directly from within the CAD program.

Material properties can now be conveniently linked to geometry in Version 4, set once for the entire model. The materials library in COMSOL includes more than 2,500 entries, many with non-linear and temperature-dependent properties. Users can define their own materials or update existing library materials to better suit their needs.

New Desktop Environment

For current users, the most striking difference in COMSOL Version 4 is the new desktop environment. Many productivity-enhancing features have been incorporated into this new interface that will benefit veteran and new users alike.

A feature-tree structure, called the Model Builder, now captures model structure and simulation workflow in addition to properties and settings. COMSOL has introduced Sequences, which are feature tree objects that represent steps in a solution or project. These can be re-ordered, activated independently or copied for repetitive tasks. Solver sequence objects allow users to easily declare the results of one study as the initial conditions of a subsequent one.

Version 4.1 expands the Copy/Paste functionality, which will allow users to rapidly build complex sequences with minimal duplication of effort. Undo/Redo was also added in version 4.1.

Users can also access multiple solutions or iterations from

the Model Builder tree for quick visualization and comparison. These comparisons can also be incorporated into detailed reports using the enhanced auto-report generation feature.

Another important feature of the new Desktop is window manipulation. Windows or menus can be docked or undocked for user-customizable screen organization. Wide-format monitor support has been added, and windows can be detached from the primary desktop for efficient use of multiple monitors.

Up to the Challenge

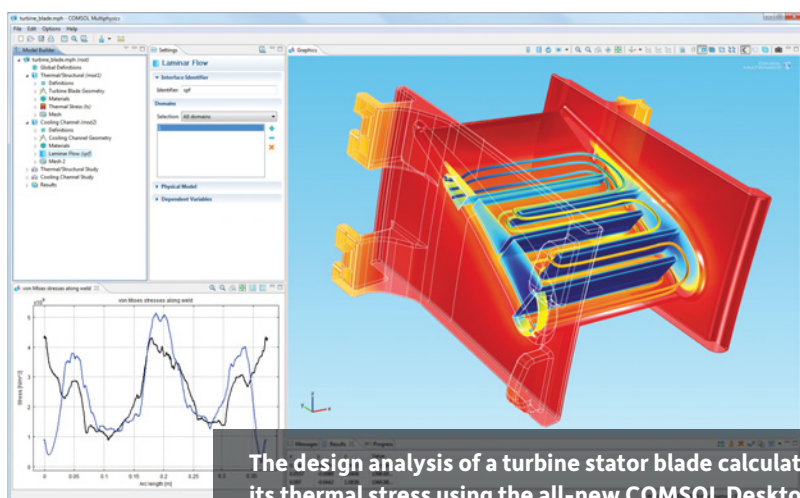
Pre-defined multi-physics combinations can be easily accessed using the Model Wizard, so there are few limitations on the problem complexity one can construct. COMSOL now offers vertical applications using the multiphysics engine for more full-featured computational fluid dynamics (CFD), plasma modeling, and batteries and fuel cells. These can incorporate interactions among chemical, electro-magnetic and fluid flow responses.

Version 4.1 provides a revamped interface for modeling lead acid batteries, and has added a Spalart-Allmaras turbulence model to the CFD module.

Finite Element meshing is a key part of any COMSOL multiphysics project. The Live Link suite of products and parametric-associativity to geometry in COMSOL Version 4 has made this task manageable and controllable for a design environment. This was enhanced in version 4.1 to provide physics-based meshing. Because the meshing needs of a stress solution are different than a CFD study, for example, analysts working in multiphysics have had to balance solution accuracy with modeling efficiency at this stage of problem set-up. Now, in CFD and plasma physics solutions, the software will adjust the mesh to the requirements of the problem automatically.

For effective completion of complex models, COMSOL has added the ability to post-process, or view calculated data, during the actual solution so problem set-up or assumption errors are more easily detected without having to wait out a lengthy completion. In version 4.1, the actual equations being solved are displayed so that users have an additional level of confidence in the process. Results from multiple solutions can be viewed at the same time. Polar plots and the ability to switch time-based solution data to the frequency domain for outputs such as fast Fourier transforms (FFTs) were added in version 4.1.

High-performance computing (HPC) is available with a floating license of COMSOL. This is important to users who build larger models with a variety of physical interactions. To simplify access to this feature, there are no pay-per-core or other model-size related charges. Termed "All Inclusive" by COM-



The design analysis of a turbine stator blade calculates its thermal stress using the all-new COMSOL Desktop in COMSOL Multiphysics Version 4.

SOL, a floating license enables customers to solve a single problem on clusters, with no limit on the number of nodes. Clusters are supported on Linux or Windows HPC Server 2008.

"Customers with a floating network license of COMSOL can run a simulation on any number of nodes for cluster computing at no additional COMSOL licensing fee," explains Bernt Nilsson, COMSOL's senior vice president of marketing. "This distinguishes COMSOL Multiphysics from other developers of simulation software who price their applications proportional to the number of computers and processors available to the user."

Another Version 4.1 feature that has a direct impact on large-model users is the auto-recovery option. The longer the run, the greater the chance that hardware problems such as server or desktop crashes—even power failures—will render hours of run-time useless. COMSOL version 4.1 now saves restart data regularly so in the event of such a failure, the model can be continued practically from the point of stoppage. A related Version 4.1 feature is the ability to Pause and Restart a job, either in anticipation of a computing problem or simply to interrupt the long solve for something more urgent.

COMSOL reports a user-base of more than 60,000 users worldwide. **DE**

Vince Adams, currently an account manager for LMS, is a longtime simulation educator, consultant and speaker. He has authored three books on finite element analysis and numerous magazine articles. Contact him via de-editors@deskeng.com.

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Working the Remote

There are advantages and disadvantages to working outside the office for everyone involved: the employee, the company and the community.

BY MIKE HUDSPETH

I heard an interesting statistic recently that got me thinking. Someone I know said that more than 100 million Americans work remotely. That number sounded a bit high to me. The last U.S. Census data I've seen said there are slightly more than 300 million Americans. So that would be just about one third, or one out of every three people in America working remotely.

The next thing I thought was what does that mean, working remotely? Is that working from home? Does it include remote offices? Do those people do it all the time, or just part of the time? Maybe all of the above.

As I delved into the statistic, I found some fascinating facts. It seems that while almost 50 million American workers (roughly 40% of the working population) could work away from a traditional office, only 0.5% of them actually say they do.

Defining the Concept

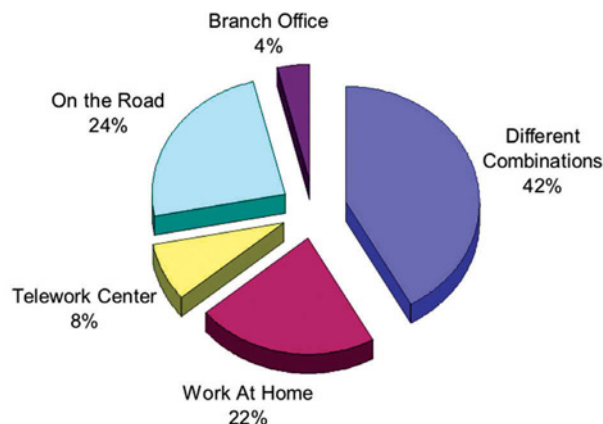
Many Americans work out of their homes. That generally means they have an office set up in their home in which they spend a lot of hours, either online, on the phone or both. According to the U.S. Census Bureau's report, "Home-Based Workers in the United States: 1999-2005," there were more

"An increasing percentage of the work force is spending at least some time working from home."

than 11 million home workers in the U.S. in 2005—half of whom make more than \$75,000 a year. The mean monthly earnings of all home workers was somewhat lower, however, at around \$2,400/month.

Of course, those who made more money also worked more hours—11 or more hours a day. But though they put in longer hours than their more traditional brethren, they reported increased flexibility. Some other fast facts: Almost a quarter of home-based workers reported their hours varied. Home-based workers make up more than 8% of the American workforce. There are just slightly more female home-based workers (51%) than male. The vast majority of home-based workers are between the ages of 35 and 64. And while nearly half (47%) of

American Telecommuters Work From:



Flexibility is one advantage to telecommuting.

Data source: *Dailywireless.com*

home-based workers have college degrees, the numbers fall off sharply with less education.

With the exception of the call center industry, there aren't many companies that employ large numbers of home-based workers. But when companies do allow employees to work from home, they view it as an employee benefit—not something that is overly beneficial for the business.

The Remote Office

Probably the most common remote working alternative is the branch office. In today's environment, the business you walk into or call is not likely to be the home office. The branch office is a great way to capitalize on talent that may be local to a particular city or region. Is your customer the U.S. Army? Doesn't it make sense to locate next to a base where it's convenient to interact with them? Your manufacturing plant has been where it's at forever, and to relocate it would be cost-prohibitive. What do you do? Open a branch office.

The local community benefits because of the added jobs. The company benefits because of the increased talent pool and efficiency of proximity. The employee benefits, obviously, because he or she doesn't have to pull up stakes and move.

Of course, there will be a certain cost involved. The com-

PROS AND CONS OF WORKING REMOTELY

One major advantage to working from home is the commute—or lack thereof. How many hours during the week do you spend sitting in rush-hour traffic just trying to get to and from your office? If you're like most Americans, you're alone in your car. That uses up a lot of time, gasoline, money and patience. Think how much better you'd feel rolling out of bed, dressing more comfortably, and having all that extra time to get ready to tackle the world.

And unless you have a webcam watching you, you can even work in the stereotypical bathrobe and slippers. Because you have a completely different work environment at home, you can be more relaxed. That's good for your concentration.

Telecommuting is also cheaper for the worker because you aren't burning the money in your gas tank and putting yourself at risk in traffic. It's cheaper for companies because they don't have to run the lights and equipment in your office. It's more efficient and greener for the environment (less pollution). What's not to love?

Well ... every coin has a flip side, and this one is no different. There are distinct disadvantages to working from home.

pany will need to finance the office. Equipment will need to either be purchased or shipped to the location. Secure lines of communication will need to be set up. Some duplication of function will be unavoidable, as every location will have common needs that just aren't well supplied over long distances.

Still, there are many tools a company can use to overcome distance.

John Preston, a mechanical engineer with Baton Rouge, LA-based The Shaw Group, is based in Charlotte, NC. He manages a geographically dispersed team of engineers with locations in North Carolina, Colorado and Texas. Preston explains that web-based networking helps him work with offices across the United States. Corporate data can be accessed over the company intranet, thus ensuring that everyone is working with the latest information.

The Shaw Group uses Knovel software to access technical data. It ensures everyone is looking at the same information. They also use products like Microsoft Office's Live Meeting for drawing review, and EMC Software's Documentum for data storage and retrieval.

When you are working with a dispersed work force, "you have to be very intentional about talking to team members," Preston says. "Technique variation is an issue."

Everyone has their own way of doing things. To succeed, your company has to be a team. That means everyone must play by the same rules. And as Preston points out, "time zones cause extra focus."

When your company doesn't want to go to the expense of a branch location but is willing to allow you to work remotely, they may opt for the office park, or Telework Center. This is a place where you have a traditional office space to which you can go. It has all the hook-ups and equipment needed to con-

duct business. Many people prefer it because of the office atmosphere. The commute to an office park is usually shorter than to an out-of-town corporate headquarters. That makes it an attractive alternative to relocation should a company's talent and place of business not coincide.

First and foremost, there are more distractions in the home, especially if you have others in the house. During school hours you may be by yourself, but what about when the family is at home (summer vacation, school holidays and the ever-popular snow days)? Kids are perhaps the greatest gift you can have in your home, but let's face it, they are noisy. They like to run and jump. They like to play and laugh. They like to watch TV—usually with the volume turned up too loud. These habits are not conducive to your concentration.

And it's not just the kids. The "spousal unit" will frequently come a-knockin' to ask you to take care of something around the house. If you were at the office, it would be unthinkable to ask you to drop what you're doing and come home to take out the trash or reach up to that high shelf in the closet. But since you are already there... and you're just sitting at your desk... it won't really take you that long, anyway.

One important disadvantage to working from home is communication. Face-to-face communication is a very important part of almost every business, either between you and your team or you and your customers.

Last, but not least, there are lots of people who don't work solely out of an office or their homes. Almost 20 million people are occasional telecommuters. Wherever they can get an Internet connection or cell signal is their office: home, office, airport, car or coffee shop, they can do business anywhere. They are the true "road warriors."

In the computer world, it's a given that distributed networks are the best way to go. For an engineering team, the remote office can offer great benefits and potential dangers. Employees must exercise greater discipline, but gain greater flexibility. Companies must resolve security and trust issues, but realize competitive advantage and cost savings. And the customer can find better access to the services they want. That makes for a powerful win-win-win situation. **DE**

Mike Hudspeth, IDSA, is an industrial designer, illustrator, and author who has been using CAD and design products for more than 20 years. He is DE's expert in ID, design, rapid prototyping, and surfacing and solid modeling. Contact him via de-editors@deskeng.com.

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A Dream Machine

The HP EliteBook 8540w mobile workstation with DreamColor 2 display depicts your work beautifully, but taking 1 billion colors on the road has an impact on both weight and battery life.

BY DAVID COHN



In test after test, HP's portable powerhouses have led the pack in features, functionality and performance. And so we looked forward to reviewing the HP EliteBook 8540w mobile workstation equipped with a DreamColor 2 display.

HP's DreamColor technology was announced in 2007, developed from work done with DreamWorks Animation SKG to deliver digital color consistency. It uses an RGB LED backlight and 10-bit graphics card to produce 30-bit color accuracy, providing more than 1 billion colors (compared to a more conventional 24-bit or 16.7 million colors). The DreamColor display comes factory-calibrated, and can be recalibrated using HP's Advanced Profiling Solution (APS) kit. The company's first DreamColor display cost more than \$3,000, but DreamColor 2 is now a \$425 option on this new HP mobile workstation.

The HP EliteBook 8540w is housed in a gunmetal gray HP DuraCase, a brushed anodized aluminum exterior bonded to a magnesium alloy chassis. We first encountered this new design of HP mobile workstations when we reviewed the HP EliteBook 8530w in the March 2009 issue. But while that system appeared more svelte than its predecessor, the 8540w looks bigger and feels bulkier. And it is, on both counts.

This new EliteBook measures 14.7 x 9.9 x 1.7 in., and tips the scales at nearly 7 lbs. The large (6.5 x 2.7 x 1.6-in.), 150-watt AC adapter supplied with our evaluation unit added nearly 2 lbs. more (including cords) to the total package.

The reason for the increased size and heft became readily apparent as soon as we raised the lid. While its predecessor came

with a 15.4-in. display with an aspect ratio of 5:4 or 16:10, the 8540w has a 15.6-in. display with a more modern 16:9 aspect ratio. This enabled HP engineers to include both a full-size, 80-key keyboard and a separate 21-key numeric keypad. HP also touts the keyboard as being spill-resistant—a thin layer of Mylar film under the keys can capture and drain small spills. This is a feature we elected not to test. A touchpad with dedicated scroll zone and three dedicated buttons is centered below the keyboard.

A strip above the keyboard contains the power button and touch-sensitive controls with LED indicators for quickly accessing your email and Web browser when the system is running, or activating HP Quicklook 3 or QuickWeb to access and edit MS Outlook data or open a Web browser, respectively, without actually booting the operating system. With QuickWeb, we were surfing the Internet within about 25 seconds.

Other touch-sensitive buttons enable you to turn wireless functions and the touchpad on and off, adjust sound volume, and access the Windows calculator. There's also a black pointing stick above the B key in the keyboard, with its own complement of three buttons just below the spacebar, as well as a fingerprint sensor in the lower-right corner of the palm rest. Indicator lights for wireless, power, battery and hard drive activity are located on the front-left edge of the case.

Our evaluation unit was powered by an Intel Core i7-720QM processor, a 1.60GHz quad-core CPU with 6MB of L3 cache, matched with 1,333MHz RAM. Although it can reach speeds of 2.8GHz with turbo-boost, this is a much lower clock speed than

what HP provided in the 8530w we previously reviewed. Other CPU options include 1.73GHz and 1.86GHz quad-core processors. The EliteBook 8540w is also available with dual-core processors up to 2.66GHz. All systems use the Intel QM57 chipset.

The quad-core version of the 8540w comes with four dual in-line memory module (DIMM) sockets, whereas dual-core versions provide just two sockets. Our evaluation unit came equipped with 8GB of system memory, installed as four 2GB DIMMs.

While that was more than enough memory for our purposes, if you envision needing more in the future, you could spend \$175 more for two 4GB memory modules, leaving the other two sockets available for later. The quad-core versions of the EliteBook 8540w can accommodate up to 32GB of memory using 8GB DIMMs, but that would add a whopping \$9,071 to the base price.

Stunning Display

The EliteBook 8540w is available with a less-expensive display, but ours came with the 1920x1080, native resolution LED-backlit Full High-Definition (FHD) DreamColor 2 display with anti-glare finish and in-plane switching (IPS) technology that allows colors to be seen more accurately at different screen angles.

HP also offers a choice between an ATI FirePro M5800 graphics accelerator—which supports up to five displays with a

docking station, or three without—and the NVIDIA Quadro FX580M or FX1800M, all of which feature 1GB of dedicated video memory. Our evaluation unit came with the FX1800M, which uses GDDR5 memory. The combination yielded the most beautiful display we've ever seen in a mobile workstation. But DreamColor isn't necessarily for everyone.

Systems equipped with the DreamColor display must also include an integrated 2-megapixel webcam, an option we would have included regardless—but it requires the large 150-watt power supply. The DreamColor display also has a significant impact on battery life.

A small LED light located above the display, just to the right of the webcam, pops out at the press of a button to illuminate the keyboard in low-light conditions. An ambient light sensor below the display can automatically adjust the backlight for changing lighting conditions.

Our evaluation unit came with a 2.5-in. 320GB Seagate 7200rpm SATA drive. Other options include 250GB and 500GB SATA drives and 160GB and 256GB solid-state drives. HP also included a DVD+/-RW SuperMulti dual-layer LightScribe drive. Other options range from a standard DVD-ROM drive to a Blu-ray Disc DVD+/-RW drive, or you can opt for a second 500GB, 7200rpm SATA hard drive.

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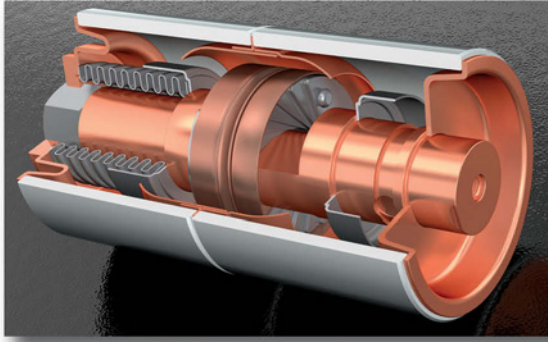


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Mobile Engineering Workstations Compared

		HP Elitebook 8540w mobile workstation with DreamColor display (1.60GHz Intel Core i7 QM720 quadcore CPU, NVIDIA Quadro FX 1800M, 8GB RAM)		Dell Precision M6500 mobile workstation (2.00GHz Intel Core i7 X920 CPU, NVIDIA Quadro FX 380M, 4GB RAM)		HP EliteBook 8530w mobile workstation (2.53GHz Intel Core 2 Duo T9400 CPU, NVIDIA Quadro FX770M, 4GB RAM)		Lenovo ThinkPad W700 mobile workstation (2.53GHz Intel Core 2 Quad Core Q9300 CPU, NVIDIA Quadro FX3700M, 4GB RAM)	Alienware Area-51 m15x mobile workstation (2.8GHz Intel Core 2 Extreme CPU, NVIDIA GeForce 8800M, 4GB RAM)	Dell Precision M6300 mobile workstation (2.60GHz Intel Core 2 Duo T9500 CPU, NVIDIA Quadro FX 3600M, 2GB RAM)
Price as tested		\$3,657		\$4,430		\$2,822		\$3,524	\$4,549	\$3,051
Date tested		12/13/10		4/23/10		12/18/8		10/22/08	10/22/08	8/28/08
Operating System		Windows XP	Windows 7	Windows XP	Windows 7	Windows XP	Windows Vista	Windows XP	Windows Vista	Windows XP
SPECviewperf	higher									
3dsmax-04		43.31	56.10	49.56	52.35	33.38	32.21	34.23	12.12	33.25
catia-02		53.08	59.43	64.31	61.72	42.41	39.75	45.01	13.64	41.85
ensight-03		41.52	41.05	58.28	47.75	37.42	34.24	43.31	15.03	39.91
maya-02		204.12	159.95	283.64	212.05	149.21	108.33	165.87	25.37	168.00
proe-04		57.51	57.06	70.91	61.96	42.92	39.33	45.67	10.28	40.98
SW-01		109.6	102.93	152.41	132.68	67.98	59.75	90.01	17.19	81.50
tcvis-01		29.84	27.15	47.71	39.44	21.42	19.19	28.34	4.48	23.93
ugnx-01		27.75	28.10	39.60	33.64	19.85	18.11	30.91	4.18	24.34
SPECapc SolidWorks	lower									
Score	seconds	198.16	n/a	175.72	n/a	182.63	n/a	187.27	n/a	192.92
Graphics	seconds	67.55	n/a	58.99	n/a	62.16	n/a	60.87	n/a	68.10
CPU	seconds	45.42	n/a	37.62	n/a	39.99	n/a	44.40	n/a	43.81
I/O	seconds	89.8	n/a	83.48	n/a	83.69	n/a	96.66	n/a	85.57
SPECapc SolidWorks	higher									
Score	ratio	4.08	n/a	4.75	n/a	4.75	n/a	4.47	n/a	4.29
Graphics	ratio	2.69	n/a	3.09	n/a	3.26	n/a	3.15	n/a	2.86
CPU	ratio	7.1	n/a	8.58	n/a	8.07	n/a	7.27	n/a	7.37
I/O	ratio	3.53	n/a	3.79	n/a	3.78	n/a	3.65	n/a	3.70
Autodesk Render Test	lower									
Time	seconds	188.5	146.81	168.33	180.16	318.4	324.60	162.00	291.60	319.40
Battery Test	higher									
Time	hours:min	1:28	1:21	2:06	2:05	3:21	3:00	2:15	1:20	3:00

Numbers in **blue** indicate best recorded results. Numbers in **red** indicate worst recorded results.

Connection Options

The EliteBook 8540w offers an assortment of connections. Along the right side of the case are an integrated smart card reader, the optical drive/upgrade bay, two USB 3.0 ports, an RJ-45/Ethernet port for the integrated Intel Gigabit Network, an RJ-11/modem port for the built-in 56K V.92 modem, and a Kensington Security Slot. Along the left side are three USB 2.0 ports, a DisplayPort, an eSATA port, a 1394a/Firewire port, stereo microphone in, stereo headphone/line-out, and an ExpressCard/54 slot.

Across the front are the system's integrated stereo speakers, a media card reader (for SD, MMC, Memory Stick and xD-Picture Card), and a slot to hold a business card (which can then be scanned using the webcam and supplied software). The back of the case has a power connector and external VGA port, with the remainder taken up by the battery. The bottom provides access to the battery release latches, docking port connector, optional battery connector, hard drive bay, and compartments for the memory, WWAN and Bluetooth modules.

Our evaluation unit came with an 8-cell, 73Whr lithium-ion battery for which HP claims up to 5 hours and 30 minutes of life. But in our battery run-down test, our system shut down after just 1 hour and 21 minutes (under Windows 7) and 1 hour and 28 minutes (under Windows XP).

HP provides new Power Assistant software that works in conjunction with Windows 7 to provide better power management for people who are not as familiar with the various settings in Windows 7. But the Power Assistant can't do anything to extend battery life if you're accessing the hard drive or optical drive continuously. HP also offers an extended life battery (\$159), which it claims can increase total battery life to 10 hours.

While the built-in display can handle resolutions up to 1920x1080, the VGA port supports resolutions up to 2048x1536. The DisplayPort can pump out up to 2560x1600 pixels and 30-bit color depth at 60Hz, and supports FHD (1920x1080) monitors with 24-bit color at 120Hz. DVI-I output is also available with the optional docking station (\$299).

Mixed Results

Our test results show how powerful Intel's latest mobile quad-core i7 processors can be despite their slower clock speeds.

On the SPECviewperf test, which looks solely at graphics performance, the HP EliteBook 8540w turned in very good numbers—although not as fast as some other systems with less-powerful graphics accelerators, thanks to the slower CPU.

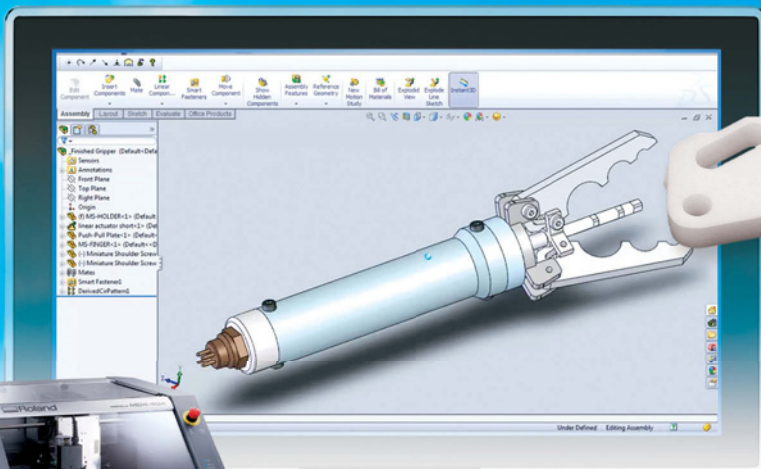
Similarly, in our SolidWorks test (which can only be run under Windows XP and breaks out graphics, CPU and I/O

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HP ELITEBOOK 8540W FEATURES

- **Price:** \$3,657 as tested (\$2,261 base price)
- **Size:** 14.7 x 9.9 x 1.7 in. (W x D x H) notebook
- **Weight:** starting at 6.37 lbs., 6.9 lbs. as tested, plus power supply
- **CPU:** 1.60GHz Intel Core i7-720QM quad-core with 6MB L3 cache
- **Memory:** 8GB 1333MHz DDR3 SDRAM (32GB max)
- **Graphics:** NVIDIA Quadro FX 1800M with 1GB memory
- **LCD:** 15.6-in. diagonal 16:9 LED-backlit FHD anti-glare DreamColor (1920x1200)
- **Hard disk:** 320GB, 7200rpm Seagate 2.5-in. Smart SATA II
- **Optical:** DVD+/-RW SuperMulti DL LightScribe
- **Audio:** microphone and headphone jacks, built-in microphone and speakers
- **Network:** integrated Intel Gigabit Ethernet (10/100/1000 NIC); Intel 802.11 wireless LAN; optional integrated Bluetooth 2.1; optional Mobile Broadband (requires separate mobile service)
- **Modem:** 56K V.92 modem
- **Keyboard:** integrated 101-key keyboard with numeric keypad
- **Pointing device:** integrated three-button touchpad and pointing stick, fingerprint reader
- **Other:** three USB 2.0, two USB 3.0, one mini IEEE 1394a FireWire, eSATA, media card reader (SC, SD, MMC, MS/Pro, XD), one Express Card/54 slot, one smart card reader, DisplayPort, 15-pin VGA, 2-megapixel webcam

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formance separately), the EliteBook 8540w also lagged a bit, again because of its slower CPU clock speed.

But when we ran our AutoCAD rendering test, the system showed the advantage of having a quad-core CPU with hyper-threading. Here, the processor appeared as eight separate CPUs, and while they may have only been running at 1.6GHz, they powered through the rendering in less than 2.5 minutes under Windows 7—the best results we've seen to date for a mobile workstation. The slower results for Windows XP were likely due to the fact that we were running the 32-bit version, so all of the extra RAM in the system could not be used.

HP backs the EliteBook 8540w with a limited 3-year warranty on parts and labor, and offers more extensive coverage for additional charges. Buyers can choose from 32- and 64-bit versions of Windows 7, Windows Vista and Windows XP, or even purchase a system with FreeDOS pre-installed. The system is certified for SUSE Linux Enterprise Desktop, and like most HP workstations, is ISV-certified for virtually all major CAD, DCC, GIS and oil and gas exploration software.

EliteBook 8540w prices start at \$1,349 for dual-core systems or \$1,749 for quad-core. As configured, our evaluation unit priced out at \$3,657, but a 24% discount (available at

the time of our review) would reduce the cost to \$2,779. Even at that price, though, there's a lot to consider. While beautiful, the DreamColor 2 display adds additional weight and cost while reducing battery life.

With or without DreamColor, the HP EliteBook 8540w is a true mobile workstation, capable of taking any professional application with you on the road. **DE**

David Cohn is the technical publishing manager at 4D Technologies. He also does consulting and technical writing from his home in Bellingham, WA, and has been benchmarking PCs since 1984. He's a contributing editor to Desktop Engineering and the author of more than a dozen books. You can contact him via email at david@dscobn.com or visit his website at DSCobn.com.

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→ **ATI:** AMD.com

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AutoCAD 2011 for Mac

Autodesk releases its first native Macintosh version of AutoCAD in 18 years.

BY DAVID COHN

In 1989, 15 versions ago, Autodesk released AutoCAD R10 on the Macintosh II and followed that up with native Macintosh versions of R11 and R12. That was back in an age when AutoCAD still ran on IBM-compatible PCs under the DOS operating system.

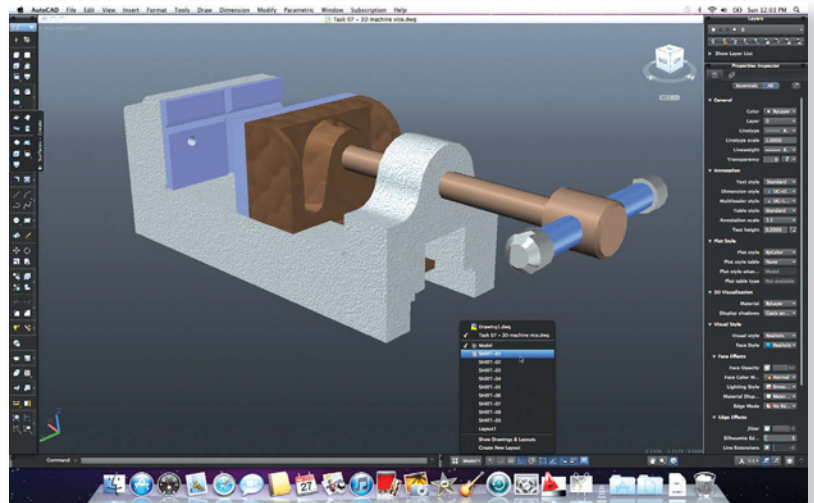
Both the Macintosh and UNIX versions of AutoCAD were discontinued when Autodesk focused its development efforts on Windows. That's not to say that plenty of people haven't been running AutoCAD on their Macs for years. Ever since Apple switched from Motorola to Intel processors, lots of Mac users have been happily running versions of AutoCAD using virtual machine software such as Parallels or VMware, or rebooting to Windows using Boot Camp. But AutoCAD 2011 for the Mac is different. It's a native Macintosh version of Autodesk's flagship CAD software and its interface is true Macintosh through and through.

Big Interface Differences

As a long-time AutoCAD user, the first thing you notice after starting AutoCAD for the Mac is the interface. Instead of the ribbon interface, which has been a defining feature since AutoCAD 2009, AutoCAD for the Mac puts its tools where Mac users expect them, in the Apple menu bar. Unlike Windows applications, which run in separate windows, each with their own menu or ribbon, that same Apple menu bar remains across the top of the screen and shows commands for whichever application is currently in the foreground.

In addition to the menu bar, AutoCAD for the Mac uses several palettes docked to the left and right of the drawing canvas. These palettes can be dragged around the screen, docked in other locations, and collapsed in various ways. There are actually three different Tool Sets providing tools commonly used for specific tasks, somewhat analogous to workspaces in AutoCAD for Windows. For example, the Drafting toolset contains tools for creating and editing basic 2D objects such as lines, arcs and circles; the Annotation toolset provides tools related to text, dimensions, and tables; and the Modeling toolset offers 3D drawing and editing tools. Some palette buttons have flyouts that display related commands and many tools are organized into tool groups that can be expanded and temporarily locked in their expanded state.

AutoCAD for the Mac has the same UCS icon and View-



AutoCAD 2011 for the Mac is a native OS X application, making full use of the Apple menu and palettes docked to the left, right, and bottom of the canvas, including a Command Line and Status Bar palette that also contains tools for switching between layouts.

Cube found on the Windows version for orienting the model in 2D or 3D space, but there are other, more subtle interface differences. For example, there is no Navigation bar in the Mac version, but AutoCAD 2011 for the Mac adds a really nice feature not found in AutoCAD 2011 for Windows. A set of viewport controls, located in the upper-left corner of each drawing viewport, let you control the number of viewports, select a named or preset view, or choose a visual style.

Lots of similarities

Another feature specific to the Mac is Multi-Touch gestures, which can be used with a Magic Mouse or a Multi-Touch track pad. For example, you can pan the view of a drawing by using a two-finger swipe on the track pad, pinch two fingers together to zoom in or apart to zoom out, and orbit around a 3D model by pressing the shift key and swiping the track pad using two fingers. Of course, you can use a more traditional mouse and spin the scroll wheel to zoom, press and hold the wheel to pan, and press the shift key and scroll wheel simultaneously to orbit in 3D, just like when using AutoCAD for Windows.

But Mac users also get the benefit of using Cover Flow in the Mac's Finder application—the equivalent of Windows Explorer—to locate and preview AutoCAD files. As you might expect, AutoCAD drawings (DWG files) are identical on both Windows and the Mac. I had no problem using Finder to lo-

cate drawings on one of my networked Windows systems and opening those drawings on my MacBook Pro. AutoCAD for the Mac can open any drawing file saved in AutoCAD R14 format or newer.

AutoCAD 2011 for the Mac incorporates the same parametric drawing tools, including implied constraints, found in the Windows version. The Mac version also includes all of the new surface modeling tools, including procedural and NURBS surfaces, found in AutoCAD 2011. And once you've created 3D models, you can use analysis tools, such as zebra striping, curvature analysis, and draft angle analysis to check your designs.

AutoCAD 2011 for the Mac also incorporates the mental ray rendering engine and uses the same materials library—and offers a similar Materials Browser palette—as the Windows version. (See the July 2010 *Desktop Engineering* for more on AutoCAD 2011 for Windows.)

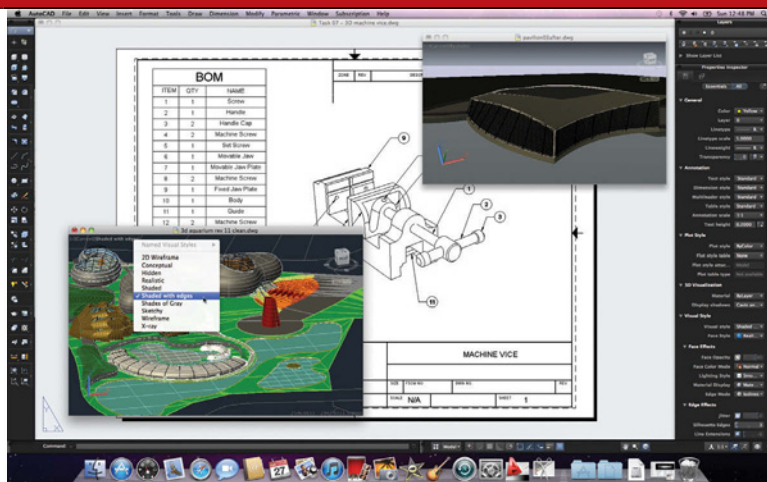
Some Things Still Missing

The Mac version uses a Customize dialog box similar to the CUI dialog in the Windows version for customizing commands, menus, and tool sets. And both AutoLISP and ObjectARX applications can be loaded and run on the Macintosh version exactly the same as in Windows.

So what's to stop a Macintosh user from switching to this native Mac release of AutoCAD? There are still some pretty big gaps to fill before Autodesk can claim full feature parity. For example, AutoCAD 2011 offered a huge improvement in the way users interact with hatch patterns and gradient fills, enabling you to preview these objects and edit them interactively before committing changes to the drawing. But since the Macintosh version does not have a ribbon bar, this feature is missing. Instead, hatch patterns and gradient fills must be created using a dialog box, similar to the way these commands worked in AutoCAD 2010 and earlier releases. Once created, however, you can modify these objects—changing the hatch angle, hatch scale, and origin point—using multifunctional grips.

But perhaps even more glaring is the list of features and functions missing from AutoCAD 2011 for the Mac. For example, there is no Action Recorder, Batch Standards Checker, dynamic block authoring, hyperlink capabilities, in-place editing of blocks or external references, no xref notification, and no layer filters or layer translation. There is also no support for DGN, DWF, or PDF files. In addition, tool palettes, the Layer Translator, the Sheet Set Manager, the Markup Set Manager, the AutoPublish tool, the eTransmit and Archive tools, and the Drawing Recovery Manager are absent from this Macintosh release.

Because AutoCAD 2011 for the Mac is a complete rewrite of AutoCAD as a native OS X application, it's hardly a surprise that not every feature of this 28-year-old program would make it into this first release. But any one of these omissions could



AutoCAD 2011 for the Mac offers several features not found in the Windows version, including viewport controls in the upper-left corner of each viewport for controlling the number of viewports, selecting a named or preset view, and choosing a visual style.

be a show stopper for some customers, who may elect to stick with running AutoCAD 2011 on their Mac using a virtual machine until more of those gaps are filled.

Missing features aside, AutoCAD 2011 for the Mac is a pleasure to use. A 30-day free trial is available from the Autodesk website; students and educators can also obtain free copies via the web. For those who have been waiting for a true Macintosh version of AutoCAD, the wait is over. Check it out. **DE**

David Cohn is the technical publishing manager at 4D Technologies. He's a contributing editor to *Desktop Engineering* and also does consulting and technical writing from his home in Bellingham, WA. Cohn has been using AutoCAD for more than 25 years and is the author of more than a dozen books on AutoCAD. You can contact him via email at david@dscohn.com or visit his website: dscohn.com.

INFO → AutoCAD 2011, Autodesk, Inc.: autodesk.com

• **Full system:** \$3,995, **Annual subscription:** \$450

System Requirements:

- **Computer:** Apple MacPro 4,1 or later; MacBookPro 5,1 or later (MacBookPro 6,1 or later recommended); iMac 8,1 or later (iMac 11,1 or later recommended); MacMini 3,1 or later (MacMini 4,1 or later recommended); MacBookAir 2,1 or later, MacBook 5,1 or later (MacBook 7,1 or later recommended)
- **Operating System:** Mac OS X Snow Leopard 10.6.4 or later; Mac OS X Leopard v10.5.8 or later
- **Memory:** 3GB of RAM (4GB recommended)
- **Disk space:** 2.5GB of free disk space for download and installation (3GB recommended)
- **Video:** 1280x800 display with true color (1600x1200 with true color recommended)

Getting the **Most** From Your Intel-Based Workstation

BY PETER VARHOL

Which workstation do you need to complete your design faster? It's an easy question, but it has a complex set of answers.

A Defining Moment: An Entirely New Workstation That Will Rock Your CAD

If all you do is CAD, then an entry level workstation with Intel's soon to be announced Intel® Xeon® processor E3 1200 family will be an ideal platform for 3D CAD.

Workstations with this new processor will also support an amazing new graphics entrant — the Intel® HD Graphics P3000 which integrates high-performance graphics and media processing right on the processor. Placing these two key components together on a single chip means visual and 3D graphics capabilities that were once only available to entry workstation users with discrete graphics cards will now be accessible to anyone with an entry workstation powered by the Intel® Xeon® processor E3 1200 family with Intel® HD Graphics P3000.

These workstations will provide the same powerful and compelling 3D performance at an entirely new price point — but you may want to take your savings and purchase a solid state drive (SSD), which will enhance your total workstation experience when dealing with large files locally at your workstation.

Maximizing the Opportunity for Simulation Based Design and Digital Prototyping

However, the original question dealt with doing design faster and an entry level workstation may not be ideal to design faster — it will help you do CAD faster, but design, where you create, test, and modify your ideas may be better served by more powerful workstations that enable the idea of simulation-based design or digital prototyping.

To effectively accomplish digital prototyping or simulation-based design you should consider more powerful workstations based on dual processor Intel® Xeon® 5600 series. These workstations provide you the memory capacity, computational performance and scalability necessary to deliver timely results for even the most demanding, rendering, simulation and modeling applications. And with design suites from companies like Autodesk, SolidWorks and others that merge traditional CAD tools with simulation and modeling applications, users now have a powerful expert workbench in which test their ideas more rapidly.

If you are really into digital prototyping or simulation-based



Did You Know...

Trillions of Transistors a Day

Intel uses its advanced manufacturing technology to build several hundred trillion transistors every day. The transistors are so small that more than 30 million of them would fit into the head of a pin.



design as an important part of your job, and you do not want to invest in a cluster yet, then there is a new alternative that can help accelerate your CAD, simulation and modeling results. This idea makes use of interesting technologies like Intel® Virtualization technology for direct I/O, which along with software suppliers like Parallels and its Professional Workstation Extreme (PWE), helps you to quickly and efficiently partition your workstation into two distinct system with defined levels of service for interactive CAD and batch-based simulation or modeling. This helps you concurrently do both CAD and simulation with no resource conflicts in your workstation. This configuration can deliver timely design results in a time frame you need.

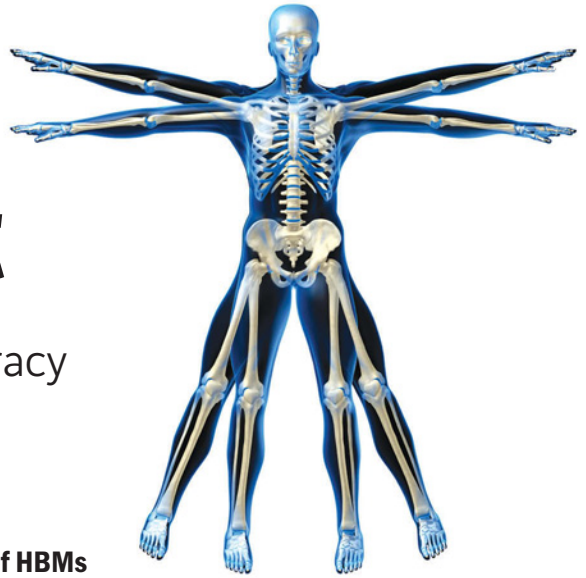
Turning a Single Workstation into a Powerful Cluster of Workstations

With multiple workstations based on Microsoft Windows 7, and with access to a single HPC server license and Parallels' PWE you can transform your department's investment in dual processor workstations into a powerful cluster that does both interactive CAD and simulation and modeling. Early results from pilots completed by Intel and HP with engineering customers suggest not only are these ideas possible, but it offers users an affordable path to achieve two things. One is to increase the pool of available computational resources for modeling and simulation; the second is reclaim unused compute cycles with no negative impact on the interactive demands of CAD users.

Which workstation do you need to complete your design faster? If you are just doing CAD, then workstations with the New Intel® Xeon® processor 1200 family with Intel® HD Graphics P3000 are what you need. If you are doing — or aspire to do — digital prototyping or simulation-based design, then you need workstations based on two Intel® Xeon® 5600 series processors. **DE**

INFO → Intel Corp: intel.com/go/workstation

Designing the Model Patient



Human body models increase the accuracy of biomedical device simulations.

BY MARC HORNER, PH.D.

To truly simulate how many medical devices will perform, design engineers must first simulate the environment those devices will perform in: the human body. In silico models predicting the in vivo performance of medical devices are becoming more and more prevalent across all biomedical sectors. The shift toward geometry derived from medical scan data is providing previously unparalleled understanding of device performance and patient safety.

Patient-specific geometry is only a local enhancement to the numerical model, however. In other words, this enhancement does not provide any information regarding the dynamic and compartmental responses of various organ systems to the presence of foreign objects or external stimuli. Therefore, a global perspective must be adopted if we want to truly understand device performance. Human body models (HBMs), can address this critical need.

The use of HBMs is enabled by:

- Our understanding of, and thus our ability to mathematically describe, the human body is to the point where we can assemble lumped parameter human body models as “boundary conditions” for biomedical simulations.
- Improvements in ease-of-use and stability of multi-physics modeling tools.
- The continuing increase in computational capabilities.

The first bullet is critical to the success of HBMs. The human body is a complex system that is impractical to model explicitly at this time. Therefore, one must make some simplification to include macro-effects. The most straightforward simplification is to use lumped parameter representations of the human body coupled to detailed 3D analyses.

System level modeling tools can be coupled to traditional mechanical (finite element analysis), fluid flow (computational fluid dynamics) and electromagnetics modeling software to incorporate the loads and boundary conditions applied by the human body.

Types of HBMs

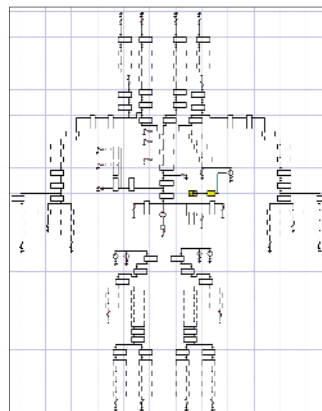
HBMs fall into two general categories: lumped parameter models and geometrically accurate models. Lumped parameter models provide boundary conditions or loads that act on the boundaries of the computational domain. Examples of lumped parameter HBMs include electrical circuit based (Windkessel) models of the circulatory system, pharmacokinetic models of drug absorption and clearance, and lumped parameter models of the musculoskeleton.

Highly accurate geometric models are the second class of HBMs. They are reconstructions of the human body down to a predetermined length scale. Geometric models are primarily used to understand the interaction between the human body and electromagnetic fields. An implanted device may or may not be present.

HBMs can be used to improve the accuracy of medical device simulations. For example, HBMs enable a designer or analyst to more accurately predict:

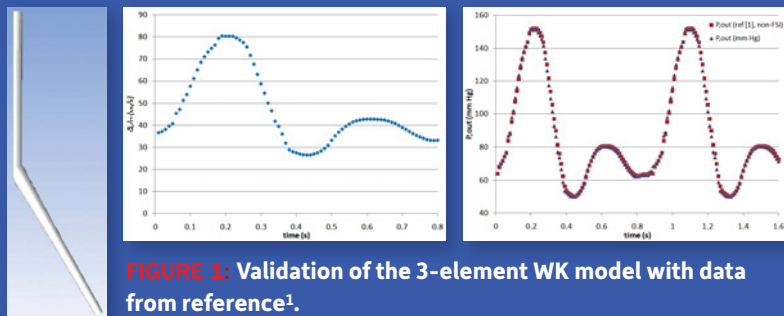
- Blood flow around implanted cardiovascular devices.
- Plasma concentration of a drug delivered from a transdermal patch.
- Loads on orthopaedic implants.
- Heating of tissues or an implant during a medical scan.

HBM coupling to traditional modelling tools is needed to understand the safety and efficacy of medical devices.



Arterial HBMs

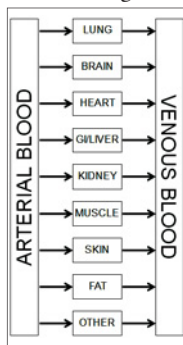
Arterial flow models, like the one to the left, are useful for predicting blood flow patterns after implanting a device, such as a stent, and for understanding the flow patterns in various diseased states, e.g. the circulation patterns that occur in a cerebral aneurysm. One com-



plicating factor in arterial flow modeling is the application of accurate outflow boundary conditions. Specialized boundary conditions are required because the flow split at a bifurcation is a function not only of the bifurcation geometry, but also the structure and state of the downstream vasculature. Without a specialized outflow condition, a designer will not have a proper understanding of the baseline flow patterns and how an implanted device will impact those patterns.

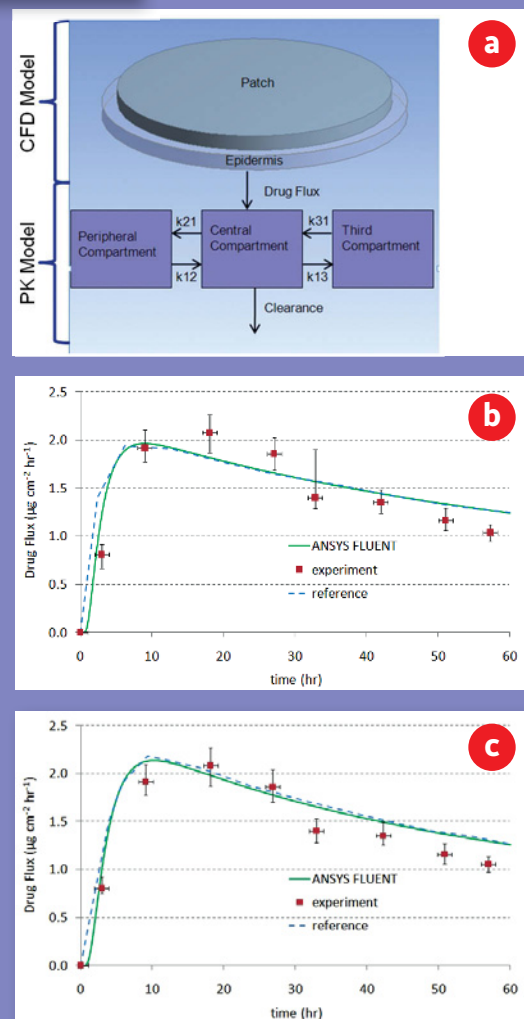
Arterial HBMs discretize the vasculature into a network of short segments. Each segment is represented using an electrical circuit or 1D flow equation. The fully discretized system predicts the flow rate and pressure in each segment. One of the more common electrical circuit representations is the 3-element Windkessel (WK) model. It represents inertial losses using an inductor (L), pressure losses with a resistor (R), and vessel compliance with a capacitor (C). The circuit is identical throughout the arterial tree, but the RLC values vary to account for physiological and structural changes, e.g. compliance dominates at the aortic root while pressure losses are more important in smaller vessels.

Figure 1 summarizes a validation case of the arterial HBM. The model consists of the 3-element WK condition applied at the outlets of an idealized abdominal aorta. The geometry and boundary conditions were symmetric in this case, therefore only half the geometry was modeled. A transient inflow waveform was culled from a literature source¹. Blood flow rates and pressure drops were modeled in ANSYS FLUENT. The results for the outlet pressure (P_{out}) show excellent agreement with the pressures reported in the literature source¹. And more importantly, “ P_{out} ” now varies between physiologically relevant values, and the curve has a physiologically realistic shape. Neither of these would be predicted by standard (constant pressure) outflow conditions.



Drug Delivery HBMs

Pharmacokinetic (PK) models, like the one to the left, are the HBMs for drug delivery. The PK approach assumes the



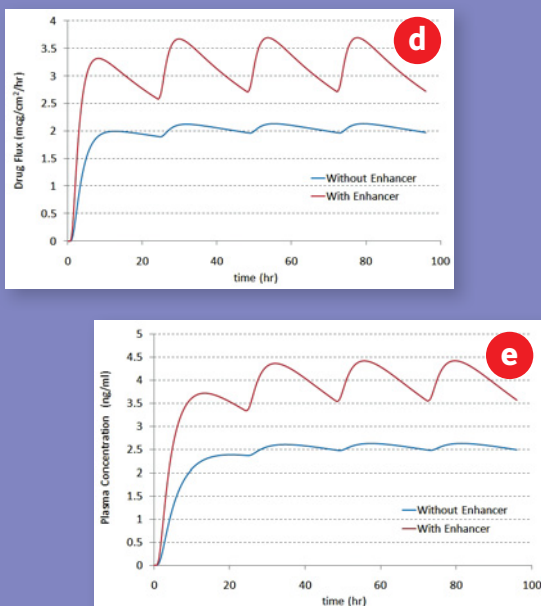


FIGURE 2, CONTINUED
Flux (d) and plasma (e) concentration over a period of 96 hours (new patch applied every 24 hours).

body can be treated as a collection of well-mixed chemical reactors. Rate constants for each reactor establish drug absorption, distribution, metabolism, and excretion rates. With appropriate parameters in place, we can predict the time course of drug concentration in the plasma and other compartments, which helps establish bioequivalence for regulatory approval.

A transdermal patch is one example where PK can help establish that the device and formulation meet clinical requirements. Figure 2 shows an example of a transdermal patch coupled to a three-compartment PK model. The patch model was initially validated against the experimental results of Rim et al². In their model, the drug diffuses through the patch and skin until reaching the far edge of the epidermis. A permeation enhancer was included in the formulation, which modifies either the drug diffusivity or drug solubility in the skin layer. There was no PK model in their experimental setup. The results in Figure 2b and 2c show excellent agreement between the Rim et al. results and the ANSYS FLUENT model.

We then coupled the validated drug transport model to the three-compartment PK model shown in Figure 2a and simulated the delivery of the analgesic fentanyl over several days. The results for drug flux and plasma concentration show the rise and fall of the drug concentration in plasma after each application. Adding PK thus provides the full understanding of how design and formulation affect drug delivery.

Musculoskeletal HBMs

Musculoskeletal (MSK) HBMs are multi-body dynamics tools that predict muscle and joint reaction forces and inertial loads encountered when the body is in motion. MSK models, like the one to the right, are comprised of hundreds of muscles that are fixed at their respective attachment points. The mechanical behavior of each muscle is modeled as a parallel circuit comprised of three elements: a spring in parallel with a spring and activator element.

The resulting strength of the muscles is highly non-linear, both with respect to elongation and accelerations. Simulations can be based on

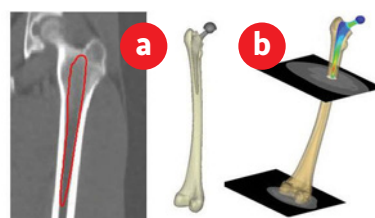
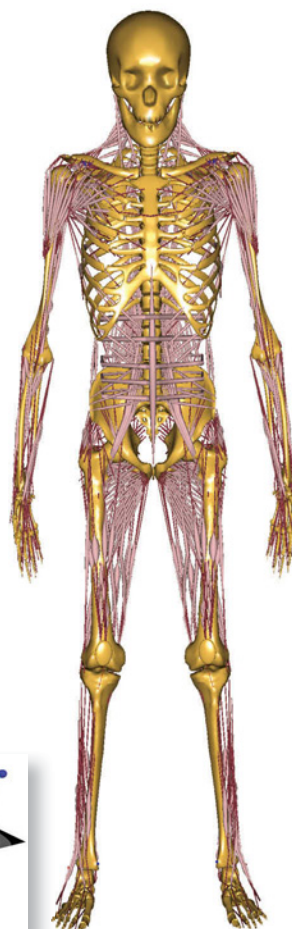


FIGURE 3: Patient-specific analysis of the stresses on a hip implant and femur under walking conditions:
(a) Medical scan
(b) Segmentation in Mimics
(c) Walking gait cycle from the AnyBody Modeling System
(d) Combination of geometry and load data into ANSYS Mechanical simulation of stresses on the implant and bone.

patient-specific data such as anthropometrics, strength, bone geometries and muscle attachment points. When coupled to FEA, MSK models can be used to predict the risk of osteoporotic fracture, predict forces and moments acting on an implant, and for surgical planning, to name only a few applications.

An example of a patient-specific workflow that uses the results of inverse dynamics is shown in Figure 3. This figure shows the extraction of a patient bone from medical scan data, the derivation of joint motions and loads from a walking cycle, and the application of this information to a femur and acetabular implant.



Electromagnetic HBMs

Electromagnetic safety standards establish exposure limits for humans to radiofrequency (RF) fields. These standards are established by national government. Limits are expressed in terms of power density and specific absorption rate (SAR). Power density quantifies the intensity of exposure and SAR represents the power that is actually absorbed by biological tissue. The last class of HBMs, geometrically accurate HBMs, are critical to establishing the electromagnetic safety of wireless technologies, diagnostic medical equipment, and therapeutic treatments. This is driven by the need for the manufacturer to have a good understanding

of the distribution of absorbed energy by the various tissues of the human body.

Geometrically accurate HBMs are comprised of various anatomical structures down to a predefined accuracy. Each object has associated frequency-dependent material properties that govern how the electromagnetic field propagates locally and how much power is absorbed. The latter is essential, because absorbed electromagnetic power is converted to heat. This forms the rationale for the aforementioned safety standards.

The ANSYS HBM is available in 1, 2, and 4 mm surface accuracies. The coarser models are useful when users want to save computer memory and simulation time. The level of detail is also adequate at not-very-high frequencies, when the wavelength is long. Figure 4 illustrates how the material properties affect the propagation and absorption. In Figure 4a, note the blue and green bands on the legs. This indicates that there is a standing wave. The wavelength of this standing wave is several times shorter than the free-space wavelength for this particular frequency (64 MHz). This is a direct consequence of the

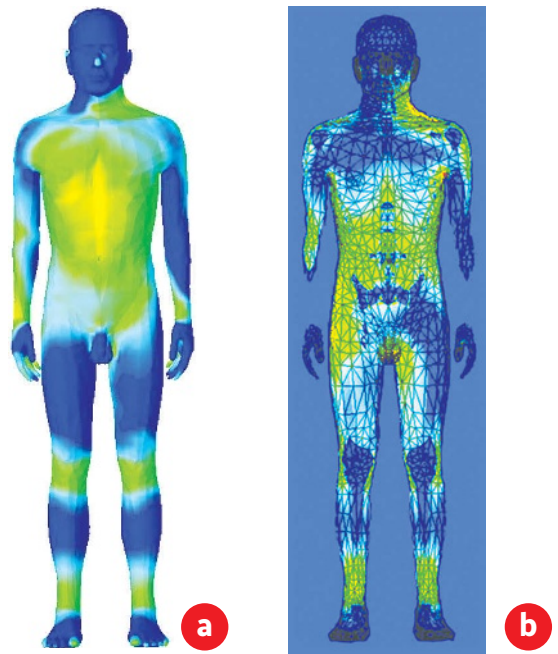


FIGURE 4. SAR calculations for a human body exposed to an MRI.

(a) SAR values for the outer skin surface
(b) SAR on a plane passing through the body

material properties, specifically of the relative electrical permittivity. In Figure 4b, note the different absorption rates for muscle and bone. The kneecaps, shinbones and hips stand out in blue, having a much lower absorption rate than muscle and organs. Again, material properties are the key player. This is because the water content of bone is much lower than that of the muscle and organs, leading to a lower electrical conductivity.

A second example requiring geometric HBMs is planning a patient-specific hyperthermia treatment. Hyperthermia is a non-invasive treatment that heats a tumor using a phased-array applicator, essentially an antenna. The benefits of hyperthermia include starving tumor cells of vital nutrients and increasing the therapeutic effect of the chemotherapeutic drug. The challenge is to apply the right amount of power to the tumor while minimizing the amount of power delivered to healthy tissue. Side effects, such as burns, blisters, or pain, are thermal in nature and can be minimized through a priori numerical simulations.

Figure 5 outlines the planning process using the ANSYS HBM as a template. First a tumor is introduced into the femur, which is then analyzed for the amount of power delivered using ANSYS HFSS. The electromagnetic losses are passed from ANSYS HFSS to ANSYS

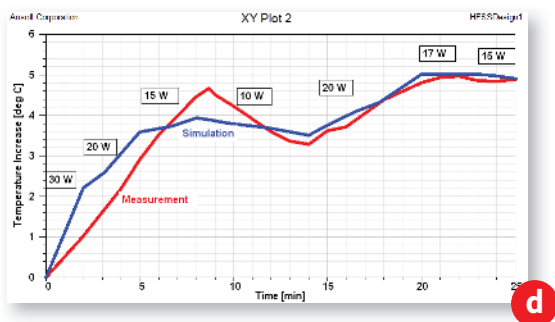
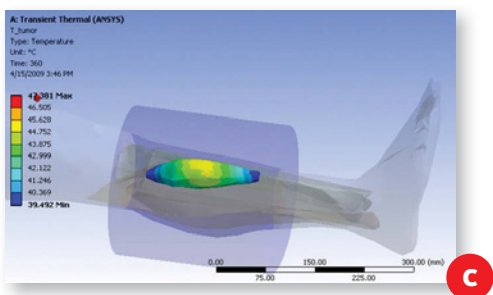
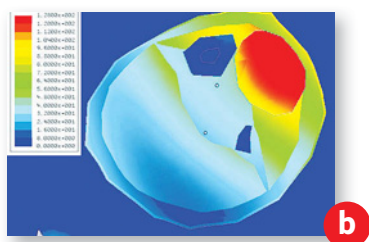
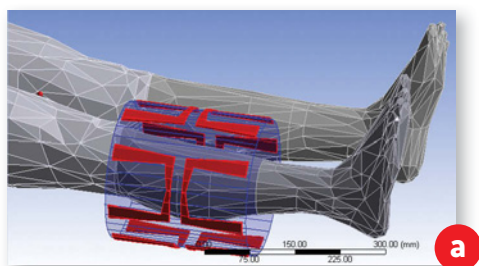


FIGURE 5: Coupling ANSYS HFSS to ANSYS Mechanical to plan a hyperthermia treatment. (a) Leg portion of the ANSYS Human Body Model (b) Local SAR with optimized array weights (performed in HFSS) (c) Thermal analysis of tumor heating (performed in ANSYS Mechanical) (d) Time evolution of the tumor max/min temperatures

Mechanical for a transient thermal analysis. Pennes' bio-heat transfer equation, a correlation that establishes the rate of heat transfer between tissues and the flowing blood³, was also implemented as a sink term in the thermal model. The SAR calculation results (Figure 5b) are passed to ANSYS Mechanical for the transient thermal calculation (Figure 5c). And as shown in Figure 5d, the tumor temperature predicted in by the multi-physics simulation agreed very well with experimental values⁴.

Take a Holistic Approach

In conclusion, a holistic approach is required for biomedical research and development because the device, drug, or other treatment interacts with human body systems. Lumped parameter models are a practical solution because of their relative simplicity, allowing the designer to further refine their technology to work together with the human body. These models are accurate enough to be used today. **DE**

Marc Horner is a Lead Technical Services Engineer at ANSYS, Inc., who focuses on the healthcare industry. This article included contributions by AnyBody Technology (Aalborg, Denmark), and Materialise Inc. (Leuven, Belgium).

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INFO → **ANSYS:** ansys.com

→ **AnyBody Technology:** anybodytech.com

→ **Materialise:** materialise.com

For more information on this topic, visit deskeng.com.

miraclefeet Brings Innovation to Braces

Objet Geometries helps design a better fit for children needing clubfoot braces all over the world.

BY SUSAN SMITH

Most of us take for granted that children with certain birth defects can be helped by surgery or corrective intervention. Thus, we never see children with cleft palates or clubfeet beyond babyhood today.

For children in developing nations, however, this is not a given. Children with a clubfoot, or congenital talipes equinovarus (CTEV), cannot walk and cannot go to school. They may be hidden away because their families are embarrassed by their condition. Subsequently, there is a high incidence of abuse and abandonment among these children.

The inability to walk presents a severe disability in developing countries because there are no school buses to deliver children to school, no wheelchairs are readily available.

So why are children in developing countries not getting treatment? The reason: The current method of correcting a clubfoot is for the foot to be casted, and then placed in a brace for a period of time. The cost of the braces can be prohibitive—around \$1,600 in countries where wages are often as low as \$2 per day. Moreover, the braces are uncomfortable and hard to put on. The children don't like to wear them, and parents don't like to put them on.

In 2010, Objet Geometries was approached by the non-profit organization *miraclefeet* and Dr. Mike North, North Design Labs (and of the former "Prototype This!" Discovery Channel TV series), to help design a more affordable, comfortable brace for children with clubfoot, their focus being on those children in developing nations.

Effective Treatment

In the 1950s, the cast-brace treatment was developed at the University of Iowa by Dr. Ignacio Ponseti as an alternative to surgery, which had limited success. Ponseti found that clubfoot could be treated much more effectively by casting. By gently manipulating the ligaments and tendons in the foot, then putting a cast on, after five to seven days, the cast comes off and the foot has moved 10 to 15 degrees.

"You do it five times, and generally in 95% of cases the foot is fully corrected," explains *miraclefeet* Managing Direc-



A baby in Botucatu, Brazil, who is in the old brace 23 hours a day. She will soon switch to nights only.

tor Chesca Colloredo-Mansfeld. "So suddenly, you have this treatment that is cheap, easy to do, non-invasive, not dangerous, and it's very easy to teach."

At that point, the foot is fully corrected. In the U.S. this is done when the child is about two weeks old. By two months, the infant has done eight casts.

"The problem is, you haven't cured clubfoot, you have corrected it," Colloredo-Mansfeld says. "Because of its genetic component, each time the child grows, the foot tries to grow back to that position. So to fix that problem, the child wears a brace—typically, a Mitchell brace."

However, compliance rates in other countries are much lower, resulting in relapses—many of which are never treated. Distance and lack of education and information are factors, but the expense, lack of comfort and ease of use of the locally made braces are huge contributors.

For example, Mexico's most experienced Ponseti doctor who works in a large public hospital in Guadalajara has a 50% dropout rate during the bracing phase of treatment.

BRINGING THE BRACE TO THE WORLD



Managing director of miraclefeet, MChesca Colloredo-Mansfeld, says that clubfoot is slightly more common than cleft palate. One out of 1,000 children around the world is born with clubfoot, and it cuts across ethnic and socioeconomic boundaries. The numbers equate to about 170,000 new clubfoot cases each year. Eighty percent of those occur in developing countries.

Brazilian doctors say the biggest deterrent to treatment is the brace itself. There are a number of reasons why, says Colloredo-Mansfeld.

"First, it's very expensive—they are usually about \$350, and in the U.S., generally it's covered by insurance, and people just pay it," she says. "But you also need multiple braces. As the kid grows, you need another one, etc. You need more shoes, so it's a very expensive little piece of equipment in developing countries."

Brazil's public health system only covers a cheap brace that doesn't seem to work, so few of the doctors will use it. These braces are little leather boots with difficult-to-use laces that attach to a metal bar. They are difficult to put on, and when they are recycled, the leather gets hard and crunchy and rubs against the skin.

"miraclefeet is making a new brace that is more affordable, easier to use, more comfortable, and more kid-friendly. Each of these factors increases the likelihood that a child will wear the brace, and hence, make successful treatment more likely," says Colloredo-Mansfeld.

The brace is a piece of metal with shoes attached that stretches all the tendons, particularly the Achilles tendon, and keeps the feet pointing in the right direction. The child wears the brace for three months after treatment full-time, and he or she only takes it off to bathe. Once the child is through that three-month period, her or she wears it only at night for the next four years.

"Because the child goes through big growth spurts, in some cases, there will be some relapses

later on and they may have to go back to wearing the braces, but generally the older the child gets, the less they will need the brace," says Colloredo-Mansfeld. "You can do the casting also for older kids who will not need to wear the brace. Then, of course, you've lost five years of development, and you don't want that to happen if possible."

Although Dr. Ignacio Ponseti did not think of treating older children in this way, Brazilian doctors have found that they can treat children up to the age of 16 with remarkable results. Other older children adopted from China or Russia and brought to the U.S. have also enjoyed good results from treatment.

"What is critical for our long-term success is to develop a low-cost, easy-to-use brace for the developing world," Colloredo-Mansfeld says. "We want to create a brace in the \$25 range, as opposed to the \$300 range in the U.S. or the \$100 range in Brazil, and we're going to be using materials that make it much easier for the parents to use."

The braces will be made in a number of sizes, and children will not need as many sizes, because the footbed of the newly designed brace will be more flexible.

"We provide the braces for all the doctors we're working with," says Colloredo-Mansfeld. "We have a model where we partner with local doctors in the countries we're working in, so we find a Brazilian doctor who is trained in the Ponseti method and we'll partner with his or her hospital. Then we provide them with grants based on how many additional children they can treat."

An example is a university hospital in Sao Paulo where they could treat an additional 20 kids—and so have increased the number to 60 kids. "We give them \$200 for each child. Now they spend \$150 on a brace and they recycle them," says Colloredo-Mansfeld. "This way they will be able to provide a lending library of braces in different sizes. In some cases parents will want to buy them, and at \$20 they will be much more affordable."



Objet's multi-material 3D printer, on which the miraclefeet brace prototype is being printed.

A Better Brace

Objet U.S. President Frank Marangell and Director of Marketing Bruce Bradshaw note that the Objet Connex 3D multi-material printer is a good fit for miraclefeet because of its multiple and flexible material technology.

"With Connex, we have the ability to prototype rigid and soft parts—essentially 11 different mechanical properties, depending upon the type of material you use in the same part," says Marangell. "This provides the folks making miraclefeet a unique way of really identifying the attributes they want to bring to market, making sure the cost for this is significantly reduced over what it costs today."

What miraclefeet and North are trying to develop is a product that:

- is much more natural;
- has soft edges;
- connects to any shoe; and
- is expandable so that it will last a little longer than two years.

The profits miraclefeet makes go toward bringing this design and this device to developing countries, "so it's a non-profit organization working to provide something that Third World countries can't even touch at \$1,600 price points," says Marangell.

The design aims to offer a more comfortable brace for children. "They were able to use the Connex technology to vary the derometer of the component that connects to the shoe," says Bradshaw.

The Connex machine allows the user to print 11 different derometers, which is like printing 11 different materials at the same time. Choices range from a rigid and a very soft rubber, with 11 different flexibilities in-between those textures.

"That allows them to actually help the design before it goes to final production by choosing one of the different rubbers, and deciding whether they are too rigid," says Marangell. "You can print another one in the next revision of the prototype before you actually go to production of this product. You can build all of that in the same prints."

He added that the machine allows the user to print moving hinges, the rigid parts and all the different soft materials at the

same time, "and it allows the prototype to mirror perfectly the end product. The result is that you get a better end product, because it really allows you to do many revisions."

For the brace, Objet prototypes will be used primarily for the bar and the footbed.

"Depending on the size of the parts they are actually testing, they can print on Connex 500 two or three of these all at the same time, all with different mechanical properties, so they could print three of them that have different flexibilities all at the same time, and try them on the child, and ask him or her 'Which one feels best to you?'" says Bradshaw. "They may not know early on what the best fit is, but the fact that they can print three at the same time—or more—means they can narrow down their choices and find out what is the best material very early on in the design process, long before production."

Bradshaw points out that typically Objet is in the business of selling equipment for people to do designs, and not very involved in the design process itself. With this project, he says, it is "exciting working with Dr. North, as he is working with visionaries and designers all over the country, collaborating to find out just what is the best design."

"The fact that they can print a part and have it in their hands very easily allowed them to visualize where this project should go," he adds. "It has really helped when miraclefeet have their board meetings to be able to show members an actual prototype."

The two base materials used for the prototype are Vero White, a rigid component, and Tango Black Plus, a black, rubber-like flexible material. "It takes combinations of those two materials to come up with the different mechanical properties that you select for the parts," Bradshaw says.

At press time, the prototype is still in development as miraclefeet works to get the brace into an aesthetically pleasing and manufacturable state. North favors materials that can be washed off easily under the kitchen tap or a standpipe in the street. The braces will perhaps have hook-and-loop strips rather than the laces, and possibly breathable silicone or foam that wraps the foot. The bar will be made of injection-molded plastic instead of metal.

miraclefeet is considering producing the braces in different colors and with soccer team logos so they have more appeal to children. **DE**

Contributing Editor Susan Smith has written and edited for various publications in the tech industry for more than 17 years. Send e-mail about this article to de-editors@deskeng.com.

INFO → Objet Geometries: Objet.com

→ miraclefeet: miraclefeet.org

→ North Design Labs: NorthDesignLabs.com

→ Ponseti International: Ponseti.info

For more information on this topic, visit deskeng.com.

Abaqus/Explicit Helps Give the Gift of Sight

BY JIM ROMEO

In the lens of the human eyes, cataracts sometimes develop and degrade a person's vision. Cataracts are opaque areas in the lens that obstruct and disperse some of the light, causing a blurred and unfocused vision.

Dassault Systèmes' Simulia Abaqus FEA (finite element analysis) suite has been used to model intraocular lenses (IOLs) for corneal transplant surgery.

To gain more insight into Dassault's work with Bausch and Lomb, Inc., we recently spoke to Subham Sett, the Life Sciences industry lead for Dassault Systèmes Simulia Corp. in Providence, RI.

Q: What were some of the more challenging aspects to the design of the IOL and the inserters used during cataract surgery?

A: From an ophthalmologist's point of view, the surgery is outpatient and typically takes less than 10 minutes.

From an engineering perspective, however, the procedure is quite challenging, given the geometry: An industry-standard precision lens has a 6mm diameter, a center thickness of 1mm, and four haptics; an average incision is 2.8mm. According to the client, it's like trying to suck a Frisbee through a vacuum. During the insertion, the lens can experience strains in excess of 60%.

Q: How did the Abaqus/Explicit software help in the design?

A: The analysis is highly non-linear with large deformations, difficult self-contact, sliding contact and hyper-elastic material properties. Our software allows the end-user to handle all of these complex features in a single analysis.

Q: Is designing a medical product different from designing other products?

A: In most cases, medical products are designed to be used within the human

body. The interaction between the device and the human aspect makes it distinctly different from designing other products. There is a lot of uncertainty and a lack of biological data, so product design relies on making assumptions about the biological environment in which it operates.

Q: For this particular application, how did the human element come into play?

A: The application design required a strong interface of Abaqus with SolidWorks, where the 3D models were generated and then linked with the Abaqus/CAE Interactive product for realistic simulation. The strong interface between design and engineering software allows designers and engineers to iterate efficiently during product development.

Q: Is breakthrough medical technology reliant on top-quality design software?

A: Most conventional engineering product designs today are heavily reliant on top quality design software during their development phase. The reliance on pure, real-world testing methods to validate and come up with new designs has been significantly reduced. Medical device companies have, in recent years, ramped up their investment in quality design and engineering software to accelerate their product development cycles—and lead to breakthrough medical technology.

Q: For this particular application, what are some of the things that the client was able to achieve, and how does it affect the ultimate end user?

A: The client was able to arrive at validated models that helped capture parameters crucial to the IOL design, such as insertion force, and measuring device strain while visualizing the deformations as it moves through the inserter. Such measurements, observations and validations allow the design-



Subham Sett
Dassault Systèmes Simulia Corp.

ers to create devices with less likelihood of failure during surgery, and design next-generation IOLs and inserters that will allow surgeons to operate with even smaller incisions during surgery. All of this has had a positive effect on patient experience, surgical outcome and patient recovery.

Q: What is the most important thing about developing engineering software products for the medical market?

A: Engineering software products must provide accurate solution results for the medical market. The accuracy of these numerical solutions is key to arriving at test data validation. Because medical devices can save patient lives and promote long-term health, engineering software solutions must be validated before they can be used for such life-critical devices. **DE**

Jim Romeo is based in Chesapeake, VA. Contact him via de-editors@deskeng.com.

INFO → Dassault Systèmes: Simulia.com/products/abaqus_explicit.html

For more information on this topic, see the related Fast App on the next page.



Visualizing Eye Surgery

Abaqus FEA brings prosthetic lens insertion into focus for Bausch + Lomb.

The medical establishment already has a very clear picture of cataracts and how to treat them.

That's encouraging, given the fact that by age 80, more than 50% of all Americans will have developed a cataract—and every year, more than 3 million will undergo eye surgery to correct it. What is also encouraging is the surgical outcome: the success rate is 95%, with vision typically restored within a 20/20 (normal) to 20/40 (good) range.

With the size of the incision directly related to post-surgical aberrations in vision, engineers at Bausch + Lomb in Rochester, NY, continue to look for improvements. They have recently set an ambitious 1mm incision goal. To achieve this, ongoing research and development is focused on new lens materials, improved IOL geometry, and better inserter designs. That's where finite element analysis (FEA), with its capability to realistically simulate a wide variety of physical phenomena, enters the picture.

MORE → deskeng.com/articles/aabajp.htm



A Project with Heart

The University College London Hospitals teams with Glassworks to create HeartWorks.

In 2006, three clinicians at University College London Hospitals (UCLH) Heart Hospital, Drs. Sue Wright, Andrew Smith and Bruce Martin, got together to share their frustration about the lack of a realistic model of the human heart that could be used to teach cardiac anatomy. They came up with the idea of creating a virtual heart, and quickly realized that if it were based on an anatomical 3D data set, such a model could be used to generate a simulated ultrasound image.

The idea had significant implications for training, as it could also be used to simulate the experience of administering a transesophageal echocardiogram (TEE, known as TOE in the UK). This is an examination difficult to practice, as it relies on inserting an internal probe to capture images of a patient's beating heart.

MORE → deskeng.com/articles/aabajr.htm

From Paper to Purpose

Pathway Medical Technologies uses PLM software to ease compliance.



In 2009, Kirkland, WA-based Pathway Medical Technologies received the U.S. Food & Drug Administration (FDA) 510(k) clearance to market its JETSTREAM G3 peripheral atherectomy catheter for use in the treatment of peripheral arterial disease (PAD) in the lower limbs (below the knee).

JETSTREAM G3 is capable of treating the entire spectrum of disease found in the PAD patient, including hard and soft plaque, calcium, thrombus and fibrotic lesions. This technology, combined with national screening initiatives, is increasing the options for patients suffering from PAD and helping them avoid long-term complications of the disease.

Streamlining Research

Pathway Medical was using a paper-based system for managing all of its medical device documentation, part drawings and engineering changes. One room housed all of the company's paper procedures and hard drawings, with a checkout system similar to how a library works.

INFO → deskeng.com/articles/aabajs.htm

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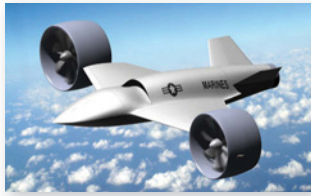


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Fast Track to Flight

ADFS partners with several HPC providers to build a better flight simulator.



American Dynamics Flight Systems (ADFS) develops aerospace defense systems and technologies. Its main product, the AD-150, is a tilt-duct vertical takeoff and landing (VTOL) unmanned aerial vehicle (UAV) capable of achieving high forward airspeeds. The aircraft uses a pair of rotating wing tip mounted ducted fans to provide the vertical lift and forward thrust needed to approach 300kts. The AD-150 has been developed around upcoming U.S. Marine Corps requirements for a high-speed VTOL UAV capable of operating in a shipboard maritime environment.

ADFS asked for help to determine the performance, scaling and optimal HPC configuration to run its complex and high-fidelity flight simulation model. ADFS partnered with QLogic, CD-adapco, Dell and Intel to find answers to these questions.

MORE → deskeng.com/articles/aabajm.htm

The Race to Victory

RENNtech designs a winning racer for Mercedes-Benz in 35 days, thanks to Dimension's 3D printing technology.



After working for slightly less than a year at RENNtech, a Florida-based shop that specializes in tuning and enhancing performance for European-made cars, product design engineer Dustin Hanna was presented with an opportunity.

Mercedes-Benz USA notified RENNtech that the shop had been chosen to compete in the Mercedes-Benz GLK Tuner Challenge, which provided four shops pre-production vehicles to modify according to themes, highlighting each respective shop's versatility. The challenge had an impossibly tight deadline for the task at hand—RENNtech was given just 35 days to design and produce an off-road racer prototype of the Mercedes-Benz GLK to present at the upcoming SEMA Show, the premier automotive specialty products trade event. The car was to be modified according to a pre-approved Mercedes-Benz proposal, dictated by the provided theme.

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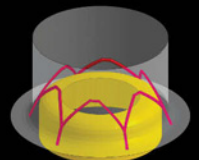
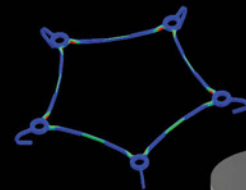
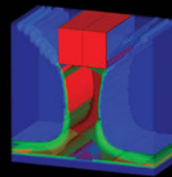
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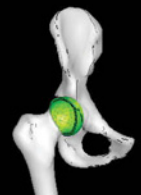
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Each week, Tony Lockwood combs through dozens of new products to bring you the ones he thinks will help you do your job better, smarter and faster. Here are Lockwood's most recent musings about the products that have really grabbed his attention.



Portable Workstations Use NVIDIA's Quadro 6000

NextComputing uses new GPU for its portable workstations and servers.

NextComputing has integrated NVIDIA's Quadro 6000 GPU for its portable workstations and servers. Incidentally, the integration comes by way of PNY Technologies, which, among other things, makes professional-level graphics cards.

The Quadro 6000's raw perfor-

mance hops to it at 1.3 billion triangles per second. The integration of the Quadro 6000 in NextComputing's line of high-end portable workstations means that you could have a visual supercomputer with you out in the middle of nowhere.

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Altair's PBS Professional 11.0 HPC Workload Manager

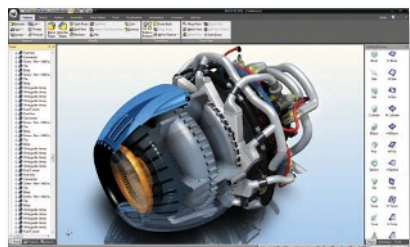
Includes optimized PetaFLOPS scalability, GPU and topology scheduling.

As a commercial-grade HPC workload and resource management, Altair's PBS Professional continues to help customers increase software use and ROI, and help improve overall productivity.

New features of PBS Professional 11.0 include faster scheduling, submission, and cold start, and re-architected Cray Support.

PBS Works also offers other HPC solutions: PBS Catalyst and PBS Analytics. PBS Catalyst simplifies the submission and management of jobs running on PBS Professional compute nodes. PBS Analytics is a data analysis and visualization solution that provides administrators with job and license analyses.

MORE → deskeng.com/articles/aaayzs.htm



IronCAD Releases New Design Collaboration Suite

Drafting component integrates 2D detailing and 3D model data.

IronCAD recently released the 2011 edition of its Design Collaboration Suite of product development applications. This series of products receives short-shrift from the US CAD/CAM media, but it deserves more attention.

The IronCAD line is widely deployed outside the US, especially in China,

a nation which, I admit, has hardly had an effect on US manufacturing over the years (not!). Snarks on all of us aside, I think IronCAD's Design Collaboration Suite 2011 XG (Next Generation) deserves a bit of your time. Here's why.

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CATIA V4/V5 Translator Supports SolidWorks 2011

CCE's CAT5Works enables bi-directional import and export of files.

CCE's CAT5Works now supports bi-directional SolidWorks 2011 to CATIA V4/V5 import and export in addition to 2009 and 2010 support. The features that interested me are, in no particular order: transfers of CATIA V5 FT&A entities to SolidWorks, the ability to import CATIA V5 Release 6 to 20 .CATPart and CATProduct files to SolidWorks

and the reverse with SolidWorks files, and the ability to translate hidden entities. Color support too.

But what I like best about what I've learned of CAT5Works is that it requires what the company says is a single button to make your data transfer happen.

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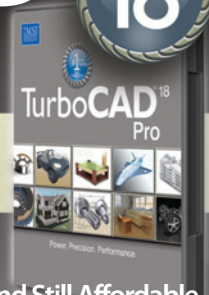
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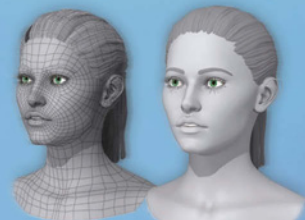
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1 New Quadro Line of Graphics Cards

NVIDIA (nvidia.com) has announced a new line of Quadro professional graphics solutions for mobile workstations. These new Quadro graphics processing units (GPUs) leverage the NVIDIA Fermi architecture. Featuring twice the number of CUDA cores and twice the graphics memory over previous generations, these new Quadro GPUs also incorporate NVIDIA Optimus technology, which automatically powers the GPU only when needed to enhance battery life. Optimus also provides users with the ability to drive up to four displays at the same time. The new cards include the Quadro 1000M, 2000M, 3000M, 4000M and 5010M (pictured above).

Omega Releases Wireless pH/Temperature Transmitter

Omega Engineering's (omega.com) UWPH-2-NEMA wireless pH temperature transmitter features a microprocessor-based wireless radio transmitter built into a NEMA enclosure. It transmits pH, temperature and signal strength in real-time. The free software that's included converts users' PCs into a multi-channel chart recorder

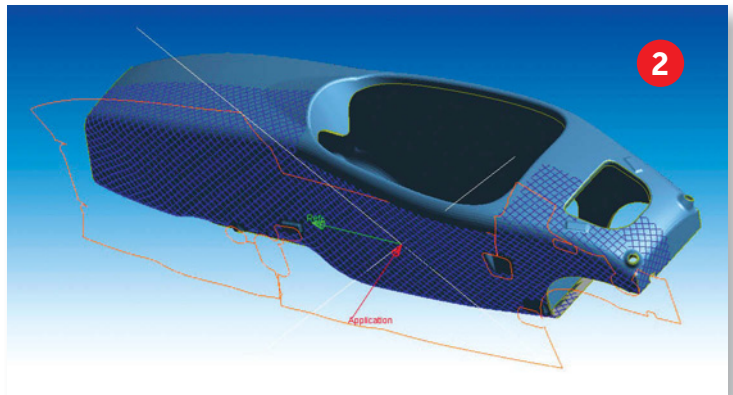
or data logger. It works with Omega's UWTC series receivers for a complete wireless system. Prices start at \$265.

VidCAD Documentation Tool for Bricscad V11

Bricsys (bricsys.com), the author of Bricscad, has announced that the VidCAD SQL Engineering (vidcad.com) suite of products is now available for Bricscad V11. VidCAD SQL Engineering is software for designing and documenting complex cabling and electric equipment installations. When changing cable or equipment info in one drawing, all other drawings and facility data automatically update to reflect changes. All reports are generated inside VidCAD and can be exported to other software or a PDF writer.

2 Version 4.1 of Laminate Tools Released

Anaglyph Ltd.'s (anaglyph.co.uk) Laminate Tools is a Windows application that integrates the design, analysis and manufacture of composite structures. It complements existing CAD systems and/or FEA environments, with native support for NASTRAN and ANSYS to help ensure compatibility in the analysis of composites. It is made to help optimize



what is being designed. The new version introduces new features in the Geometry, Design and Manufacture modules to improve the Laminate Tools CAD interface, including a new embedded SolidWorks environment for ply definition.

Platform Computing Launches Platform LSF 8

Platform Computing (platform.com) has announced the release of Platform LSF 8. The HPC workload management platform's enhancements enable users to guarantee resources to groups of jobs, perform live reconfiguration to apply common configuration changes dynamically via a CLI or API without the need for reconfiguration or restart, delegate administrative rights, configure different shares at the queue and global level, and more. Updates to several key add-on products are now also available in conjunction with the release.

Firehole Releases Helius:MCT Version 4.0

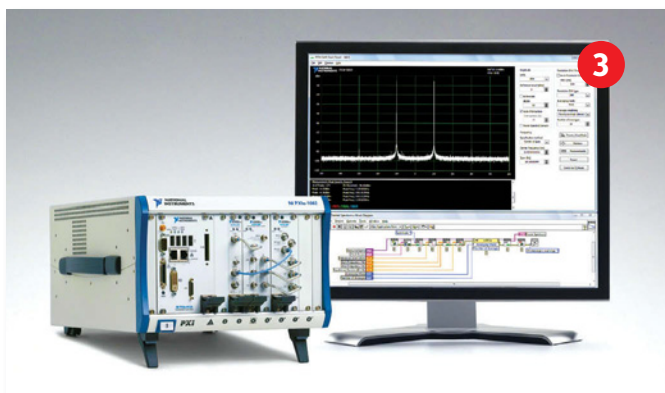
Firehole Composites (firehole.com) has launched Helius:MCT v4.0, the newest edition of the finite element add-on built to improve the accuracy and efficiency of composite structural analysis. Version 4.0 offers solu-

tions to the challenges of delamination and FEA mesh dependency. Helius:MCT v4.0 is designed to combine cohesive layer modeling with multiscale progressive failure analysis and eliminate the need to artificially prescribe a crack initiation.

KeyCreator 2011 Released

Kubotek USA (kubotekusa.com) has released the latest version of its 3D direct CAD software: KeyCreator 2011. KeyCreator 2011 supports 64-bit architecture, new and improved dynamic editing, and a re-engineered IGES translator that the company says imports files quicker and more accurately than previous KeyCreator versions. With the 64-bit version, KeyCreator 2011 can work with more data and larger files. KeyCreator 2011 file size is only limited by the amount of memory available on the PC. KeyCreator imports common CAD file types and works with them as if they were created within KeyCreator, according to the company.

Cymbet Launches Energy-Chip EP Universal Energy Harvesting Evaluation Kit
Cymbet (cymbet.com) has announced the global avail-



ability of its EnerChip EP CBC-EVAL-09 Universal Energy Harvesting evaluation kit. The EVAL-09 kit supports all types of ambient energy harvesting from light and vibration, to thermal gradients and flow/motion. The kit features the EnerChip Energy Processor (EP) CBC915-ACA, a universal energy harvesting power management unit for ultra-low power energy systems. According to the company, the EnerChip EP is the first device to work universally across all energy harvesting transducer technologies, including photovoltaic, thermoelectric, piezoelectric and electromagnetic.

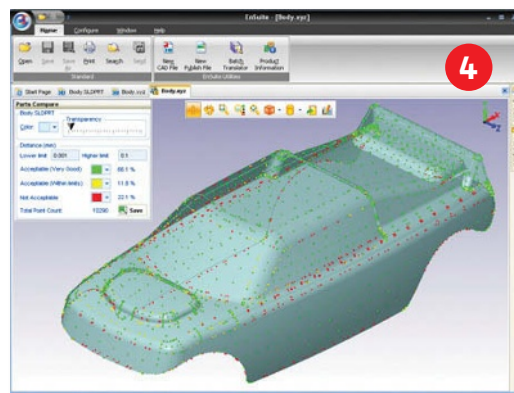
3 National Instruments Releases PXI RF Vector Signal Analyzer

National Instruments (ni.com) has introduced the NI PXIe-5665, a 3.6 GHz RF vector signal analyzer (VSA) that is designed to deliver RF performance in a cost-effective PXI form factor. The new VSA features phase noise, average noise level, amplitude accuracy and dynamic range. The PXI platform also facilitates peer-to-peer streaming; includes a flexible multiple input, multiple output (MIMO) architecture for phase-coherent measurements, and offers fast measurement speeds. The

VSA combines the NI PXIe-5603 downconverter with the NI PXIe-5653 local oscillator synthesizer and the NI PXIe-5622 intermediate frequency (IF) digitizer.

Autodesk 3ds Max 2012 Software Announced

Autodesk (autodesk.com) has released Autodesk 3ds Max 2012, the latest version of the company's 3D modeling, animation, rendering and compositing application. Mapping to the Excalibur (XBR) initiative—a phased plan for the restructuring of 3ds Max—the new version provides improvements in workflow, user interface and performance



intended to give designers enhanced creative capabilities for increased productivity.

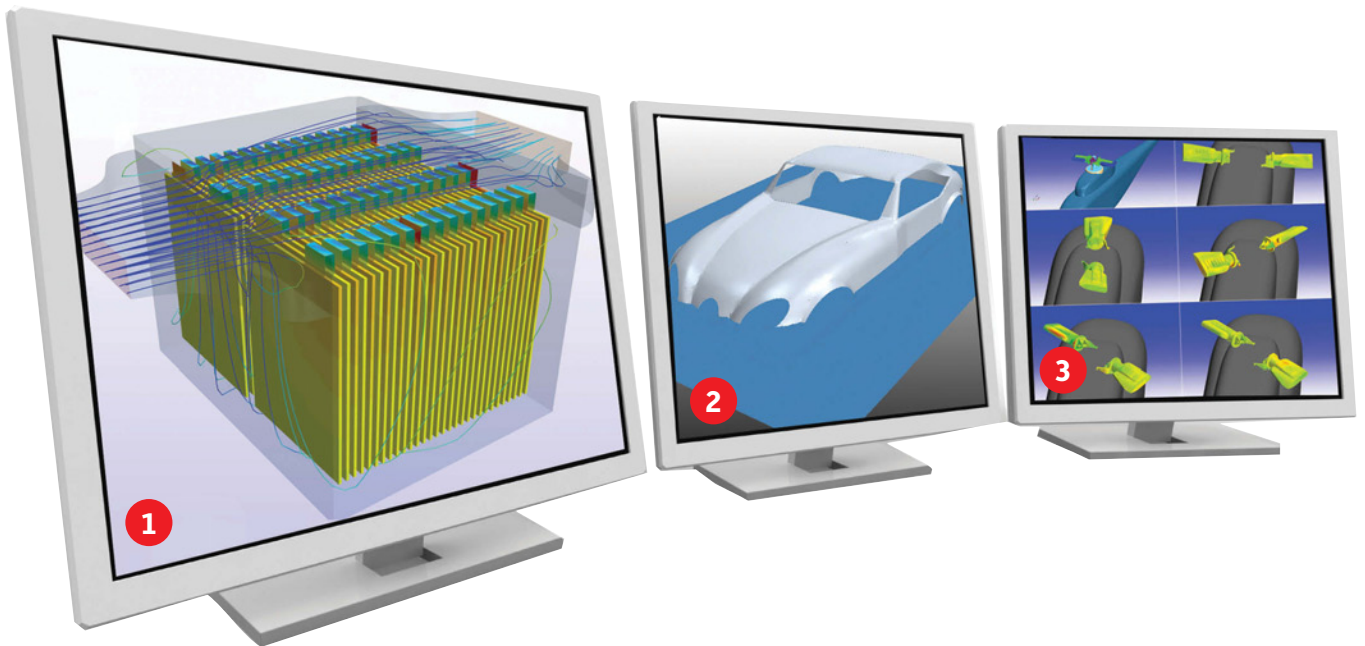
4 CCE's EnSuite Enhanced for Reverse Engineering and Rapid Prototyping

CCE (cadcam-e.com) has released EnSuite with new tools for reverse engineering and rapid prototyping applications. EnSuite's Model Compare functionality has been extended to compare Native CAD data with scanned point cloud data, and STL files. The results of the comparison are visually displayed showing the deviations from the original design. The results can also be exported to an XLS file. **DE**

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Battery Simulation Module

1 The multiphysics engineering tool's new battery simulation module allows the simulation of flow, thermal and electrochemistry phenomena for Li-Ion battery cells and packs. It includes user defined discretization controls for the thermal and electrochemical network within a cell and automated problem definition designed to quickly create battery packs from defined cells.

E-coating

2 A new electro-deposition coating (e-coating) model simulates the deposition of paint under the influence of an electric field when a charged product is dipped into a bath of paint. With user defined paint properties, analysts can examine the efficiency of a painting process by predicting exactly how the layers of paint accumulate over time.

Motion Superposition

3 Version 6.02 also includes Motion Superposition, which allows users to prescribe more complex body motion within a simulation and combine multiple rigid body motions or rigid body motions with mesh morphing.

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ADDITIONAL FUNCTIONALITY

As simulation becomes more readily accessible to more design engineers, conveying simulation data becomes even more important. STAR-CCM+ v6.02 includes new post-processing functionality, such as:

- Histogram graph types used for statistical analysis (appropriate for Lagrangian analysis, cell quality visualization, etc.)
- Start and end markers for stream lines, iso-line values, log color scales, and uniformity index reports.

In addition, a new STAR-CCM+ plug-in for Isight is available. Isight is a process flow and optimization code from SIMULIA, a Dassault Systèmes brand, that can be used to drive a variety of different CAE tools. The plugin allows for control of STAR-CCM+ within an optimization problem with full access to field functions and design parameters.

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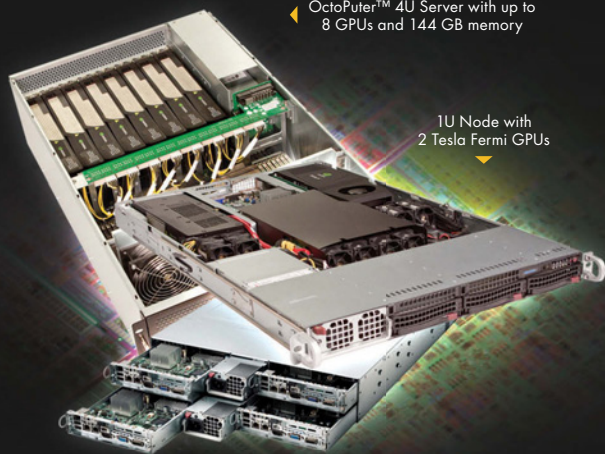
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