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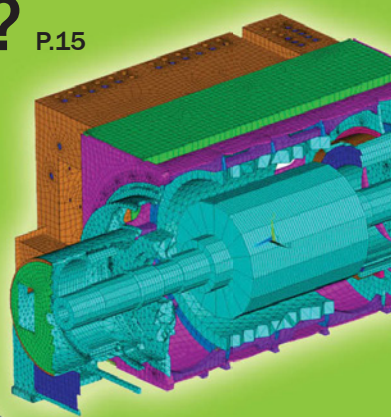

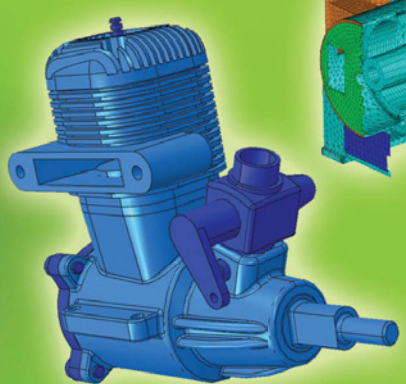

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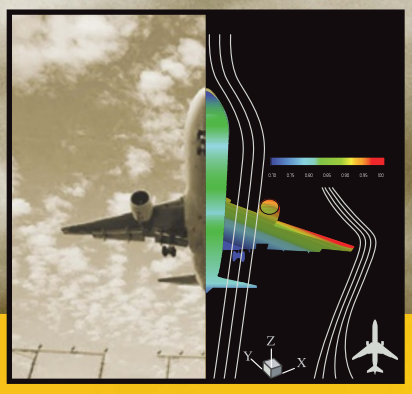

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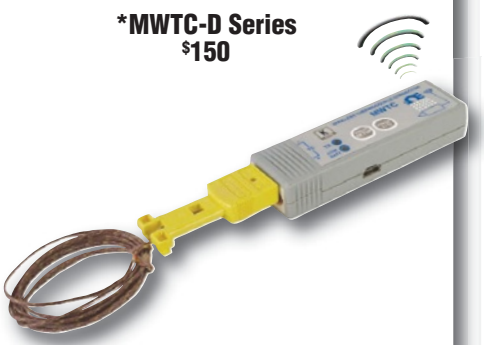

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by Steve Robbins

Engineering Convergence

I've been traveling a lot recently, first to the Siemens CAE Symposium at the Joe Gibbs NASCAR Racing facility outside of Charlotte, NC, then off to Supercomputing 2011 in Seattle, WA, and finally to Las Vegas to attend Autodesk University. They say travel broadens the mind, and my trips were no exception to that rule.

I had the pleasure of meeting with engineers whose ability to create great designs has been positively changed by the adoption of new technologies. I saw the results of companies using new modeling tools, simulation software, PLM and engineering data management, rapid prototyping and 3D printing, all enabled by faster computer technologies. I'm lucky to be an editor at *DE*, because it allows me to see all that is happening in the design engineering world.

Many of you experience only the tools your companies or organizations use. You have seen new technologies that might be of great benefit to you and our team, but often, it takes years to adopt what has been available for decades. If engineers were left to their own devices, most would be early adopters of new technology, but often there is a layer of management asking you to justify an investment in new technologies. Well, the world is about to change. We are at an inflection point.

CAD/CAM/CAE is going where no engineer has gone before.

Change is Coming Fast

History has shown us that technology increases in performance as it decreases in cost. Think VCRs to DVDs and now, to streaming video; personal computers to workstations to local high-performance computing and the cloud. At Supercomputing 2011, Jen-Hsun Huang, NVIDIA's CEO, discussed where we are today and where computing will be going in the future. The world's fastest supercomputer is currently running at 10.51 Petaflop/s . That's 10 quadrillion calculations per second. However, Huang said the power requirements of these machines is tremendous, with a 6-petaflop/s computer using about 9 megawatts of power. So how are supercomputer companies going to power the next generation of computers? These exaflop computers will need about as much power as a full-sized aircraft carrier if they use conventional CPUs. The A4W Reactor used by the U.S. Navy produces 104 megawatts. Most aircraft carriers have two of these. We'll need more efficient floating point processors to reach exaflop computing levels.

Huang predicted reaching exascale computing somewhere between 2019 and 2022, and the goal is to reach this scale using about 20 megawatts of power. That still sounds like a lot, but if we can reach that for exaflop/s computing, a 5-watt device like a smart phone or tablet will have the power to run a few teraflop/s of compute power and today's workstations, with 1,000 watts, will run at hundreds of teraflop/s. This translates into real-time multiphysics simulations on your desktop in about 10 years.

Speed Delivers on Technology's Promise

Meanwhile, as software has been eyeing the cloud, our workstations and local HPC systems are getting much more powerful. CAE, simulation and analysis software are becoming increasingly easier to use while becoming exponentially more powerful. Being able to send models out to the cloud to be rendered, or sending a CFD simulation job to the cloud to run a large number of times works in certain situations, but keeping things local would be more efficient. In the next couple of years, we will see a dividing line in our work, with more compute power on our desks and access to very large amounts of data and compute power on the cloud.

Sharing and collaboration will become increasingly important and will produce unexpected results. Security will come to the forefront. PLM and data management will be able to deliver the promise of ease of use, data reuse, and sharing to the complete enterprise. It will be used by everyone in engineering, small or large companies, designers, manufacturing engineers, sales people and management.

Direct modeling and one-button analysis will be the norm during the creative processes. Running multiple simulations on large assemblies locally before prototyping the complete design using many different materials will change the way we work. And simulation isn't limited to the mechanical model, it will include motors, electronics, and control systems. We will be able to determine manufacturability before handing the design off to the factory floor.

In 2012 we will see many changes. It will be a year of exponentially moving forward as software meets the challenge of using increasingly powerful hardware technologies now available. CAD/CAM/CAE is going where no engineer has gone before. 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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NATIONAL INSTRUMENTS™

DE January 2012 VOLUME 17/ISSUE 5

COVER STORY

Sustainability vs. Affordability

15 Consumers are increasingly demanding more environmentally-friendly products at lower prices, so design engineers are charged with making it faster, better and cheaper as well as sustainable for the environment. Fortunately, a number of software packages and plug-ins can help you determine how much that sustainability will cost vs. the environmental benefits it provides. Kenneth Wong explains some of your options.

ON THE COVER: There's a balancing act between cost and environmentally-friendly design. *Images courtesy of Granta, Autodesk and Bigstock.*

ENGINEERING COMPUTING

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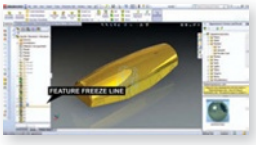

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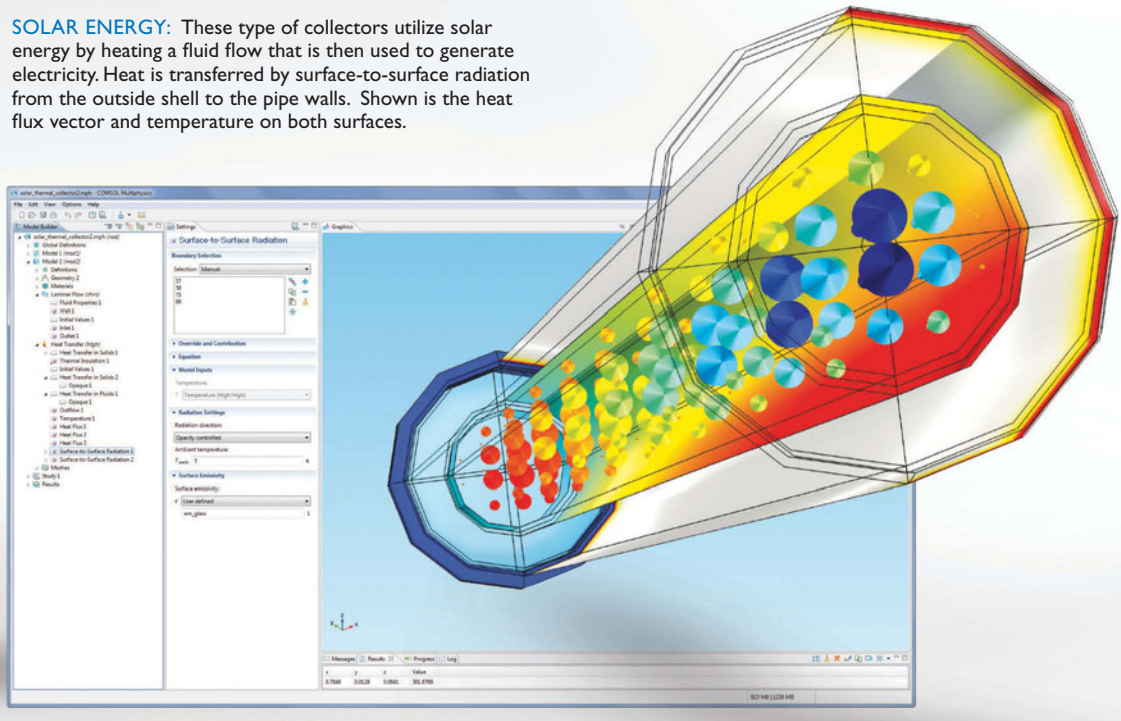

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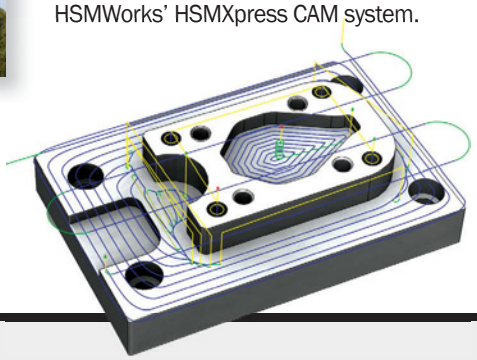

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BPA WORLDWIDE

Getting a Step Up On the Competition

Screen image courtesy of ANSYS

Engineers need the best and fastest workstations to get better products to market.

BY PETER VARHOL

Most design engineers work in highly competitive industries. The difference between success and failure is small, and is often driven by the ability to get superior products to market ahead of the competition. Because of the time and effort needed to produce new designs, often getting to market first can be a matter of luck.

But smart engineering groups can tilt luck in their favor through the use of better design tools and smarter processes. HP Z800 Workstations enable engineers to perform computations and analyses at the speed of a supercomputer only a few years ago. With up to two Intel® Xeon® processors, 12 total cores, and 192GB of memory, the HP Z800 Workstation excels at executing long-running jobs that can be broken up into many independent and parallel computations. More of these types of jobs can be run locally, on the workstation, rather than being sent off to a cluster. And even if they do require a cluster, the problems can be better defined than they could be in the past.

But it is also designed for detailed interactive work, such as creating a design visually or with computations. With NVIDIA Quadro or AMD FirePro graphics and up to 12GB of graphics RAM with two Nvidia Quadro 6000 cards, it's possible to create fast visual designs with intricate detail and stunning realism.

The best tools can be game changers. Engineers can express their skill and creativity without being concerned about the limitations of the tools. The HP Z800 Workstation provides the graphics and computational flexibility for engineers to work effectively on any project.

Better Design Tools Are Only Half the Answer

But better tools don't always result in better products or faster time to market. They may simply accelerate poor work processes. Engineers also have to look at their design processes to find ways of improving how designs are developed and evaluated, while also reducing redundant or unnecessary steps.

The HP Z800 Workstation with two Intel® Xeon® processors provides the features needed to both accelerate design processes and make them more efficient for today's demanding markets. HP's alliance with Parallels means that Parallels' Workstation Extreme, a virtualization tool that enables engineers to partition off resources so that they can be used in separate and distinct computations, with system and I/O performance comparable to that found natively on the workstation. The combination of an HP Z800 Workstation and Parallels Workstation Extreme means users have access to virtual machines on their desktop which can operate independently of user interaction. Highly computational analyses can run in the background on the same machine without interfering with the user doing their day-to-day design.

Further, the virtual machine side of the HP Z800 Workstations can be networked together to form a virtual machine workstation cluster to run analyses and simulations on designs in progress. Using the second gigbit Ethernet interface, multiple HP Z800 Workstations can be configured into a private network that can pool those resources into a cluster configuration. A cluster of up to eight workstations can provide dozens of cores and hundreds of gigabytes of memory for demanding computations.

The best part about this configuration is that it all runs in a virtual environment, enabling the engineers to continue design work on the native workstation environments.

Making Designs Successful

Engineers want their designs to be commercially successful. Most have the technical ability to achieve that success. What is often lacking is the tools to translate that ability into concrete designs.

The HP Z800 Workstation provides many of the tools that can take good designs and help make them commercially successful. It does so through a combination of high performance, flexibility, and the ability to seamlessly multitask between design and analysis. Using the best set of tools doesn't guarantee that you'll get a superior product to market before your competition, but it greatly improves your chances. DE

by Kenneth Wong

Autodesk's 180 Turn with Nexus 360

In 2007, addressing the press crowd inside Zeum Theater in San Francisco, Autodesk CEO Carl Bass took a few jabs at his competitors who specialize in PLM (product lifecycle management) software suites. His memorable words were, "The only people who need PLM are the ones selling PLM … PLM is a solution in search of a problem."

Last December, at Autodesk University (AU) conference in Las Vegas, Bass faced many of the same members of the trade press and said, "When I looked back at my anti-PLM rap, it pleased me that we didn't do it until we could do it right." With these words, Autodesk prepared to take a swim in the PLM pool it had previous shunned.

Autodesk's PLM brand, dubbed Autodesk 360, will come in two flavors: 360 for PLM (for manufacturing) and 360 for BIM (for building information modeling, aimed at architecture, engineering, and construction industries).

The one for manufacturing includes:

- Autodesk Vault, for product data management;
- Autodesk Buzzsaw, for project management and collaboration; and
- Autodesk Nexus, for business process management.

Autodesk gets into PLM market with the unveiling of Nexus 360, a cloud-hosted solution scheduled to debut next year.

The first two components are existing products, but the last item is a newly developed application, built on the cloud and meant to operate as SaaS (software as a service). Judging from the screenshots and video captures shown to the press, Nexus will allow you to build your own customized flowchart-style business process map in a drag-and-drop interface.

Steve Bodnar, Autodesk's vice president for data management and PLM, shared his views on PLM. "PLM is a lot more than engineering and PDM (product data management)," he said. "We do believe PDM and CAD should be tightly coupled … PDM users and PLM users are not the same people."

There are surprisingly few references to mobile apps in Autodesk's debut PLM vision, despite the long list of mobile apps the company has released to accommodate engineering and design software users. Autodesk's PLM competitor, Siemens PLM Software, has released the second incarnation of its PLM mobile app, Teamcenter Mobility. PTC is hard at work on its first, Windchill Mobility. Autodesk's Bodnar said, "In the beginning, [mobile devices] will be supported via web browsers. Over time, we will develop specific mobile apps."

In the same week, Autodesk signed an agreement to acquire Horizontal Systems, a provider of cloud-hosted BIM software. Most likely, Horizontal's platform will become part of Autodesk 360 for BIM.

Autodesk hasn't specified how or for what price it will market its PLM product. However, it states that it plans to sell it at a price point much lower than its competitors, targeting small and midsize businesses primarily.

Autodesk Wants You to Sketch and Solve on iPad

Simulation, generally associated with powerful desktop workstations and server clusters, is getting the iPad treatment, dubbed Autodesk ForceEffect.

Available now from Apple App Store, the mobile application allows users to sketch diagrams that represent joints and connections in a mechanical assembly, define loads and constraints, and then run the solver to simulate the force's impact on a particular design.

"For almost all customers, simulation has become mission critical," according to Scott Reese, Autodesk's senior director of digital simulation.

For complex analysis jobs (such as multiphysics and computational fluid dynamics), most engineers and designers may still rely on workstations and server clusters, but for simple stress analysis jobs and force-impact calculations, they now have the option to use mobile devices. Other software makers who share this vision have also developed and released mobile apps. Examples include NEi Software's NEi Stratus and Maplesoft's Maplesoft Player.

CATIA Adds 3D Sketch

Last November, Dassault Systèmes launched what could be a powerful comeback against Autodesk Alias and Maya. CATIA Natural Sketch, according to Dassault, "brings together the intuitiveness of creative 2D painting gestures and the power of accurate, realistic 3D modeling."

In the last few years, Dassault's rival Autodesk has made headway in introducing sophisticated sketching functions to its mechanical design software users. Autodesk titles like Alias and Maya, used by many in industrial design and digital content creation, offer Spline-driven sketching in 3D space, a method that offers greater flexibility and expressiveness in geometry. The use of touch-responsive tablets, like the iPad, also allows Autodesk to experiment further with apps like SketchBook Mobile. Traditional mechanical CAD packages offer simple sketching functions, but they hardly rival the capacity found in Spline- or NURBS-based drawing programs.

Dasssault's latest offering, CATIA Natural Sketch, seems to take a similar approach, allowing users to draw editable, malleable Spline objects in 3D space. (Dassault posted a YouTube clip to illustrate the software at youtu.be/66FoxykeT0w.) Details on the software, however, are still a bit sketchy.

The announcement calls CATIA Natural Sketch part of CATIA V6, Dassault's comprehensive design suite, but doesn't mention whether Natural Sketch will be delivered as part of CATIA's CAD modeling features, an optional plug-in, or an independent title. The video clip shows the software operating on a Wacon tablet, but it's unclear if such a device is essential to using the software.

According to Dassault, "CATIA Natural Sketch completes the CATIA for Creative Designers solution, which now combines 3D sketching, concept modeling, class-A surface modeling, rapid prototyping and visualization."

NVIDIA *Opens* Pandora's Box

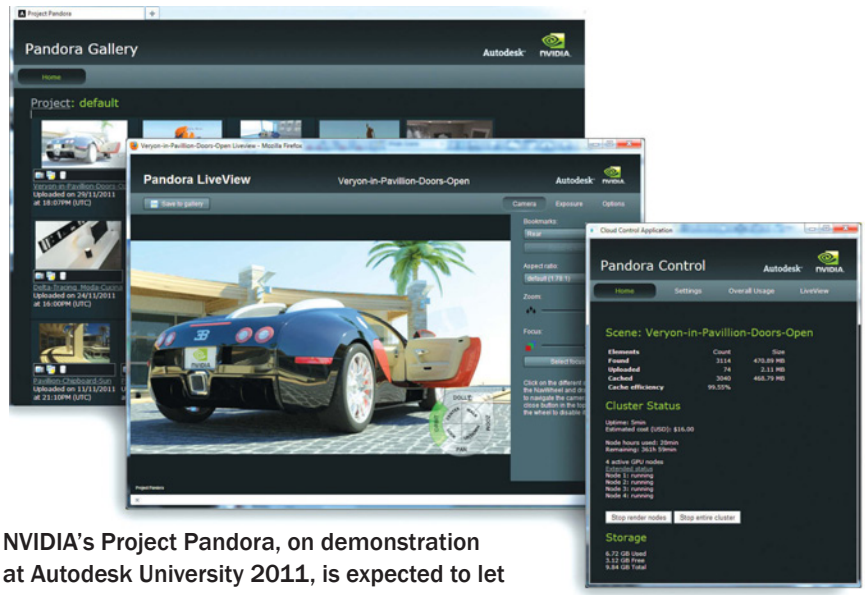
You'll find Pandora's box in the cloud, in a manner of speaking. Project Pandora is the joint effort between Autodesk and NVIDIA to enable Autodesk 3ds Max users to tap into cloud-hosted Tesla GPUs to render time-consuming scenes and clips. Last December, NVIDIA opened Pandora's box at Autodesk University, demonstrating it alongside its newly launched Maximus workstations.

Discussing Pandora's magic in a company blog post, Phil Miller, NVIDIA's director of software product management, said, "Project Pandora harnesses the compute power of a GPU cluster on any Flash-capable PC running 3ds Max and [NVIDIA's rendering engine] iray. This allows 3ds Max users to add virtual dual-GPU rendering machines to their workflow on demand. Unlike 'batch' network rendering, where each machine renders one frame, Project Pandora coordinates the entire cluster to accelerate the current frame. Jobs that used to take over a day can now be done in under an hour by leveraging dozens of cloud nodes."

Typically, the computing power available in mobile tablets and consumer laptops would be inadequate to render a complex 3D scene in a timely fashion, but the use of remote GPUs over a web browser can make this possible, as shown in early prototypes of Pandora.

"At AU 2011 Las Vegas, we're using tablets powered by the NVIDIA Tegra 2 mobile processor to show how to navigate photorealistic scenes, composed of millions of polygons, in under a minute," Miller wrote.

Neither company has specified dates for Pandora's public availability.



NVIDIA's Project Pandora, on demonstration at Autodesk University 2011, is expected to let Autodesk 3ds Max users render scenes and animations using remote GPUs.

by Kenneth Wong

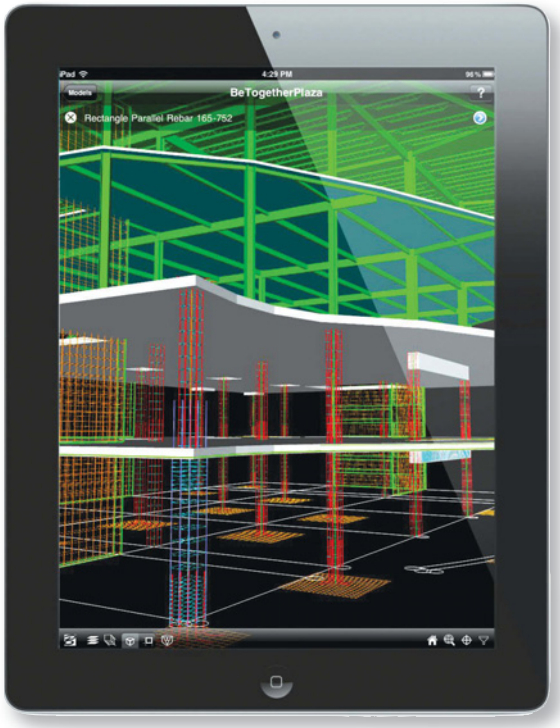
Bentley Puts Plant Structures in the Cloud

Structural Synchronizer View, the latest addition to Bentley Systems' iWare app family, is now available at Apple app store as a free download. With this app, Bentley software users can store infrastructure data in the cloud and access it from an iPad. The app advances Bentley's Integrated Structural Modeling (ISM) vision by providing field technicians with what the company describes as "information mobility."

According to Bentley, "Structural Synchronizer is the core component of an ISM workflow. Facilitated by i-models (containers for open infrastructure information exchange), it provides data synchronization, change management, revision history, and model viewing."

The Structural Synchronizer View iPad app gives you direct access to plant structure models stored in Amazon S3, ProjectWise databases, Dropbox, and other online storages. You can use the device's touch sensitivity to zoom, pan, rotate, and navigate your 3D structural data using fingertips. You can also use its filtering system to turn on or off selective layers and floors to investigate the model in various permutations. You can select identifiable components (beams and trusses, for instances) and further query them for their item numbers, locations, orientations, and placement points.

Huw Roberts, Bentley global marketing director, pointed out that Bentley's ISM innovations give customers "the ability to accomplish structural modeling, analysis, design, documentation, and detailing within synchronized and flexible workflows — further empowering intelligent structural design practices."



Bentley Systems extends its iWare mobile app collection with the release of Structural Synchronizer View.

3D Systems **Adds Color** with Acquisition

Just a few months ago, 3D Systems snatched up Alibre, a low-cost CAD package that's gaining ground among makers and hobbyists. In December, the company signed an agreement to buy Z Corp, a competing 3D printer vendor with color-printing technology.

Among competing rapid prototyping vendors, Z Corp distinguishes itself with machines that can print 3D models in multiple colors — an advantage for those using 3D printing for sales and marketing or those using it to study finite element analysis results. Z Corp also offers a line of 3D scanners — portable, handheld devices that can capture the shape of objects in point clouds.

When the transaction closes, Z Corp's printers and scanners are expected to bolster 3D Systems' lineup, which spans from low-cost, hobbyist-friendly models (BotMill, RapMan, ProJet, and V-Flash) to professional, production-capable models (ProJet, iPro, sPro, and VX brands). The pending merger puts pressure on other major players in the rapid prototyping market, dominated by a handful of names (Stratasys and Objet, to name but two).

3D Systems is buying not just Z Corp but also Vidar Systems, which makes medical and dental imaging systems. Both are subsidiaries of Contex Group, an imaging systems provider. The sale of Z Corp and Vidar Systems suggests Contex has decided to return to its origin, to focus on large-format scanners. DE

Kenneth Wong *is senior editor of* Desktop Engineering. *Contact him via de-editors@deskeng.com, at deskeng.com/virtual_desktop or via Twitter @KennethwongSF.*

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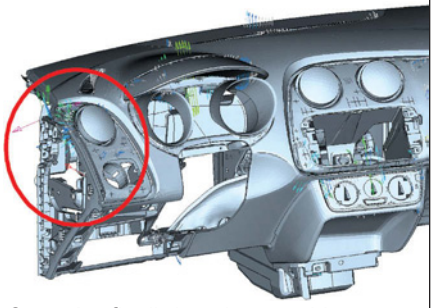

So you've finally bought your shiny, new car. But then one day, the noise starts—an unidentifiable, repetitive, distracting sound coming from somewhere inside your vehicle. In no time at all, that annoying sound is driving you crazy.

The problem is called squeak and rattle (S&R), and it's been driving the automotive industry crazy, too. Paradoxically, while great progress has been made in other areas of noise and vibration (N&V), the fact that modern automobiles run more quietly than ever has made lingering S&R issues even more apparent. With engine and road noise diminished, smaller sounds that used to be hidden become magnified to the driver's ear.

S&R is often located in the interior trim of a vehicle, such as the dashboard, but the exact source can be hard to pinpoint. "Squeak" happens when components periodically slip and stick together. "Rattle" occurs when parts hit each other intermittently. Both noises usually stem from inconsistent assembly tolerances or lack of stiffness.

"Since we'd already been using Abaqus in vehicle cockpit design and testing for thermal, impact and normal modal analyses, it made a lot of sense to simply develop a new load case for squeak and rattle inside Abaqus," says Inés Lama, project manager, design engineering, for IDIADA.

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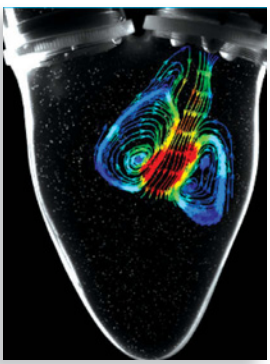
Designing Safer Bioprosthetic Heart Valves with CFD/PIV

University of California researchers use Tecplot 360 CFD visualization software to help identify vortex abnormalities.

In 1960, Dr. Albert Starr successfully implanted the world's first prosthetic heart valve, a mechanical device that he co-invented with M. Lowell Edwards, a prominent engineer. More than 50 years later, millions of patients' lives have been saved or improved by technological advancements based on the work of pioneers like Starr, Edwards and others. Today, more than 250,000 patients receive prosthetic heart valves each year.



Patients who undergo heart valve replacement have a better quality of life. Still, complications can occur from device failure, damage to the valve caused by infection, poor valve design, material deterioration, or host tissue overgrowth.

Ahmad Falahatpisheh, a Ph.D. candidate in the Kheradvar Research Group (KLAB) at the University of California, Irvine, is pioneering research to improve bioprosthetic heart valves. With the help of Tecplot 360 CFD visualization software to view and analyze his Digital Particle Image Velocimetry (DPIV) data, he is helping develop the first bi-leaflet bioprosthetic mitral valve with a dynamic saddle annulus designed to mimic the natural mitral valve.

MORE ➜ deskeng.com/articles/aabdgp.htm

When Push Comes to Shove(l)

VISI's software helps deliver a new collapsible snow shovel, designed to help motorists avoid getting stranded.

With its two-hinged handle, the Senior & Dickson collapsible shovel is designed and manufactured with the help of specialist CADCAM tools from Vero Software.

Senior & Dickson specializes in plastic injection, rubber molding and die-casting. The UK-based company develops ideas from concept through to working prototypes and on to production tooling, as demonstrated by the snow shovel project.

While the snow shovel is aimed at motorists because of its handy folding design, the manufacturer also expects it to become an essential tool for helping householders keep their driveways clear of snow and other debris with its interchangeable shovel and fork heads.

The VISI suite of CADCAM software was instrumental in designing these head configurations, specialist handle and 3D tooling, along with the CNC toolpaths. All design work and electrode extraction is performed in the CAD office, while toolpath generation is carried out on the shop floor next to the milling machines.

Senior & Dickson Technical Director Chris Hodgson explains the advantages of taking the toolpath creation out of the CAD office.

"We moved the CAM onto the shop floor, as the machinists are closest to the action and can react immediately without having to wait for the design team," Hodgson says.

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➜ For the complete application stories visit deskeng.com/fastapps

Engineering on the Edge

HRL Develops Ultra-Light Micro-Lattice Material

HRL has developed a new material that makes Styrofoam feel overweight. This new metallic micro-lattice material has a density of 0.9 mg/cc. It is the result of a team effort by HRL, The California Institute of Technology and the University of California, Irvine. It has been found to have complete recovery from compression exceeding 50% strain and extraordinarily high energy absorption.

The "micro-lattice" cellular architecture consists of 99.99% open volume by designing the 0.01% solid at the nanometer, micron and millimeter scales. It could have a number of applications, including use for battery electrodes, catalyst supports, and acoustic, vibration or shock energy damping.

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3D Printing Robotic Spiders

Researchers at the Fraunhofer Institute for Manufacturing Engineering and Automation in Stuttgart, Germany hope to use selective laser sintering to create small, low-cost robots that look and walk like spiders. The team can generate interchangeable, modular parts for the robots using the 3D printers.

Potential applications include rescue scenarios, in which the spiders could carry video cameras and sensors into hard-to-reach areas.

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SME Lists Innovations

The Society of Manufacturing Engineers (SME) has revealed a list of seven innovations called "Innovations That Could Change The Way You Manufacture."

This year's list included:

- Smart magnets: Magnetic material can now be "reprogrammed" with multiple poles of varying strength, opening the door for new applications like precision switches, self-assembling toys and furniture, and even robots that can scale walls without touching them.
- Graphene: This 1-atom-thick sheet of carbon is strong (50 times stronger than steel), flexible, transparent, and can conduct electricity.
- Quantum dots: These nanoparticles of semiconductor material have optical and electrical properties. Controlling their size allows a manufacturer to determine the color of light emitted.
- Remote presence robots: These robots can "stand in" for a person who wants to remotely attend a meeting using Web cams, digital video and sound, and guided laser pointers. According to SME, companies like Procter & Gamble are already using them.

Check out the rest on the Engineering on the Edge site.

MORE ➜ engineeringontheedge.com/?p=338

NASA Tech Demonstrated to Auto Industry

Cleveland's NASA Glenn Research Center hosted a workshop that included more than 30 exhibits demonstrating the latest NASA technologies that could benefit the automotive industry. The workshop was arranged by The Manufacturing Advocacy & Growth Network in Cleveland (MAGNET) and the Center for Automotive Research at The Ohio State University.

During the workshop, which was held in Glenn's aircraft hangar, attendees learned about technologies such as advanced materials, including metal and fiberglass foam, nanotechnology, extreme environment sensors, and power generation via fuel cells and new battery gels. The goal was to inform the automotive industry about cutting-edge technologies that could be leveraged to improve automobile performance, efficiency and manufacturing processes.

Attendees had the opportunity to have one-on-one conversations with NASA innovators to discuss their near-term technology needs and how NASA's research and development could help address their future technology requirements.

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Sensors Help Man Fly Electric Multicopter

Perhaps you've seen the Parot AR.Drone quadricopter. It's a toy helicopter with four rotors that can be controlled via an iPhone, iPod or iPad. As the saying goes, the only difference between men and boys is the cost (and the size) of their toys.

A company in Germany named e-volvo has built a man-sized multicopter. It has 16 rotors, four on each of the four jibs that jut out from a central hub where the test pilot, Thomas Senkel, sat during it's first flight, which lasted 90 seconds.

The multicopter, which measures a little over 16x16 ft. and weighs about 176 lbs., uses a position sensor to ensure the correct position in space and permanently balances position changes with rotary speed adjustment, according to the company. Its lithium batteries enable flight times of up to 20 minutes, depending on payload.

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Supporting PLM and Workflow

BY JIM ROMEO

Product design often entails product lifecycle management (PLM) software for the maintenance and subsequent production of a manufactured product.

As such, engineering design software must be able to integrate with other software and databases to promote workflow, cut production time, increase accuracy and ensure the supply chain supports the product. *DE* recently spoke with Conrad Leiva of iBASEt, Foothill Ranch, CA, to understand what its Solumina software does for PLM.

DE: How does iBASEt work?

CL: *Our software suite, Solumina, provides the execution side of the extended enterprise PLM system, providing oversight and control of supply chain quality management, manufacturing and aftermarket services operations. Solumina excels in industries where integration with engineering data and workflow is critical to product quality, such as aerospace, defense, electronics, medical devices and industrial equipment.*

In Solumina, manufacturing and quality engineers define the work and inspection-process details that will guide mechanics and inspectors to produce quality products consistently. This information package is delivered to the shop floor via a completely paperless-execution system that enforces the management disciplines, including handling of exceptions, deviations and continuous improvement to the planned procedures.

The Solumina system maintains cross-referenced data to the engineering models, drawings and specifications used as the basis for planning work and inspection. The business processes for managing changes are integrated first with engineering change notices (ECNs), and flow down to inspection and work orders at suppliers' sites and production shop floor. This assures that as-built and as-maintained configurations always match as-designed, or have explicit approvals on record for any deviations. Quality and performance metrics help engineers identify areas where design improvements can make a big impact to the manufacturing or service processes.

DE: How does Solumina help designers?

CL: *There is enormous pressure to get new products out to market quickly. This is driven by a couple of forces: customers demanding more product variants, and technology advancing faster than ever.*

Solumina helps expedite the incorporation of engineering changes into work-in-process at the shop floor, and ensures the traceability of the changes to the ECNs coming from the engineering system. The end result is that as-built and as-designed are always in sync.

DE: Can you give us an example?

CL: *Let's say an issue is discovered at the shop floor, and an urgent ECN is issued as a result of the investigation and corrective action. In Solumina, the manufacturing engineer can place all the affected work orders on hold until the ECN is processed, and all of the work orders are updated with the latest specifications and updated work instructions. This process is facilitated by a wizard in Solumina that groups work orders according to their status, while assessing the impact of the change. After a few clicks, the changes are incorporated—or the wizard guides the engineer to additional steps where conflicts are found.*

DE: What features would you say are most appealing to end-users?

CL: *The software is designed to streamline specific processes for specific users and specific industries—mainly documentation and verification processes that are traditionally clerically intensive, tedious and error-prone. The product addresses areas of functionality that have not been addressed by enterprise resource planning (ERP) and PLM solutions. The users also find the workflow-driven, integrated-business processes among the Engineering, Operations, Production Control, Inventory and Quality Management departments very appealing.*

Solumina provides oversight and control of supply chain quality management, manufacturing and aftermarket services operations.

DE: What are the greatest challenges facing product design engineers?

CL: *Besides the challenges of supporting more product variants and quicker product launches that we discussed earlier, there are also challenges in meeting stricter regulatory-compliance guidelines, and working with foreign partners and suppliers, while maintaining intellectual property (IP) protection and compliance to International Traffic in Arms Regulations (ITAR).*

The Solumina software suite provides an integrated "execution" solution that ensures regulatory compliance to the strictest quality management guidelines in highly regulated industries, including aerospace, defense, nuclear and medical devices. **DE**

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

INFO ➜ iBASEt: iBASEt.com

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

Sustainable Design as a Balancing Act

Eco-impact calculators become part of design engineering.

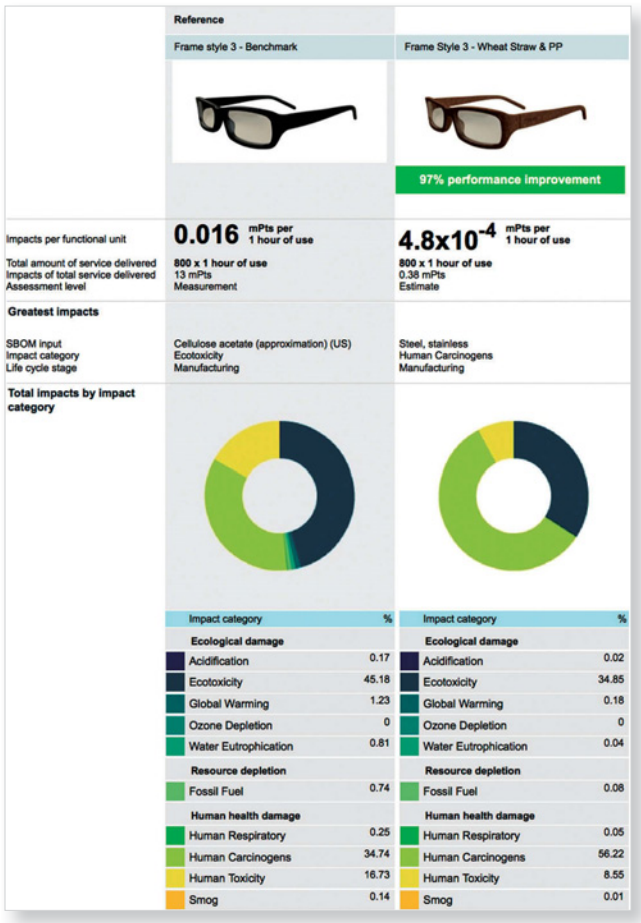
BY KENNETH WONG

The sleek mobile tablet at your fingertips, the stylish sunglasses in your pocket, and the point-and-shoot camera you use to capture your Kodak moments—they all have an ecological lifespan that's much longer than you think. The time the product remains in your possession—its duration of operation and service—may be just a few months (a pair of sunglasses) to a couple of years (a tablet or a digital camera), but its ecological footprint has been established long before you pick it up from your local mall. It will continue to grow long after its disposal. A series of decisions made in the manufacturing process—using polycarbonate instead of scratch-resistant borosilicate materials for a lens, or using injection molding instead of machining for a latch—affects a product's environmental impact.

Depending on the size of the product and the ease with which it can be recycled, many products will likely end up in a waste stream, literally swelling the size of a landfill somewhere. Many city-dwelling consumers would gladly reclaim some precious countertop and desktop space by getting rid of old microwaves, broken electric fans, and damaged LCD monitors, but, confronted with inconvenient disposal options, they'll be tempted to dump them with the trash or leave them in a street corner.

Developed first and foremost to express a product's geometric shape, most engineering software titles can now help you evaluate a design's aesthetics (with photorealistic rendering), durability (with finite element analysis), and manufacturability (with simulation of computer-controlled machining), but they're still primitive when it comes to environmental assessment. However, in the last few years, a number of companies have begun to develop software tools to address lifecycle assessment (LCA).

There's still no consensus on where the lifecycle begins and ends: In your environmental assessment of a design, should you, for instance, include the ecological impact of early prototypes later discarded? But most LCA software users and software developers seem to agree that impact calculation has to include more than the manufacturing bill of materials (BOM).

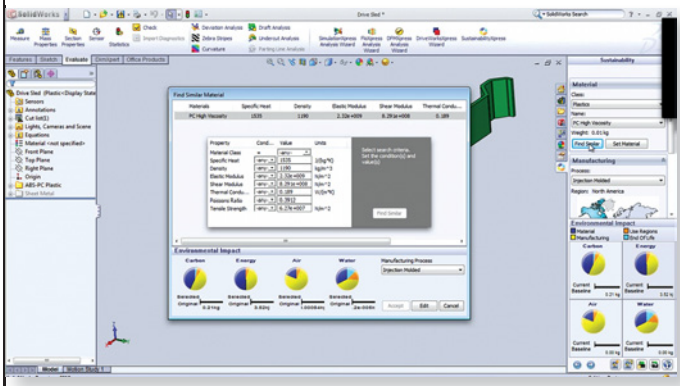


Using Sustainable Minds' browser-based environmental impact calculator, designers at Fred Sparks examine greener alternatives to existing solutions. Shown here is a comparative report of different versions of sunglasses.

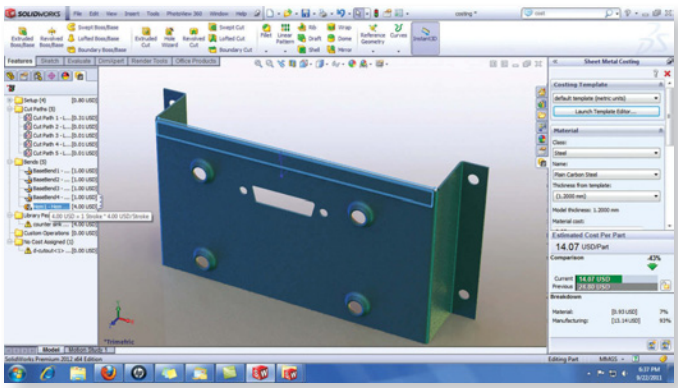
A Sustainable Baseline

The office of Fred Sparks, an industrial design agency, is perched along South Kingshighway Boulevard, within a short distance from Tower Grove Park in St. Louis. The firm has, quite literally, helped shaped many familiar household products, ranging from football helmets and golf bags to outdoor furniture.

Who is Fred, you ask? Well, there is no Fred per se. It's just a personification of the three founders: Ken Harris, Aaron Brookhart and Brandon Hefer.



First released as an optional module, SolidWorks Sustainability Xpress has since become a standard design evaluation tool in subsequent releases of the software. Shown here is the software's dialog window, suggesting similar materials that may be greener or less costly.



In SolidWorks 2012, the software adds a cost analysis module, allowing you to weigh a product's manufacturing cost against its sustainable features.

Fred Sparks is often hired as a design consultant to develop sustainable solutions to existing products. Because its role is consultative, the firm doesn't always have access to 3D CAD models of the products. "Sometimes, those files exist in a factory somewhere in China, and the factory doesn't want to give up that [intellectual property]," observes Harris.

By contrast, Harris finds that it's a lot easier to obtain a physical unit of the product itself, allowing him and his team to disassemble it to understand how its subcomponents work together. For Fred Sparks, the ideal LCA software turns out to be Sustainable Minds, an environmental impact assessment program delivered in a browser-based interface.

Terry Swack, co-founder and CEO of the program's eponymous, Cambridge, MA-based manufacturing company, will tell you there is no such thing as a green product. There are only greener products. Every product has some impact on the environment. Nevertheless, as responsible designers, you can make an effort to reduce the anticipated impact, or find an alternative that creates the least impact. For consultants like Fred Sparks, the first task is establishing a baseline.

"We have to know what the impact of a particular product is," says Harris. "We can disassemble an object, weigh its materials, use Sustainable Minds to get a benchmark, then we use different design strategies to reduce the environmental footprint."

System BOM

Just as CAD users would catalog the content of their assembly in a BOM, Sustainable Minds subscribers use the software's web-based input system to create an itemized bill of a product's lifecycle. In this case, the lifecycle includes not only a list of objects to be manufactured (camera housing, lens, battery, memory chip release latch, etc.), but certain aspects of manufacturing that are bound to have an impact on the environment as well—such as transportation methods, choice of materials, and disposal methods.

You might think of Sustainable Minds as the LCA equivalent of TurboTax. Whereas TurboTax will automatically tally up your income statements and deductions, and provide you with an amount owed to the government, Sustainable Minds provides you with an estimated eco-impact of your design, calculated using the TRACI metrics (Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts) developed by the U.S. Environmental Protection Agency's (EPA's) Office of Research and Development. Measurements are made primarily in anticipated carbon dioxide (CO_2) volume, with accompanying assessments for ecological damage, human health damage, and resource depletion.

One of the much-debated items on Sustainable Minds' system BOM may be the line item dubbed "Unit of Measure" for measuring the impact of a product over its life expectancy. "It's an estimate," Harris acknowledges, "but as long as you use the same unit of measurement for two different concepts, as long as their lifecycles are the same, your comparison will be valid—like comparing apples to apples."

For example, Fred Sparks is currently engaged in designing (or redesigning) a brand of ready-made reading eyewear, the kind you can purchase at your local drugstore without a prescription.

"We interviewed some consumers, found out the frequency of use, asked them how long their readers lasted, then we figured out the [unit of service] by [multiplying] the typical hours of usage per day with the lifespan of the glasses," Harris explains.

In seeking greener alternatives, the team discovered that "manufacturing methods and transportations are big [impact generators], because we now make so many products in Asia and import them," he adds.

Sustainable Minds software allows Harris and his colleagues to play what-if scenarios, by switching materials, manufacturing options and transportation options. Fred Sparks also investigates possible secondary use: For instance, a product package that can be reused as a stand reduces the consumer's tendency

to throw away the package after unwrapping.

"We look at designing packaging to make it apparent that it can be recycled," Harris adds. "We look at developing recycling programs at end of life. During brainstorming sessions, we look at all of those strategies."

Still, Harris admits, some metrics are not guaranteed: Consumers may still choose to dispose of the product improperly instead of recycling it.

CAD Integration

Sustainable Minds works as a standalone web-based program, but the company has worked with Autodesk to ensure that, if you upload a BOM exported from Autodesk Inventor CAD package, the appropriate fields are automatically populated with the right numbers—for instance, component volumes and material specifications, as deduced from the 3D CAD assembly model.

Increased attention to LCA and green design has prompted some CAD software makers to add environmental impact assessment tools to their 3D modeling interface. SolidWorks and Autodesk Inventor—two fierce competitors in the design software market—have both incorporated the function.

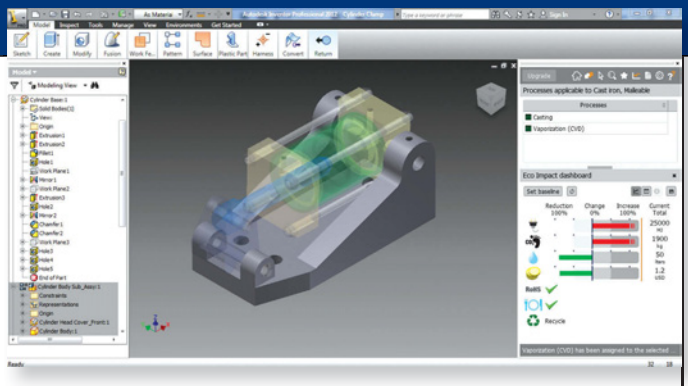
First released as in 2009, SolidWorks Sustainability Xpress has since become a standard part of the software's design evaluation tools, taking its place alongside stress and surface analysis tools. Once you've specified material choices and manufacturing methods for a part, Sustainability Xpress can begin calculating its environmental impact, expressed in four categories: carbon emission, energy usage, air pollution and water pollution. The module also lets you identify materials with similar strength and cost that might be a better substitute (that is, greener or cheaper materials).

In the optional module SolidWorks Sustainability (which requires an additional fee), you can evaluate the impact of entire assemblies, not just parts. In addition to metrics available in Xpress, the full version of Sustainability takes transportation into account in its calculations.

A little more than a year after the debut of SolidWorks Sustainability Xpress, Autodesk released its version, called Eco Materials Adviser. Integrated right into the 3D modeling interface of Autodesk Inventor, the module lets you obtain estimates on your design's manufacturing cost, water usage, energy usage and carbon footprint. The initial release of Eco Materials Adviser is meant for parts analysis only, not assemblies. SolidWorks Sustainability Xpress allows you to evaluate multiple designs with different geometry (for instance, comparing two versions of a camera housing with different wall thicknesses), and generate a comparison report. To perform a similar task in Autodesk Eco Materials Adviser, you'll need to run two different sessions of analysis (one for each version of the design) and compare the reports on your own.

Three Pillars

In most engineering software, basic stress analysis tools have become standard, providing designers and engineers with an easy way to evaluate the structural integrity of their proposed design. Current crops of LCA tools may be harbingers of things to come, paving the way for such features to become the norm.



Based on your input, Autodesk Inventor's Eco Materials Adviser gives you an estimate of your design's eco impact, along with its cost and Restriction of Hazardous Substances Directive (RoHS)-compliant status.

"Sustainable is here to stay, by way of consumer desire or government regulation," says Harris. "Those who're not making it part of their offerings, either as design consultants or manufacturers, are going to miss the boat—and somebody will each their lunch."

But a sustainable product with a high price tag isn't a practical solution. In the final analysis, cost still drives most consumers' purchasing decisions. It's also a critical factor that dictates most manufacturing decisions, such as choice of materials, production sites and manufacturing methods. (In the latest release of SolidWorks, the software adds a cost estimation module to its 3D modeling interface.)

In the service industry, conventional wisdom suggests you can reasonably expect—and get—two of the three basic characteristics: fast, cheap or good. If the service is fast and cheap, it won't be good; if it's cheap and good, it won't come fast; and if it's good and fast, it won't come cheap. Most service providers will tell you that to expect a service to be all three is just unreasonable.

In manufacturing today, the challenge is to find the right balance of durability (how well does the product perform under duress?), sustainability (how safe is it for the environment?), and cost (how much does it cost to make it?). It is, indeed, a tall order to come up with a design that satisfies all three criteria, but such is the demand of the consumers today. DE

Kenneth Wong *is senior editor of* Desktop Engineering. *Contact him via de-editors@deskeng.com, at deskeng.com/virtual_desktop or via Twitter @KennethwongSF.*

INFO ➜ **Sustainable Minds:** SustainableMinds.com

➜ **Autodesk:** Autodesk.com

➜ **SolidWorks:** SolidWorks.com

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

University of Michigan Refines Solar Car Design

Building a competitive solar car from scratch is a big, expensive and somewhat secretive project.

BY MARK CLARKSON

Power Electrical Engineer Joe Menzia drives Quantum along Grand Traverse Bay during the team's mock race in Michigan last summer. ***Photo courtesy of Evan Dougherty***

For the last year-and-a-half, Andrew Huang has been the interim engineering director of the University of Michigan Solar Car team. He helps guide the engineering component of a team of more than 100 students designing and building a solar-powered car to compete in the World Solar Challenge in Australia—where they recently took third—and the American Solar Challenge in the U.S. Not all of these students are engineers; some are involved in business, logistics and operations, media relations, etc.

"We build a car every two years," says Huang. "We'll race the car twice: once in the Australian race and then again in the North American race."

The bi-annual races are held on alternate years.

The team's current car, Quantum, weighs in at 320 lbs. (sans driver), has a coefficient of drag (CDA) of less than 0.1, and should easily break 100 mph. Its predecessor, Infinium, was clocked at 105 mph. "I would expect Quantum to have a higher top speed and much better acceleration than our previous car," says Huang. "Unfortunately, I can't give you any numbers or estimates without revealing too much information about our battery pack."

CAD, Of Course

DE was unable to obtain any sexy engineering drawings or CAD models to accompany this article; they're also top secret, although

we have been assured they exist. After all, not using CAD on a cutting-edge project like this wouldn't just be crazy, it would be … philosophically impossible.

"Our design philosophy," says Huang, "is that anything that exists on the car has to be modeled and assembled [in the computer first]. You can't just say, 'It looks good to me,' without knowing that the bolts will actually fit."

The team does its mechanical design and visualization in SolidWorks, which has been a team sponsor since 2006. "We used SolidWorks to model all of our mechanical components," says Huang, noting that includes the suspension, steering system, carbon monocoque chassis and wheels, among other parts. "We used SolidWorks to make sure power electrical systems would have enough space inside their enclosures. The circuit boards themselves—fuses, circuit breakers, the battery cells and so forth—all take up physical space."

The team also uses SolidWorks to generate drawings for the manufacturers, sending designs out to professional machine shops to get the actual parts made.

The solar car team and their car, Quantum, pose with Jack Roush, founder of Roush Fenway Racing and one of the team's gold sponsors. ***Photo courtesy of Diane Thach.***

Other Software

The solar car team uses a number of software packages to help design and optimize the car, most of which are available to as a part of the students' tuition. If they're not available, well, "software companies tend to be very charitable," says Huang.

The team employed COMSOL multiphysics to do optimization on the car's battery pack.

"Our first battery pack had some issues with overheating, internal resistance … all that sort of business," says Huang. "We used COMSOL to model our connections within the battery pack and look for places where there was too much current."

The team was able to fix the issues, and Huang says he can foresee multiphysics software "playing a big role in further optimizing the car."

The computational fluid dynamics (CFD) component of the

design requires its own specialized software. Huang reports that the vehicle's aero team does all of its modeling in Siemens NX Unigraphics, the meshing in BETA CAE Systems ANSA, and the solving in ANSYS FLUENT.

No Free Ride

Free software notwithstanding, the cost of putting together a competitive solar car capable of making an 1,800-mile run across Australia's Outback is north of $1 million — although Huang is quick to point out that "we actually don't see nearly a million in cash. Most of that is in-kind donations." Those donations include everything from raw carbon fiber to machine shop time.

Still, there's a lot of money that goes into building the car.

"A lot of components we need tend to be hard to get for free, and are rather expensive," says Huang, "It's mostly because they're custom, and they're the cutting edge in performance."

Solar cells, for example, are expensive and not, Huang says, something you can generally get for free: "The battery pack is a huge part of the car, so that's one of our large expenditures. We try to get the best cells that we can." The car uses Panasonic lithium-ion batteries, which are not currently available to the public.

A Team Effort

Huang has been impressed by how dedicated people are to the solar car team.

"This summer, sometimes we would spend 90 hours a week on the car for about four months straight," he says. "A solar car seems simple in principle, but to make a really great car, you have to spend all this time to make the tiniest, 0.5% improvement that will put you ahead of the competition. [You have to] get your craftsmanship up to those really high levels."

Plus, the cars are never really done. There's always the next race to get ready for and, after that, the next car to design and build.

"You'll finish the original design and you'll think, 'This looks a little strange; we should change that,'" says Huang. "Or, 'Oh, we left out a heat sink in this place.' It's just constant revisions all the time.

"We have a saying: Good grades, solar car and a social life—pick two. It's kind of a rough life." DE

Contributing Editor **Mark Clarkson** *is DE's expert in visualization, computer animation, and graphics. His newest book is "Photoshop Elements by Example." Visit him on the web at markclarkson.com or send e-mail about this article to de-editors@deskeng.com.*

BUT WHAT'S IT GOOD FOR?

Sure, the University of Michigan Solar Car project is fun for the students involved, but does anything practical come out of all this time and money? Yes, says Andrew Huang, the team's interim engineering director.

"The solar car is essentially the most efficient battery-electric vehicle possible," he says. "We use the most advanced batteries, carbon fiber composites, electric drivetrains and aerodynamic designs to create such an efficient car. These are incredibly critical areas of development to an auto industry that is moving toward battery-powered vehicles. To meet consumer requirements, companies will have to increase their vehicle's battery capacities, decrease their weight, and waste less energy in their motors and to aerodynamic drag."

Huang admits that the public will likely never see a purely solar-powered car for sale—not unless you want a car with an 8-hp motor. However, he notes that "we do a lot of work in increasing the power output, and thus viability of solar cells for power generation.

"Our 2007 car, Continuum, had a concentrator system (co-developed with Boeing) that reflected sunlight off parabolic mirrors and concentrated them onto a much smaller area of solar cells," he offers as an example. "This essentially gave us an array the size of the mirrors, which were much less expensive per unit area than the advanced cells used in the concentrators."

Technologies similar to this are being developed and deployed in the southwestern US and other sunny places of the world—concentrated photovoltaics, he says.

"Companies like Amonix, Concentrix and Solfocus are developing technologies very similar in concept to our system to generate electricity for the grid," Huang continues. "I'm not implying they derived it from us, but it is cool to see these technologies being developed. I would even venture as far to say that our work is applicable to the computer industry—all the microelectronic systems that control the car and broadcast telemetry (the car's status for battery level, temperatures, solar input, etc.) to our race caravan are designed to consume as little energy as possible."

INFO

- **ANSYS:** ANSYS.com
- **BETA CAE Systems USA:** ANSA-USA.com
- **COMSOL:** COMSOL.com
- **Dassault Systèmes SolidWorks:** SolidWorks.com
- **Panasonic:** Panasonic.com
- **Siemens:** Siemens.com
- **University of Michigan Solar Car team:** SolarCar.engin.umich.edu

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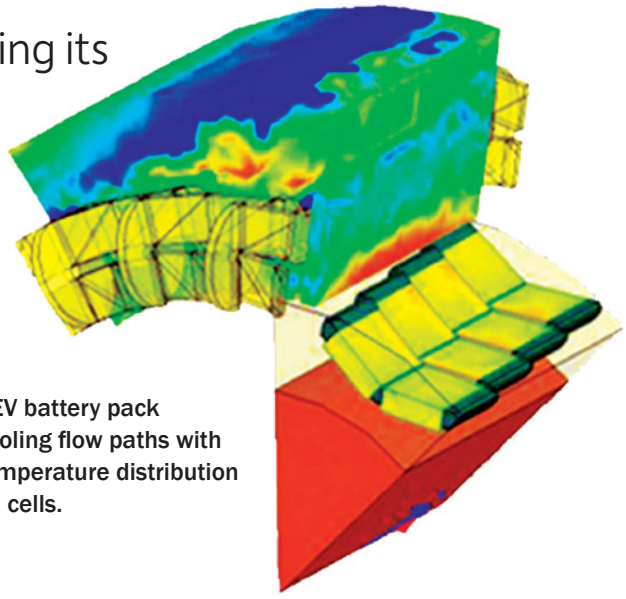
Simulation of Hybrid and Electric Vehicles

The automotive industry is engineering its future with integrated multiphysics simulation software.

BY SCOTT STANTON AND SANDEEP SOVANI



HEV battery pack cooling flow paths with temperature distribution on cells.

With concerns over air pollution and petroleum supplies, the use of hybrid electric vehicles (HEVs) and electric vehicles (EVs) has come to the forefront as alternatives to conventional gasoline and diesel engines. Governments worldwide are promoting HEV/EV research. The U.S. government has announced $2.4 billion in funding for new designs of battery packs, electric motors and other components, setting the goal of 1 million HEVs on the road by 2015. The U.S. Department of Energy predicts that by 2030, alternative vehicles will comprise 28% of the total U.S. light-duty cars and trucks—a 20% increase from 2005 (source: *Annual Energy Outlook 2007 with Projections to 2030*, report DOE/EIA).

To meet these increased demands for HEV/EV applications, competition is intense to develop improved and cost-effective electric powertrains. In meeting these demands, leading automotive companies with HEV/EV initiatives are focusing on development efforts driven by simulation, rather than prototype testing.

Numerous software solutions are available for the diverse types of analysis needed in such development work including mechanical, electrical, electromagnetic (EM), electrochemical, computational fluid dynamics (CFD) and thermal management applications.

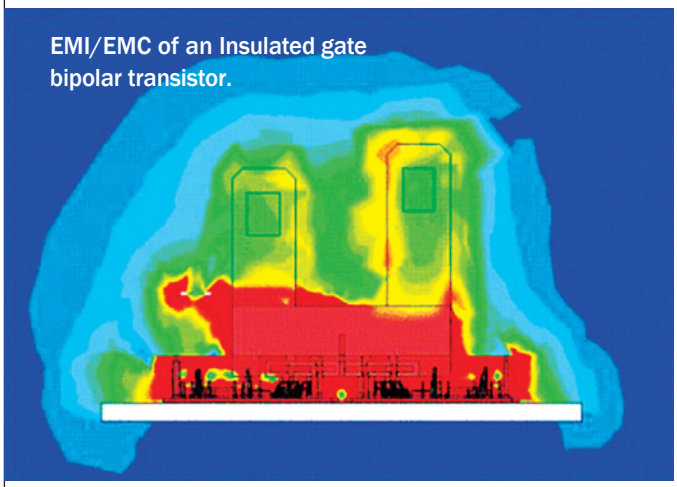
Design Challenges

Today's automotive engineers are challenged with designing new electric powertrain technologies almost entirely from scratch. Key components included in this task are electric battery packs, electric traction motors/generators and power electronics. The design of these HEV components involves complex physical problems—and an enormous amount of challenging system integration:

- **Battery Packs:** As engineers design batteries with large energy capacity and greater power output, they must consider the thermal, structural and EM influences on the battery pack—as well as the cells within. For example, batteries generate heat while charging and discharging. The temperature of all cells within the battery pack must be strictly maintained within a few temperature degrees of each other. Otherwise, harmful internal current loops can form within the pack that drastically shorten battery life. This necessitates a cooling system—whether by air or liquid—and sometimes creates a side challenge of minimizing noise close to the passenger cabin. Drivers of HEV/EVs expect an ultra-quiet driving experience, which is not compatible with a loud cooling system.

Engineers must also take into account the physical placement of an electric battery pack within the HEV, as well as any stresses the battery will experience under a range of driving conditions. The battery must be designed to safely withstand multiple variables such as external heating, over-charging, over-discharging, nail penetration, crush or external short. The same safety goals apply to crash scenarios, in which passengers must be protected from toxic acids released from the battery during such an event.

- **Motor/Generator:** For years, automakers invested relatively little time and money in electric machine (that is, the electric traction motor/generator) design because the internal combustion engine was so widely used. These conventional engines accomplished what they needed to: Consumer requirements were met; emissions regulations were not as strin-


EMI/EMC of an Insulated gate bipolar transistor.

gent; and oil prices were not a concern.

Today, all that has changed, with a huge amount of interest in new motors—and a correspondingly huge pressure on companies to develop the most efficient, cost-effective electric design. Brainpower and investment dollars are flowing into this area, and the electric motor, just as with the electric battery pack, poses its own set of design challenges.

The motor/generator plays an essential role in the propulsion of the vehicle. It also recharges the battery via regenerative braking. HEV/EV traction motors are different from other motors because they must work reliably in a demanding physical environment. Motors must operate consistently under extreme hot and cold temperatures, severe vibrations, hard duty cycles and rough road conditions. In the HEV, an electric motor is also exposed to high temperatures produced under the hood by the engine. All of these variables must be addressed in motor design.

Customers also expect high fuel efficiency from HEV/EVs. Fuel efficiency, low emissions, safety and performance aspects of a vehicle drive consumer purchasing decisions and, therefore, directly affect market success. Because the electric motor design determines how much electrical energy provided by the battery is transformed into physical energy used to run the vehicle, designing a highly fuel-efficient motor is one of the most important challenges HEV/EV powertrain engineers face today.

- **Power Electronics:** The "heart and brain" of an electric powertrain system must precisely control the power transfer between the battery and the motor/generator, and also implement the logic to adjust the powertrain to various driving conditions and driver inputs. To operate at the highest efficiency under a variety of driving conditions, power supplied to the traction motor needs to be carefully controlled at a relatively high switching frequency. This is accomplished through devices such as insulated gate bipolar transistors (IGBTs), based on position, speed, temperature, etc., via feedback continuously received from sensors monitoring the motor.

Thermal management is a major concern with power electronics in HEVs. The entire power delivered by the electric powertrain to the wheels (as well as the power needed to recharge the battery) has to travel through the power electronics. Therefore, even the slightest power loss in the electronics creates a large amount of heat. The heat needs to be carefully managed and dissipated under a wide range of operating conditions, such as driving in a hot desert or in sub-zero winter conditions, to avoid heat damage to the power electronics and nearby components. Optimally, the electric losses in the electronics need to be accurately calculated, and heat dissipation paths need to be identified and designed to ensure effective cooling.

- **Electromagnetic Interference and Compatibility (EMI/EMC):** Because the power supplied to the motor needs to be controlled at relatively high switching frequencies, the EMI among the various electrical components becomes an important concern. If EMI is unaccounted for, it will destroy signals and prohibit the motor from operating. This requires a comprehensive study of the EM fields in and around the motor, bus bars and nearby components while these components are operating in an interconnected, coupled way.

From Theory to Practice

Multiphysics (MP) simulation software allows engineers to understand how a design will perform under various loading conditions before prototyping takes place. Not only can physical, real-life scenarios be modeled with accurate simulation, but the effects of and interactions between fluids, mechanics, thermal physics, electrochemistry and EM forces can be simulated and the design adjusted based on those models. In this way, designs can be generated faster—and systems can be optimized up front in the cycle, to avoid surprises and problems that might occur in the later stages of product development.

Simulation tools for HEV/EV development span a wide range. They include CFD, EM, mechanical, thermal and electrical issues. These tools can be used in tackling the challenges of developing individual powertrain components—electric battery packs, electric traction motors/generators and power electronics—as well as the tremendous complexities when these subsystems are integrated into the complete vehicle powertrain.

- **Battery Pack Simulation:** For cylindrical cells, engineers typically employ an air-cooling strategy in which pack housings are shaped for optimal cooling, provided by a blower and guiding vanes to direct an adequate airflow. For rectangular cells, cooling generally is accomplished using liquid circulating through heat exchanger elements in contact with cells. A control algorithm is used to vary loads on different cells, based on temperatures and charger status.

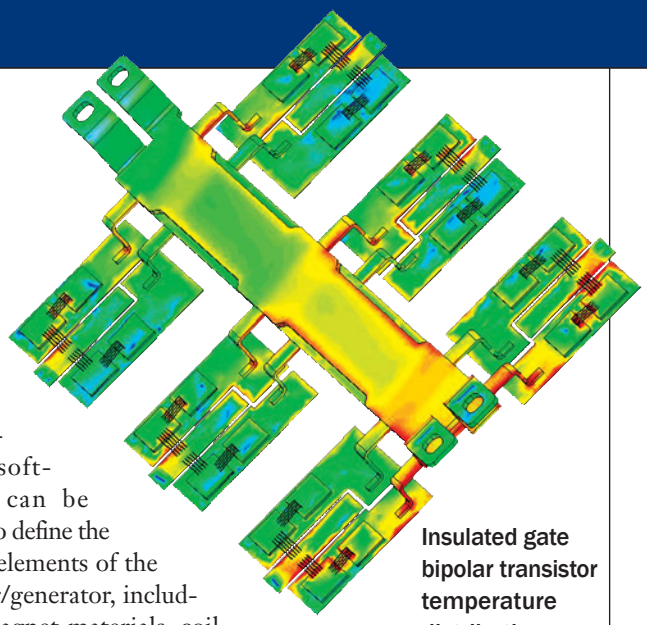
In evaluating and optimizing the various thermal management configurations, parameterization and methods such as design of experiments (DOE) are used in combination with CFD

solvers for analyzing the complex 3D cooling flows and conjugate (solid-to-fluid) heat transfer. For evaluating pack performance for long driving cycles, the linear time invariant (LTI) method is useful for efficiently performing such real-time simulations.

Engineers can apply electronics circuit simulation technology in evaluating the control algorithms for studying overcharging, high-current charging/discharging, external shorts or other electrical problems that could reduce battery life and risk battery explosion. The software can be used for studying such algorithms because of its ability to tightly integrate 3D physical models (CFD and mechanical) into the control circuit simulation.

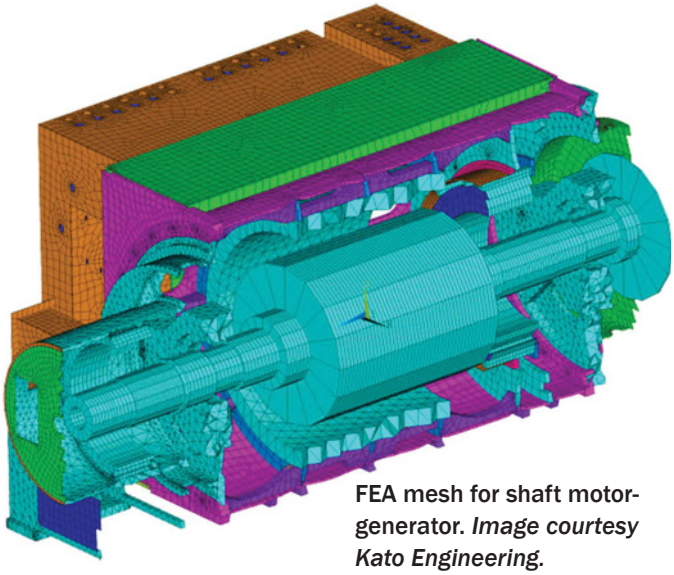
For solving structural problems caused by incidents such as a crash or foreign body penetration of the battery pack, structural mechanics software can be leveraged to evaluate the structural integrity of the assembly to prevent toxic battery contents from escaping, or damage to cells that could cause thermal runaway and battery explosion. Such virtual prototyping is also useful in studying vibrations, as well as durability and fatigue life of the battery pack.

- **Motor/Generator Simulation:** In developing the motor/generator, the design team must focus considerable attention on the EM of this electric machine. From initial CAD drawings and related engineering specifications of the assembly, electronics design optimization software can be used to define the main elements of the motor/generator, including magnet materials, coil configurations, number of turns, air gaps and more. Parasitic extraction tools can be used to compute the machine's electrical properties.



Insulated gate bipolar transistor temperature distribution.

These outputs can be entered into EM field simulation software, which computes the torque profile of the machine—that is, how the torque ramps up over time for driving the vehicle in motor mode, as well as electrical resistance in stopping the vehicle in brake mode. Vehicle weight is brought into



FEA mesh for shaft motor-generator. *Image courtesy Kato Engineering.*

the analysis to determine acceleration and stopping time for various scenarios.

The computed torque output may be used further in structural mechanics software for computing stresses, loads, deformations and vibrations of the physical parts of the powertrain, including the driveshaft and gearing. Vibration analysis is important because tractions can be a prominent source of noise in EVs, which are expected to be quiet by nature. CFD analysis may be used for studying thermal management issues, mapping energy losses, and determining heat distributions in the motor/generator assembly.

Throughout the EM and mechanical development processes, integrated MP software coordinates the actions and exchanges of data among the various tools in the many computations performed for different load scenarios, and in comparing various design alternatives. This MP co-simulation process is facilitated by the software all running on a single unified environment with a smooth flow of data among programs.

- **Power Electronics Simulation:** For thermal management of the HEV power electronics, engineers enter representations of IGBT characteristics (switching voltages, current waveforms, etc.), control algorithms (for turning the IGBT on and off) and the motor/generator into power electronics circuit simulation software for virtual analysis. From this data, the software determines how the levels of electrical current flowing through the entire system vary at given times for vehicle acceleration, cruising and braking.

Using electronic thermal current tools, engineers then specify the geometry of the major heat sources in the powertrain system (IGBTs and current-carrying parts of the motor/generator). Through parametric analysis, each heat source is applied individually at major points of interest in the system, with air circulation and conducted thermal energy taken into consideration. Software then processes this data and generates a thermal model, which engineers use to determine overall temperature profiles of each IGBT together with temperature-dependent performance variables, such as energy drained from the batteries to ensure that heat levels do not exceed specified limits to adversely affect IGBT performance.

From this temperature profile, engineers can utilize the thermal-structural analysis capabilities of FEA software to determine the resulting thermal stresses. Electronic design analysis tools can be applied to calculate EM forces acting on motor/generator components to determine deformations and mechanical stress distributions on the structure. Engineers can then modify the structure to eliminate stress concentrations and excessive deformation—or conversely, to lighten regions that may have been overdesigned with excess material.

- **EMI/EMC Simulation:** In HEV/EV development, switching speeds of IGBTs ranging from tens to hundreds of kHz—with turn-on rise times and turn-off fall times in the order of 50 nanoseconds to 100 nanoseconds—can cause two major EM problems:

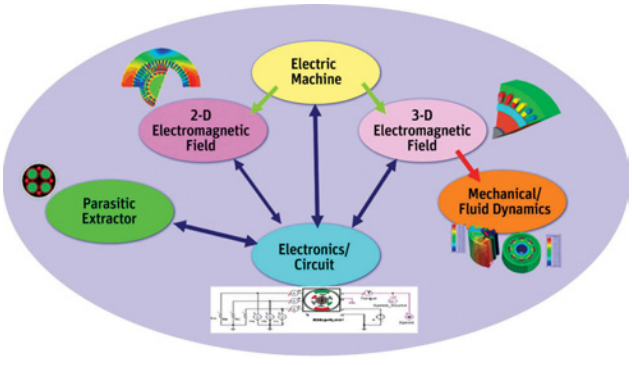
1. Conducted emissions (through current-carrying structures) can cause power integrity issues or set up reflected waves of energy that can potentially damage the inverter and the motor.
2. Radiated EM fields (through air) can affect the rest of the vehicle's many electronic systems.

Both types of interference problems must be considered. Engineers must design for EMI/EMC in vehicles.

To accurately characterize the behavior of a switching device such as an IGBT, engineers typically begin by using a parameterization wizard that takes into account performance curves and tabular data from vendor-supplied specification sheets. This process automatically extracts the required parameters to aid in creating a semiconductor circuit model of the IGBT.

Next, the physical layout of the power inverter is imported from CAD geometry into parasitic extraction software, which then computes the frequency-dependent resistance, partial inductance and capacitance (RLC) along the conduction paths. The tool is used to create an equivalent circuit model for system simulation.

Results of these simulations can be used to examine radiated emissions, enabling engineers to calculate the field intensity at



Hybrid electric vehicle and electric vehicle system simulation spans EM, thermal, fluid and structural physics.

any given point in space to determine whether the inverter package is in compliance with federal and international standards.

System Integration

System integration is perhaps the largest challenge in electric powertrain development. Each component of the electric powertrain has distinct characteristics, attributes, strengths and other complexities that must be taken into account. The objective is to ensure that the entire electric powertrain performs at the highest overall efficiency under a wide variety of loads and operating conditions experienced in real-life driving scenarios. Because subsystems and components work together in a coherent, tightly coupled way, they cannot be developed entirely in isolation from one another. Rather, the performance of each subsystem must be carefully matched with those of all others.

To successfully simulate such complexities in the HEV/EV powertrain, simulation solutions should be capable of multidimensional, multiphysical and multiscale simulation, providing the technology needed in addressing the many mechanical, fluid, electrical, electrochemical and EM issues of these complex powertrain systems.

The pace of HEV/EV development is incredibly fast, with original equipment manufacturers (OEMs) and suppliers alike having to meet challenging demands in a market with huge potential gains for cutting-edge companies. Instead, MP-based simulation-driven development can be used to balance the intricate, interdependent and often-conflicting mechanical, electrical, EM, fluidic and thermal management requirements. DE

Scott Stanton *is technical director and* **Sandeep Sovani** *is manager of Global Automotive Strategy for Canonsburg, PA-based ANSYS Inc.*

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

References:

- J.S. Hsu, C.W Ayers, C.L. Coomer, R.H. Wiles, S.L. Campbell, K.T. Michelhaugh, "Report on Toyota/Prius Motor Torque Capability, Torque Property, No-Load Back EMF, and Mechanical Losses," Oak Ridge National Laboratory, Oak Ridge Institute for Science and Education, ORNL/TM-2004/185.
- S. Stanton, D. Lin, Z. Tang, "Interior Permanent Magnet Machine Analysis Using Finite Element Based Equivalent Circuit Model," IEEE Vehicle Power and Propulsion Conference 2009 proceedings, pages 291-294, ISBN 978-1-4244-2600-3.

The *Eco-Friendly* Prototype

With the advent of recyclable and biodegradable additive manufacturing materials, interest in sustainability grows with demand.

BY DEBBIE SNIDERMAN

Additive manufacturing (AM) technologies speed prototyping by allowing design engineers to make prototypes on demand, rather than using large amounts of energy and raw materials for a small number of items. That, in itself, is environmentally friendly.

Parts can be produced using many materials: plastics, waxes, paraffins, glass, metals, ceramics, composites, sand, even paper. Though many of these materials are recyclable, parts produced by some AM techniques can't be recycled because their composition is changed with additives, stabilizers, finishes and binders. As AM becomes mainstream, some are beginning to look toward recyclable and biodegradable plastic material options.

On the Horizon

According to Dr. Ian Gibson, founder and advisor of Global Alliance of Rapid Prototyping Associations (GARPA) and associate professor in the Department of Mechanical Engineering at National University of Singapore, sustainability in the AM industry is not yet an immediate concern for two reasons:

1. "The processes are not so cheap as to make parts in a throw-away fashion," he says. "People are still concerned about cost when they build, and therefore, need to justify the actual fabrication."
2. The volume of machines and parts has not yet intensified, Gibson points out: "One city probably creates more polymer waste than all the AM machines of the world."

But, he notes, sustainability is likely to become a concern in the future, when the industry experiences a rapid increase as a result of low-cost machines aimed at personal use.

"None of the large printer manufacturers have yet to introduce machines to the world. When they do, they will have automated assembly plants capable of generating a veritable flood of machines. This is the tip of a potentially huge iceberg," says Gibson.

Currently in Use

Polycarbonate (PC), recycled in some cities with resin code 7, and acrylonitrile butadiene styrene (ABS) recycled with resin code 9 or ABS, are the most commonly known recyclable plastics used in AM.

ABS and PC are among some of equipment producer Stratasys' fused deposition modeling (FDM) recyclable material choices, which, according to Bill Macy in a Direct Part Manufacturing Workshop at the March 2011 Midwest SAMPE Conference, "are 100% recyclable." Others he mentioned currently in use include Ultem 9085 and FDM-PPSF (polyphenylsulfone thermoplastic).

Bioplastics

Over the last year, technologies for recycling items made from the biopolymer polylactic acid (PLA), formed from glucose and currently available for 3D printing, have improved. Near-infrared recycling separation processes have matured, and are now able to distinguish among PLA, polyethylene terephthalate (PET) or HDPE for effective sorting in mixed waste, so recycling PLA is becoming easier and more widespread. PLA will also degrade in commercial composting environments, according to Cargill's Natureworks, maker of Ingeo PLA biopolymers.

Polyamide (PA) 11 (Nylon 11), a bio-based engineering thermoplastic polymer produced from renewable castor oil sources, is available in fine powder form and is used in the selective laser sintering (SLS) market. It can be recycled in some cities under plastic resin code 7, Other or O. Material producers such as Arkema, through its French partner Agiplast, collect, sort and reuse production scraps, pellets and end-of-life articles made from Rilsan technical polymers, including PA11.

Biodegradable Biomedical Materials

The biomedical industry is developing structures from composite materials, combining biopolymers as binders with bioceramics, which are more rigid (and brittle) to achieve their desired material properties.

"There are numerous biodegradable materials available for AM technologies that were developed specifically for medical applications," Gibson says, "but there is no reason why they cannot be developed for mainstream manufacturing. Many of

the materials have sufficient strength to withstand heavy and regular use, and it is possible to 'tune' the degradation rate to suit a particular application, including its recycling."

Some biodegradable materials currently used with AM technologies include:

- Mirel bioplastic, made through fermentation of sugar.
- Poly-L-lactic acid (PLLA), a biodegradable semi-crystalline polymer derived from lactic acid used with AM for bone tissue and other biomedical applications.
- Hydroxyapatite (HA or HAp), a biodegradable bioceramic available in powder form for SLS, a complex phosphate of calcium (Ca (PO4)3OH) that occurs as a mineral.
- PGA poly(glycolic acid), a newer material PLGA — bioresorbable poly(lactic-co-glycolic acid), and PLGLA.

Sustainability

Gibson says the AM industry needs to look at sustainability in many ways, and material use is just one of them.

"Currently, very few AM applications include plans for material degradation," Gibson says. "Most products are designed according to the desired function, and very few of these functions focus on the lifetime of the product. This issue should be given more attention, since we are aware that most AM materials do not have considerable longevity when compared with many commonly used industrial polymers."

Usually, other manufacturing methods are considered when high durability is concerned, Gibson adds, and AM is used to fabricate the less-durable, but customizable features of a product.

"One concern would be to examine the use of composites in AM," he points out. "Many processes use a non-polymer filler material to enhance the overall material properties. Another thought might be to specifically develop recyclable materials and processes for short-term part applications, like prototyping.

"Finally, we really need to raise the awareness of this potential problem to the increasing number of users through a comprehensive training and education program. If the potential risks are realized, we can prepare this new technology in a way that won't result in the next plastic-bag nightmare."

Fully Recyclable Digital Printing

Some AM processes, such as FDM and fused filament fabrication (FFF), that lay down streams of layered plastic such as ABS, produce parts that could be recycled by "starting over" and melting down the whole object as if it were raw material. But most parts created by AM processes are still not recycled for re-use.

Cornell University researcher Jonathan Hiller explains: "The fundamentals of some AM technologies cause materials to undergo irreversible processes, such as polymerization, infiltration with a binder, or UV curing, making further re-use of the material impossible. At the current low volumes, there are prohibitive costs, a lack of recycling infrastructure, and virtually no incentives for consumers and manufacturers to recycle—financial or otherwise."

In 2009, Hiller explored an AM approach that enabled the same physical material to be used multiple times. Under a Defense Advanced Research Projects Agency Programmable Matter grant and National Science Foundation research fellowship, he demonstrated a method in which printed items could be completely recycled using "digital material elements."

His fabricator assembled repeated elements. In the future, they could be made small enough and with sufficiently high accuracy to form products that appear natural to the human eye. Units called "voxels" can be pre-made in a range of sizes, and lock together or be used with binders that do not change their properties, but hold them together during assembly and use.

A structure was "printed" using steel and Delrin spheres and binder. At the product's end of life, the binder was dissolved, disassembling the repeated elements, which were sorted and placed back into the fabricator bins. A different structure was then printed from the reclaimed material.

Hiller says he believes multi-material AM is the way of the future, so when other materials are mixed together in an object, they could not be melted down and reformed, but disassembled voxels could be sorted by material. The goal of his research was "to draw the attention of printing manufacturers and consumers to encourage a focus on total lifecycle analysis, and think about how to fully recycle," he says. Over time, as more users consider the lifecycle of the materials they use, and demand grows, the cost-effectiveness of reusable materials should help make them feasible. DE

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INFO

- **Agiplast RCycle Program:** Agiplast.fr
- **Biodegradable Polymers:** MDPI.com/1996-1944/2/2/307
- **Durable BioResins:** PTonline.com/articles/bio-resins-tackle-durable-applications
- **End of life roadmap for PLA biopolymer:** NatureworksLLC.com/Data/Flash-Items/EOL-Flash.aspx
- **Fully Recyclable Multi-material Printing:** CreativeMachines.Cornell.edu/sites/default/files/SFF09_Hiller3.pdf
- **PLA in RepRap:** RepRap.org/wiki/PLA
- **PLA Recycling:** InnovativeIndustry.net/pla-recycling-infrastructure
- **PLGA Biopolymers:** PCAS.com/expansorb-range-resorbable-polymer-excipient.html
- **Rapid Assembly for Physical Voxel Manufacturing:** CreativeMachines.Cornell.edu/Rapid_Assembler
- **Rilsan PA11:** Arkema.com/pdf/EN/products/technical_polymers/rilsan/Rilsan_PA11_Renewable.pdf
- **Stratasys:** Stratasys.com

Streamlining the Prius

SimuTech Group uses computational fluid dynamics software from ANSYS to analyze aerodynamics on the Toyota Prius.

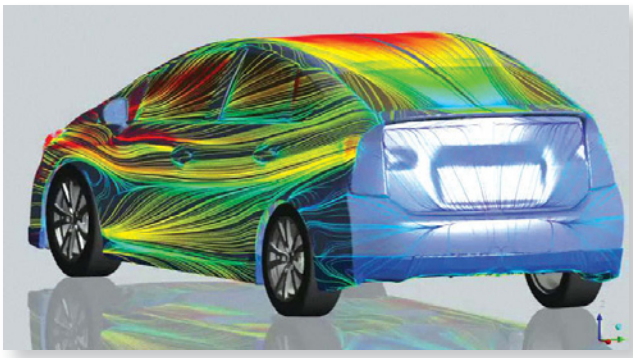
BY JAMIE J. GOOCH

What can you do to sell more cars when you've already got the best-selling hybrid in America? If you're Toyota, you go for the cool factor. Some might find 50 miles per gallon to be cool enough, but for those not convinced, Toyota has released the Prius PLUS Performance Package.

"PLUS enhances the driving experience for Toyota hybrid enthusiasts by offering cool and fun accessories that add sporty looks with performance handling," according to the car manufacturer's news release. "It features several Toyota accessories that complement the Prius' core values of Eco and Advanced Technology."

Complementing core values means the PLUS package doesn't have a negative effect on the car's biggest selling point: gas mileage. Before making that claim, Toyota made sure the ground effects kit, which includes front and rear spoilers, side skirts and a rear diffuser, were aerodynamic.

The Toyota Prius PLUS Performance Package was proven to improve aerodynamics thanks to CFD software.



Testing the Prius PLUS Performance package's aerodynamics in ANSYS CFD software.

CFD for MPG

SimuTech Group, an ANSYS Channel Partner based in Rochester, NY, performed a computational fluid dynamics (CFD) analysis for Toyota and its supplier Tiercon. SimuTech used ANSYS CFD software to conduct aerodynamic comparison studies on the new PLUS Performance Package. SimuTech engineers then performed simulations to determine optimum airflow across the vehicle's outer body. As a result of using the software simulations, the engineers verified that the ground effects kit developed for the new package provided an overall improvement in aerodynamic drag for the Prius.

That's right, not only did the PLUS package—which also includes "race-inspired" 17-in. forged alloy wheels low-profile tires and lowered springs—not hurt the Prius' fuel efficiency, it improved it. That could help Toyota move the performance packages, which cost between $2,999 and $3,699.

"We were pleased to work with Toyota and Tiercon to assure they achieved the results they were looking for," said Alan McKim, SimuTech vice president of customer services in a news release. The company says its upfront analysis helps optimize designs without costly trial and error testing.

"Though the majority of our work is providing engineering technical support and guidance to our ANSYS software users, we were more than happy to work with Tiercon and Toyota by providing advanced consulting services for this particular analysis," McKim said. DE

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Make Me a System with *Everything*

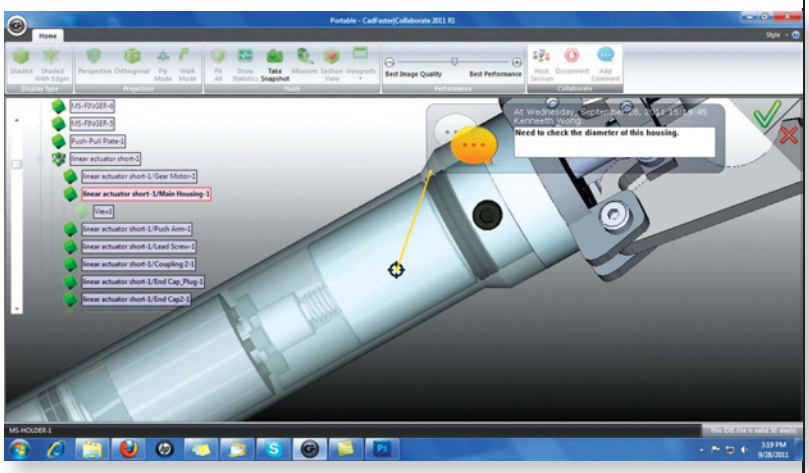
Boundaries blur as the desktop, mobile apps and the cloud merge.

BY KENNETH WONG

Have you heard the one about a Buddhist monk ordering pizza? The monk walks into a pizza parlor and says, "Make me one with everything."

It's OK if you didn't get it. Apparently, the Dalai Lama didn't either. When Australian morning show host Karl Stefanovic tried the one-liner during his recent interview with the Tibetan spiritual leader, the joke fell flat. The punch line could mean "make me a pizza with every available topping" or "let me be part of the larger universe," but somehow the double entendre got lost in translation.

So why am I repeating the joke (at my own peril) to a bunch of engineers who may or may not be Buddhist? Because the product-design discipline, once confined almost entirely to desktop operations, is heading for a transformation. The new workflow is not confined to local workstations and on-premise client-server setups. It's also augmented with mobile tablets, smartphones, cloud-hosted functions and online communities. To facilitate smooth data exchange and collaboration these days, you'll need a product design system where everything becomes one.



CadFaster bridges the desktop and mobile devices with a CAD plug-in for exporting mobile-viewable 3D files, an executable file with embedded viewing and markup tools (shown here), and an iPad app called CadFaster Collaborate.

Reconciling Your Differences in the Cloud

Some people who regularly shop at Amazon.com may not even realize they have a virtual storage locker, a 5GB Amazon Cloud Drive, waiting for them—free of charge. In March, the online retailer unleashed its Cloud Drive offer, along with free music players for web-connected PCs and Android devices. It's no coincidence that the size of Amazon's giveaway was identical to Apple's iCloud offer, which at the time was still several months away from going public. The Amazon offer, some industry watchers noted, was the retailer's plan to beat Apple to the punch.

So why are Amazon and Apple so eager to give away free storage? Because the cloud is essential to the appeal of mobile devices like Amazon Kindle and Apple iPad. Both companies foresee that, in the near future, many consumers would use a cloud drive—a small chunk of a remote server dedicated to their multimedia content—as the hub for their ebooks, songs, movies and photos.

The cloud's connectivity to your desktop, notebook, Wi-Fi-enabled tablets and smartphones is what allows Amazon and Apple to keep your libraries in sync. It doesn't matter that you initially highlighted a passage in an ebook or on your PC. You'll be able to see the same highlight when you access the title from your Kindle device or your iPad. (Amazon calls it Whispersync, emphasizing its ability to quietly reconcile different copies of your content in the background.) Similarly, when you add an appointment to your calendar on your iPhone, you'll find your desktop's calendar automatically populated with the same appointment.

Without their link to the cloud, your mobile devices are little more than handheld hard drives. Without automatic synching through the cloud, you will have to painstakingly duplicate every edit you make to your playlists, contacts and photo albums, one device at a time.

This September, Autodesk made a similar move, giving away

Siemens PLM Software's Teamcenter Mobility 2.0 gives you the option to work offline (in cache mode), then go back online to sync with files kept in Teamcenter repositories.

The 3DVIA Mobile app gives you the option to browse and interact with 3DVIA community content, both members' and user-submitted 3D models.

3GB of online storage space free of charge to its subscription customers. You may use the online vault to store your design files. But more importantly, many of Autodesk's mobile applications like AutoCAD WS Mobile and Autodesk Inventor Publisher Mobile Viewer give you direct access to files stored in Autodesk Cloud.

Autodesk's rival Dassault Systèmes, which offers 3DVIA Mobile app for iPhone and iPad users, gives you a 1GB quota for free. If you need more, you can upgrade to a 3DVIA Online Hosting account—a plan with 5GB to 100GB storage space for varying fees.

As more people begin using mobile devices for concept review, annotation and approval of design changes, the client-server approach (a central repository housed on the premises, accessible only through sanctioned desktop clients) shows its limitations. For product design to scale across multiple devices, the ability to host, share and synchronize mobile-viewable 3D models (usually lightweight versions of CAD models) over the cloud becomes much more important.

Collaboration across Multiple Devices

With an eye toward collaboration across multiple devices, newcomer CadFaster launched its business with plug-ins to some popular CAD software titles (currently available for Bentley MicroStation, Autodesk Revit and SolidWorks) and an iPad app. The plug-in allows you to publish mobile-viewable versions of your 3D design files and directly upload them to your cloud-hosted drive (100MB for a start, with the option to upgrade for more space). It also gives you the option to publish an executable file, which functions as a self-contained viewing and markup application for those who need to inspect the design, but don't necessarily need to edit the original CAD file.

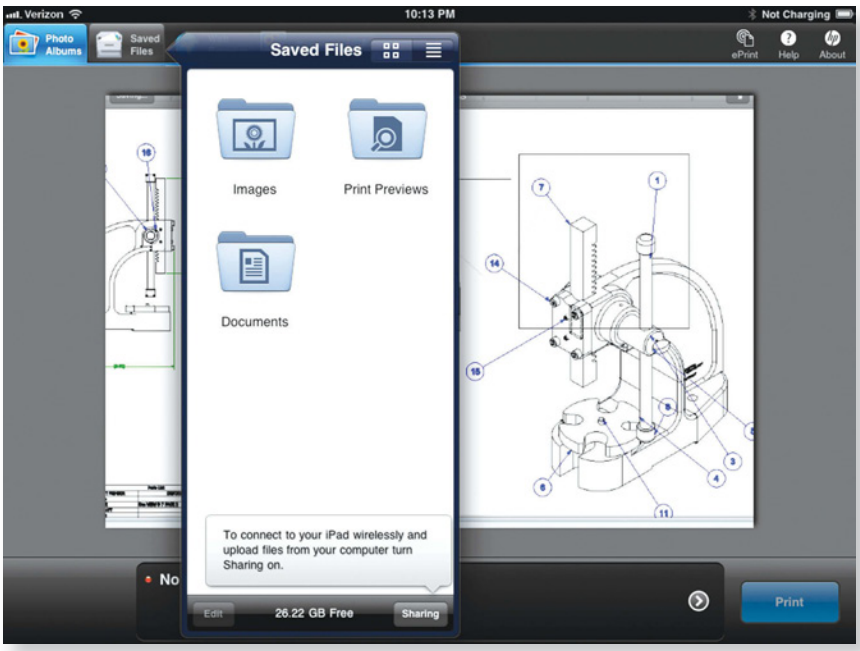
Publishing options aside, what distinguishes CadFaster is the co-viewing function, which lets you discuss the shared design file (either as a host or a participant) with a number of others in real-time at the same time. The use of the cloud also allows CadFaster to keep markups and annotations in sync, so notes added to the published model from the iPad app will be visible to anyone launching the file from the desktop, and vice versa. (Because the .exe file with unknown origin can be mistaken for a malicious file by some overprotective antivirus software, at press time CadFaster is considering a thin client as an alternative.)

Previously limited to viewing functions only, Siemens PLM Software's Teamcenter Mobility now offers users a way to submit tasks into the workflow from an iPad. The app, now in version 2.0, supports Facebook-style notifications (showing the number of issues awaiting your attention on the launch icon itself) and limited markup. The app serves as a portal into Teamcenter databases, housed and maintained by Siemens PLM Software users. The software offers both an offline mode (working from cached data in the device when the device is disconnected) and online mode. Changes made during offline mode will automatically be synced to relevant files when it goes back online.

Community Portals

Long before the emergence of mobile devices, CAD vendors established user communities to foster friendship, file sharing, tip sharing and collaboration among their customers. Long established communities include SolidWorks' 3D ContentCentral, Dassault Systèmes' 3DVIA.com, and AutoCAD Exchange. New ones are also springing up, such as GrabCad and Solid Edge PART Community. Some—like SolidWorks' 3D ContentCentral, 3DVIA.com and GrabCad—support multiple 3D formats and are open to user-created content. Others, like Solid Edge PART Community, are limited to authorized part suppliers with downloadable part catalogs.

SolidWorks' 3D ContentCentral, which houses both



HP ePrint lets you remotely print your drawings to ePrint-enabled printers in your local area network and web-connected printers. You also have the option to save and share a digital version of your drawing.

supplier content and user content, is integrated into the CAD modeling software itself, so you can search for a part, download it and insert it into your design in progress, right from the CAD modeling environment. 3DVIA.com content—both user profiles and uploaded 3D files—is available on 3DVIA Mobile, so you can use a Wi-Fi-enabled tablet to browse models, view ratings and histories of users, and inspect the model from your preferred mobile device. Solid Edge PART Community works as an alternative to paper catalogs, offering you a way to download the standard part directly into your Solid Edge modeling environment.

With the introduction of 3DVIA hosting service, you now have the option to embed a cloud-hosted 3D model into a web page (in the same way you might embed a YouTube video clip). After installing the 3DVIA viewer plug-in, visitors to the page can interact with the hosted design model—zoom, pan, rotate, etc.—from a standard browser.

On-demand Horsepower

In some cases, desktop CAD software will be augmented with additional horsepower, available from remote CPU and GPU clusters, delivered on demand over the web. With the latest launch of Autodesk Cloud, the company plans to offer its subscription customers cloud-hosted rendering, design optimization (for Autodesk Inventor users), energy analysis (for Autodesk Revit users), environment footprint calculation (for Autodesk Green Building Studio users), and project management (for Autodesk Buzzsaw users).

Printing over the Web

Even an operation once confined exclusively to paper and stationary hardware—printing—is getting a mobile upgrade. HP, one of a handful of wide-format printer suppliers still in the market, now offers a free mobile app: HP ePrint for iPhone and iPad. With the app installed, you can remotely print your design files to ePrint-enabled printers within your local area network or web-connected printers.

This would allow, for example, a facility manager to print a floor plan directly to an owner's web-connected printer by emailing the drawing to a unique email address dedicated to the remote printer. That same drawing can

also be saved as a digital copy and shared (you'll need to create an ePrint account), offering you a way to digitally collaborate and physically archive documents at the same time.

Systemic Change

There's a second part to the joke about the Buddhist monk's pizza order. After paying for his pizza with a large bill, the monk waited for change, which never came. "Where's my change?" the monk asked. "Change must come from within," replied the witty shop owner.

Change is, indeed, coming from within software developers and user communities, inspired by the swift uptake of touch-enabled mobile devices. But a eulogy for the desktop PC is premature. With comparatively smaller hard drives, mobile devices will have to rely on cloud-hosted storage and remote servers, especially to appease those who routinely send, receive and share large 3D design files. The need to reconcile and merge edits and annotations from multiple users using desktop and mobile hardware makes data syncing a critical feature in most apps.

I've always believed that the frequent use of the word system (as in "my CAD modeling system") to refer to a desktop machine is a misnomer. However, in the future, when engineers talk about their system, they may indeed be referring to a collection of hardware and software that act as one—a desktop workstation, a traveling laptop, a mobile tablet, a smartphone and an online vault, always syncing among themselves in the background.

For more on mobile computing's impact on product lifecycle management, read "Get Ready for RLM: Wherever You May Roam," *DE*, October 2011. DE

Kenneth Wong *is senior editor of* Desktop Engineering. *Contact him via de-editors@deskeng.com, at deskeng.com/virtual_desktop or via Twitter @KennethwongSF.*

INFO ➜ **AutoCAD:** AutoCAD.com
➜ **Autodesk:** USA.Autodesk.com
➜ **Bentley:** Bentley.com
➜ **CadFaster:** CadFaster.com
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➜ **Dassault Systèmes:** 3DS.com
➜ **DS SolidWorks:** SolidWorks.com
➜ **Siemens PLM Software:** PLM.automation.Siemens.com

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Surrogates **Promise** Better, Faster Designs

Using an approximation model is often the best way to address a challenging problem or to accelerate a lengthy process.

BY JOHN EDWARDS

Experiments and simulations lie at the heart of a wide range of engineering design projects. From creating aerodynamic vehicles to pinpointing the best place on a wing to place an aircraft engine, experiments and/or simulations are used to isolate design objectives and constraints. There's a down side, however: Experiments and simulations are both time-consuming and costly.

One way of reducing the burden is by building approximation models, otherwise known as surrogate models.

Surrogate modeling's roots trace back several decades to the mining industry (minerals, not data), says Dr. András Sóbester, a lecturer at the University of Southampton's School of Engineering Sciences in England, and co-author of *Engineering Design via Surrogate Modeling: A Practical Guide* (Wiley, 2008). The goal in a mining environment is to find the location containing the highest ore grade using the minimum amount of test drilling.

To achieve this goal, engineers created a three-dimensional surrogate model of the ore grade function, based on a few known concentration values.

"A whole new science—geostatistics—developed around the question of how to do this most efficiently," Sóbester says.

Design engineering, beginning with the automotive and aerospace sectors, picked up many of the formulations developed for geostatistics.

"Oddly, it works much better in these fields than in mining, as most of our functions are continuous and smooth—ore grade variations are not," Sóbester says.

Quality on the Quick

Sóbester observes that surrogate modeling is all about reducing time and cost without sacrificing accuracy.

"It allows you to make the most of your experiments, whether they are numerical or physical," he says. "In essence, if you can only afford to measure the performance of a parametrically defined product in a few points in the design space, it gives you a statistical estimate—complete with error bars—of what the performance is at untested locations."

In desktop engineering, the surrogate "killer app" is design optimization, Sóbester says. Say, for example, that your parametric design has five variables. You can only afford to simulate the performance of 15 instances—15 sets of five variables. Conventional, so-called "direct" optimizers have little chance of getting anywhere in 15 evaluations, he notes—but a surrogate model might.

"A surrogate model of a 5d function based on 15 points may not be terribly accurate, but it will give you a good idea of the most promising region of the design space," he says. Plus, he adds, "You can search the surrogate to your heart's content (with direct optimizers), as its computational cost is negligible."

More designers are turning to surrogate models to meet the accelerating development timeframes demanded by real-world business demands.

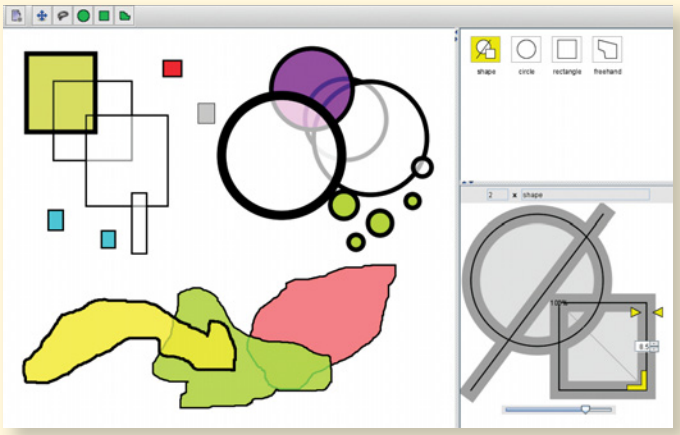
"We have recently completed a study supported by the Royal Academy of Engineering, looking into the acoustic and aerodynamic performance of an unusual engine installation geometry for passenger airliners," Sóbester says. The designers placed the engines on pylons on top of the wings, to use the wings as noise shields between the engines and communities on the ground.

"We could test the acoustic performance of about 40 different designs via experiments conducted in the University of Southampton Large Anechoic Facility," Sóbester notes. "At the same time, we were able to run a similar number of high-fidelity computational simulations of the airflow around the aircraft."

By fitting a surrogate model to each dataset, the designers were able to locate the best trade-offs between noise shielding performance and aerodynamic performance—many of these designs being at untested points. "But at points where the surrogate had low error margins," Sóbester points out.

Sóbester notes that wider surrogate modeling adoption

Another Role for Surrogates



Just as surrogate modeling can eliminate or reduce the need for expensive and time-consuming experiments and simulations, surrogates can also be used to make desktop design software more flexible and easier to use. Dr. Niklas Elmqvist, a Purdue University assistant professor of electrical and computer engineering, says that "surrogate interaction," a term he and his fellow researchers recently coined, could lead to a new generation of intuitive desktop design software.

In a surrogate interaction design environment, surrogates are used to present interactive graphical representations of real objects, with icons on the side labeling specific parts of the figure. Elmqvist notes that while many design software developers have already incorporated surrogate interaction approaches into their products, the concept has so far evolved on a piecemeal, ad hoc basis. He maintains that a formal definition of what surrogate interaction is, and how it should be used, would help speed its development and refinement—while expanding the number of applications using the approach.

"Design tools incorporating surrogate interaction have the potential to greatly simplify everyday design tasks," Elmqvist says. "Conventional computer-aided design (CAD) applications typically rely on the use of scores of menus with hundreds of selection options."

Surrogate interaction, on the other hand, generates images that aim to mimic real objects, giving users a helpful, intuitive interface instead of a series of confusing menus and selections.

Elmqvist says that working on a design in a surrogate interaction design environment is almost like tinkering with the actual object.

"You can click on a label to change a color or pull on a border to adjust its length or width," he explains. "Whatever changes you make to the surrogate will affect the actual object you are working with."

Elmqvist says surrogate modeling will make life easier and more pleasant for designers, while shortening the time needed to accomplish specific tasks and, ultimately, slash project costs.

"It changes the way designers work," he says. On a car design, for example, one could easily and intuitively change the placement of the wheels, the doors, the antenna, etc. "As things exist now, I can't make those changes to the drawing directly, but have to scroll through a bunch of menus or use arcane commands," Elmqvist says.

Elmqvist notes that while design software makers have strived over the years to make their products more intuitive and interactive, the results have been mixed. A big drawback, Elmqvist says, is that designers must learn new rules every time they switch to another developer's software—or sometimes, even products within a particular vendor's line.

"There's currently no coherent underlying principle," he says. "We want the surrogate interaction concept to unify all of the other techniques that have been created over the years."

has been blocked by a potential for ambiguity that has deterred many designers.

"Some of the mathematical apparatus behind surrogate modeling is actually quite complex, and it makes some assumptions regarding the underlying objective function we are trying to model," he says. "I think it took engineers a while to realize that, although we can almost never be certain that our objective functions do not violate these assumptions."

He notes that in practice, however, this rarely matters. "After all, if you have 10 shots at a five-dimensional function whose optimum you seek, you are not going to lose sleep over whether it is continuous for any 'x.' Surrogate modeling is the only weapon you have, so you might as well use it."

A Tool, Not a Shortcut

Designers must take care not to view surrogate modeling as a quick and easy shortcut, Sóbester warns. While the approach can save time and effort, care must still be taken to ensure that all the pieces are in place for quality results.

"Like any sharp tool, (surrogate modeling) has to be treated with some caution," he says, noting that surrogate model formulations often have a large number of parameters that must be "trained" to the data at hand.

"This process requires some care, in particular when the response being fitted is corrupted by noise—numerical or

experimental," Sóbester says. "An incorrectly trained model can be seriously misleading."

Just about any designer can become reasonably proficient in surrogate modeling without going back to school or neglecting current work obligations, however. In fact, Sóbester's journey started with a pair of papers by Dr. Don Jones, a mathematician working for General Motors, that were "easy to follow, yet based on solid foundations."

Sóbester also recommends reading an introductory textbook on the topic that "will highlight some of the main pitfalls, without going too deeply into the statistical subtleties." Perhaps the best way to get started with surrogate modeling, however, is by practicing the technique.

"Depending on your favorite way of interacting with a computer, there are a number of tools available," Sóbester says. "For the tinkerer who likes to customize a code to their own specific application, there are some decent Matlab codes out there."

Meanwhile, designers who prefer a graphical interface and a higher-level approach will be glad to know that most of the big design process integration tools now have a surrogate modeling facility.

Sóbester sees a bright future for surrogate modeling, although he says he believes that the approach must undergo some changes to make it more appealing to a wider number of designers.

"If this technology is to be fully embraced by industry, it has to be made user-friendly without sacrificing too much mathematical rigor," he says. "This is a challenge that will have to be addressed."

Increased computational efficiency should help bring surrogate modeling more deeply into the design mainstream, he says, by making the necessary software tools easier to use and faster while reducing overhead costs.

"While querying surrogate models, once built, is usually very cheap, their actual construction process can be computationally expensive at the moment, especially for large training data sets," Sóbester concludes. DE

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INFO ➜ University of Southampton's School of Engineering Sciences: Soton.ac.uk/engineering

➜ **Purdue University College of Engineering:** Engineering.Purdue.edu

➜ **MathWorks:** mathworks.com/products/matlab/

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

SolidWorks 2012 Marks Debut of Cost Analysis

SolidWorks Costing calculates manufacturing costs during the design stage.

BY KENNETH WONG

In the last several years, sustainability, durability and cost have emerged as the three pillars of manufacturing. In SolidWorks, you can address the first two with Sustainability Xpress (first previewed in 2009, now included with every license) and SolidWorks Simulation. In SolidWorks 2012, you'll get a new tool called SolidWorks Costing to address the remaining pillar.

Although it's in pre-release code at press time, in structure and setup, SolidWorks Costing is uncannily similar to SolidWorks Sustainability Xpress. You can use the Costing module to estimate how much it'll cost to produce a sheet-metal part or a machined part. The software calculates manufacturing costs using a set of preloaded templates with prices for standard sheet-metal and machining operations. (There's no template for injection-molded plastic parts in this release, but perhaps one is in development.) To get more accurate results, most manufacturers should modify the templates by populating relevant fields with their own materials, known unit costs and supplier quotes from previous transactions.

The module, found under Tools tab, is fairly straightforward. The moment you launch it, it begins calculating your design's probable manufacturing cost. The software can tell the difference between a sheet-metal and a machined part, so you'll only get the option that's relevant to the part found in your modeling window.

Calculations are done based on standard sheet-metal punching or machining operations required to produce the features found in your geometry—for instance, the number of pockets, holes and bends. The results are updated in real time. (OK, "near real-time," if you want to nitpick, because it does take a few seconds for the software to crunch the numbers.)

Perhaps this is the type of calculation you're used to doing with pen and paper; perhaps you already have an Excel spreadsheet with embedded formulas that can spit out the same estimates based on manual input. Either way, you'll find that the ability to automate this grueling process comes with great benefits.

You may, for instance, change the thickness of a sheet-metal part, or switch from steel to iron to find out how it affects the production cost. You may also experiment with removing or adding features to see if you can reduce the cost (sometimes, the feature that drives up manufacturing cost the most is not necessarily what you think it is). Tight integration with a 3D model makes it easy to explore different alternatives. Currently, the module can be used only to estimate costs on parts, but you can get the roll-up cost of an assembly.

Exploded Multi-body Parts

Several releases ago, SolidWorks introduced multi-body parts—parts with more than a single solid body. The easiest way to create a multi-body part is to uncheck the Merge Results option when you're extruding a sketch profile into a solid volume. This creates a single part with two—or more—independent solid volumes.

In the new release, you'll be able to create exploded views of such multi-body parts. When you choose Insert > Exploded View, you'll get the option to drag and reposition the solid volumes in your part along X, Y or Z axis, as though they were sub-assemblies in an assembly model.

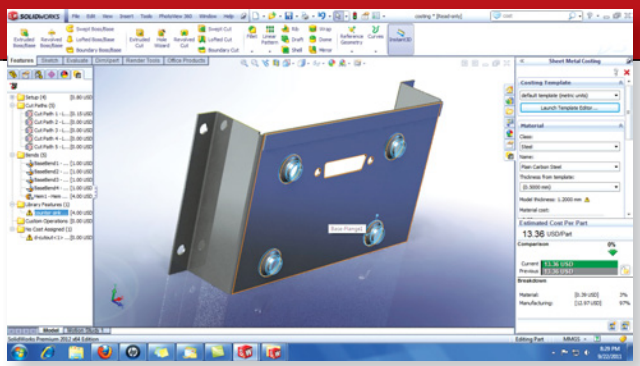
Frozen Features

For those who work with complex parts with a lengthy feature history, SolidWorks 2012 offers the option to freeze features. You can activate the tool by going to the application setting options and checking the Enable Feature Freeze box. In doing so, you activate a feature-history marker—a line you can drag up and down your feature history. Once you place the line, features above the line become "frozen."

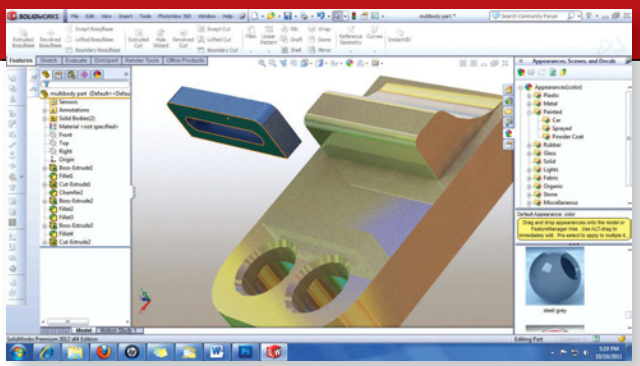
This is a good method to prevent unnecessary geometry rebuilds when you're making edits that don't affect earlier features. However, effective use of this tool requires a thorough understanding of parametric (or feature-based) modeling. If you're making subsequent edits that reshape earlier geometry, freezing earlier features may produce unintended deformations and error messages.

Balloons, Punch Tables and Large Models

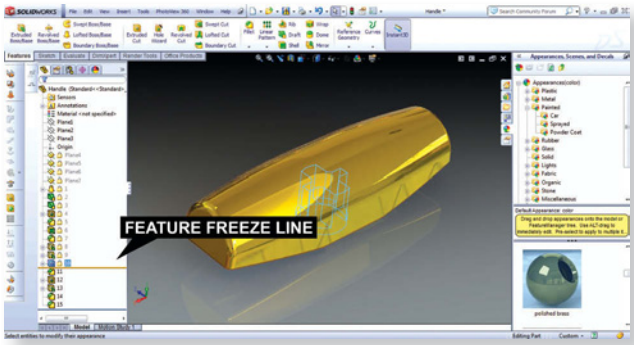
If you have a series of balloon-nested text strings with crisscrossing arrows, you'll probably like to use the magnetic line to untangle the mess. As the name suggests, the magnetic line behaves as a line to which you can stick your balloons. By dragging the balloons within close proximity to the magnetic line you've drawn, you can align the ballooned objects into a



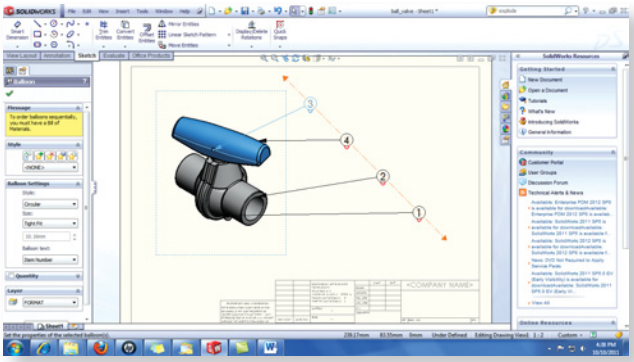
SolidWorks 2012 marks the debut of SolidWorks Costing, a module you can use to obtain cost estimates on sheet-metal parts and machined parts.



In SolidWorks 2012, you can create exploded views of multi-body parts. Individual solid volumes in multi-body parts behave like subassemblies.



Feature Freeze (shown here as a line marking the freezing point in the history) prevents unnecessary geometry rebuild during edits.



The Magnetic Line function helps you align your ballooned text by anchoring them on an invisible line.

neat stack, pinned to the invisible line.

With sheet-metal parts, SolidWorks 2012 gives you the option to include Excel-style punch tables in the drawing view of the flattened pattern. The table can contain punch IDs, quantities, locations of the holes (measured from X and Y axes), angle and other attributes.

For those who work with large assemblies, SolidWorks 2012 provides a way to load them faster with the Large Design Review option (available as one of the drop-down options when you're opening a file). With this mode, you can load the model—and its sub-components—into the program window as display-only geometry, which demands less memory and processing power. It's a useful tool for those who need to inspect, but don't need to modify large assemblies.

Looking Beyond 2012

SolidWorks is going through a leadership change. Austin O'Malley, one of the original developers of SolidWorks (dating back to version 95) has left his post as vice president of research and development. O'Malley shepherded the company through eight major product releases. The post vacated by O'Malley is being filled by Gian Paolo Bassi, founder and CTO of RIWEBB. Bassi's past roles included vice president and chief technology officer of ImpactXoft, director of think3, and program manager at Computervision.

SolidWorks 2012 is a notable upgrade, particularly for its debut Costing module. Other enhancements—such as Large Design Review mode and Magnetic Line—are expected to make assembly edits and drawing production easier and faster. Feature Freeze, when used appropriately, will save time by preventing unnecessary geometry regeneration. However, the new version doesn't sufficiently address an area where SolidWorks' rivals have been making consistent improvement: direct modeling. Bassi may change this in a subsequent release.

When asked to describe his vision for SolidWorks for both the near future and long term, he replied, "Models need to have more freedom in the way they are designed, modified and behave. I will bring hybrid methodologies beyond geometric parameters to functional design." (*Editor's Note: His reply is part of a Q&A published as a blog post titled "SolidWorks in Transition," which is available here at deskeng.com/virtual_desktop/?p=4454.*) DE

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INFO → SolidWorks: SolidWorks.com

To view a video demonstration of SolidWorks 2012's features, visit:

- deskeng.com/virtual_desktop/?p=4438
- deskeng.com/virtual_desktop/?p=4325

Plenty of Power *at an Attractive Price*

The entry-level Dell Precision T1600 workstation proves that performance can be affordable.

BY DAVID COHN

Entry-level workstations are one of the hottest market segments these days, perhaps attesting to tough economic times. Addressing the needs of budget-conscious design professionals, Dell has introduced its Precision T1600. This single-socket workstation is purpose-built for professional 2D and entry-level 3D applications, and is independent software vendor (ISV)-certified for AutoCAD, Pro/ENGINEER and other select software applications.

Based on Intel second-generation Core and Xeon processors, with a choice of Intel HD or add-in professional graphics from AMD and NVIDIA, the Precision T1600 comes housed in a gray and black, tool-less small tower chassis measuring 6.73x17.64x14.25 in. and weighing just 20 lbs. The T1600 looks like a scaled-down version of the T5500 we reviewed early last year (see *DE*, March 2011).

Like other systems in the Precision family, the front panel provides two 5.25-in. drive bays, one of which came filled with a 16X DVD+/- RW drive. Below these, a sloping panel contains microphone and headphone jacks, four USB 2.0 ports, and cleverly concealed hard drive and network activity lights.

INFO ➜ Dell: Dell.com

Dell Precision T1600

Price: $1,875 as tested ($629 base price)

System Specifications:

- **Size:** 6.73x17.64x14.25-in. (WxDxH) tower
- **Weight:** 20.25 lbs.
- **CPU:** 3.4GHz Intel Xeon E31270 quad-core w/8MB L3 cache
- **Memory:** 4GB 1333MHz DDR3 SDRAM (16GB max)
- **Graphics:** NVIDIA Quadro 2000 w/1GB memory
- **Hard Disk:** one 500GB Seagate Barracuda SATA 7,200 rpm drive
- **Optical:** one 16X DVD +/-RW
- **Audio:** onboard integrated four-channel High Definition audio (microphone, headphone, line-in and line-out)
- **Network:** integrated Intel 82579LM 10/100/1000 Ethernet LAN
- **Keyboard:** 104-key Dell USB keyboard
- **Pointing device:** three-button USB optical roller-wheel mouse
- **Other:** one 9-pin serial, eight USB 2.0

The rear panel hosts a 9-pin serial port, line-out and line-in/microphone jacks, an RJ-45 connector for the integrated Intel 82579LM Gigabit Ethernet LAN, PS/2 mouse and keyboard connectors, and six more USB 2.0 ports. A DisplayPort connector is also provided for those systems with integrated graphics.

Well-organized Interior

Unlike other workstations in the Dell Precision series, the T1600 case opens on the left and reveals a clean, organized interior. A drive cage located near the base of the unit behind the front bezel accommodates up to two 3.5-in. hard drives. Our evaluation unit came with a 3.5-in. 500GB Seagate Barracuda 7200rpm SATA hard drive with a 16MB cache.

A rather small (9-in.-sq.) motherboard provides four memory sockets that can accommodate up to 16GB of RAM. Our evaluation unit came with 4GB, installed as a pair of 2MB 1333MHz DDR3 dual in-line memory modules (DIMMs). The CPU socket occupies the center of the motherboard. You can order the T1600 with one of seven different Intel processors, ranging from a 3.1GHz dual-core i3 up to a 3.6GHz quad-core Xeon E3 processor, including two with built-in Intel HD graphics. Our evaluation unit came with a 3.4GHz quad-core Xeon E3-1270 processor with 8MB of Intel SmartCache.

The motherboard also provides two PCI-Express x16 slots and one PCI slot, all of which can accommodate full-height cards. If you opt to forego the integrated Intel HD graphics, you can choose from among nine ATI or NVIDIA graphic cards. Our evaluation unit came with an NVIDIA Quadro 2000, which provides 1GB of dedicated GDDR5 memory.

Great Performance

Because the Dell Precision T1600 was equipped with just a single quad-core CPU and midrange graphics, we anticipated decent performance, but nothing stellar. Boy, were we surprised. First of all, the system booted up in just 40 seconds—quite fast for a system equipped with only mechanical hard drives.

On the SPECviewperf test, which looks solely at graphics performance, the Dell T1600 turned in impressive results thanks to its relatively fast CPU and NVIDIA GPU. While

Single-Socket Workstations Compared

		Dell Precision T1600 workstation (one 3.4GHz Intel Xeon E3-1270 quad-core CPU, NVIDIA Quadro 2000, 4GB RAM)		**@Xi Computer MTower** workstation (one 3.4GHz Intel Core i7 2600K quad-core CPU over-clocked to 4.1GHz, NVIDIA Quadro 5000, 16GB RAM)		**Digital Storm PROTUS 226060** workstation (one 3.33GHz Intel i7-X980 six-core CPU, NVIDIA Quadro FX 3800, 12GB RAM)		**BOXX 3DBOXX 4860 Extreme** workstation (one 3.33GHz Intel i7-X980 six-core CPU over-clocked to 4.15GHz, NVIDIA Quadro 5000, 12GB RAM)		**Lenov E20** workstation (one 3.19GHz Intel i5-650 dual core CPUs, NVIDIA Quadro FX 580, 4GB RAM)		**BOXX 3DBOXX 8550XTREME** workstation (two 3.33GHz Intel Xeon X5680 six-core CPUs over-clocked to 4.2GHz, NVIDIA Quadro 5000, 24GB RAM)		**Dell T5500** workstation (two 3.33GHz Intel Xeon X5680 six-core CPUs, NVIDIA Quadro 5000, 6GB RAM)	
Price as tested		$1,875		$4,465		$6,545		$6,325		$1,224		$11,396		$9,242	
Date tested		9/11/11		4/30/11		12/13/10		11/14/10		9/15/10		3/20/11		1/14/11	
Operating System		Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit
SPECviewperf	higher														
3dsmax-04		83.61	81.72	n/a	89.36	88.15	87.07	n/a	90.25	66.73	64.98	95.97	95.44[1]	75.05	78.72
catia-02		96.38	93.28	n/a	121.7[1]	75.35	84.85	n/a	115.36	68.28	63.79	120.44	121.1[1]	98.48	100.25
ensight-03		76.62	74.16	n/a	131.19[1]	62.22	58.33	n/a	120.41	45.79	43.40	132.41	130.13[1]	118.29	121.70
maya-02		297.27	270.53	n/a	465.88	174.45	218.33	n/a	458.21	185.81	157.57	529.89	476.95[1]	490.95	435.44
proe-04		89.24	85.86	n/a	128.25	83.16	77.29	n/a	114.34	64.08	59.17	113.84	113.24	92.19	90.61
SW-01		169.31	160.61[1]	n/a	239.78	174.74	157.70	n/a	233.03	97.07	89.67	221.31	214.06	180.49	169.75
tcvis-01		56.76	54.24	n/a	97.45	40.16	37.36	n/a	95.26	23.66	23.00	98.58	94.17	93.99	90.34
ugnx-01		43.40	42.47	n/a	88.87[1]	37.46	35.49	n/a	88.75	23.15	16.93	89.32	86.90	89.31	87.95
SPECapc SolidWorks	lower														
Score	seconds	106.63[1]	n/a	n/a	n/a	106.51[1]	n/a	n/a	n/a	153.29	n/a	106.56[1]	n/a	146.86	n/a
Graphics	seconds	34.24[1]	n/a	n/a	n/a	32.17[1]	n/a	n/a	n/a	58.71	n/a	35.33[1]	n/a	58.42	n/a
CPU	seconds	25.05[1]	n/a	n/a	27.48[1]	26.87[1]	n/a	n/a	31.63	33.67	n/a	25.99[1]	n/a	32.27	n/a
I/O	seconds	48.26[1]	n/a	n/a	49.48[1]	47.99[1]	n/a	n/a	54.68	65.44	n/a	46.51[1]	n/a	60.76	n/a
SPECapc SolidWorks	higher														
Score	ratio	8.04[1]	n/a	n/a	n/a	8.04[1]	n/a	n/a	n/a	5.21	n/a	8.23[1]	n/a	5.32	n/a
Graphics	ratio	5.74[1]	n/a	n/a	n/a	6.07[1]	n/a	n/a	n/a	3.25	n/a	6.08[1]	n/a	3.23	n/a
CPU	ratio	12.88[1]	n/a	n/a	11.74[1]	12.01[1]	n/a	n/a	10.20	9.58	n/a	12.61[1]	n/a	10.00	n/a
I/O	ratio	6.56[1]	n/a	n/a	6.40[1]	6.60[1]	n/a	n/a	5.79	4.84	n/a	6.81[1]	n/a	5.21	n/a
Autodesk Render Test	lower														
Time	seconds	82.2[1]	60.5[1]	n/a	49.8[1]	53.5[1]	46.3[1]	n/a	39.6[1]	222.3[1]	203.0[1]	34.0[1]	19.0[1]	42.0[1]	28.0[1]

Numbers in blue indicate best recorded results. Numbers in red indicate worst recorded results. 1: Hyper-threading enabled

it certainly didn't set any records, it proved to be the fastest single-socket system we've tested that didn't have an over-clocked CPU and gobs of memory.

When we turned our attention to the SolidWorks benchmark, which is more of a real-world test and additionally breaks out graphics, CPU and I/O performance separately from the overall scores, the Dell Precision T1600 truly held its own—equaling or outperforming systems costing thousands of dollars more, including several equipped with two CPUs.

On the AutoCAD rendering test, the T1600's results were again very impressive. With hyper-threading enabled, giving the equivalent of eight processor cores, the Dell Precision T1600 completed our presentation quality rendering in 60.5 seconds—the best result to-date for a system with just one quad-core CPU running at its standard speed.

Prices for the Dell Precision T1600 start at $869. As configured, our evaluation unit priced out at just $1,875. That makes the Dell Precision T1600 a price/performance leader, guaranteed to meet the needs of design professionals without breaking the bank. 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. Contact him via email at david@dscohn.com or visit his website at DSCohn.com.*

Smart *and* Fast

The 3DBOXX 3970 XTREME harnesses several new technologies to deliver incredible performance.

BY DAVID COHN

The 3DBOXX 3970 XTREME workstation from BOXX Technologies houses an over-clocked Intel Core i7-2600K quad-core CPU in an attractive brushed aluminum case. ***Photo courtesy of David Cohn.***

We've come to expect a lot from BOXX Technologies. The Austin, TX-based company has been building computers since 1996, and its systems epitomize peak performance. The 3DBOXX 4860- and 8550-series workstations we recently reviewed (*DE* January 2011 and May 2011, respectively) proved to be the fastest single and dual-CPU systems to date. So we were quite excited when we received the latest BOXX workstation, the 3DBOXX 3970 XTREME—particularly because it incorporated several novel new technologies.

Like the other BOXX workstations before it, the 3DBOXX 3970 XTREME came housed in a beautiful, custom-designed aluminum chassis sporting a brushed aluminum front panel with the BOXX logo emblazoned in the middle. Above this panel are two 5.25-in. drive bays and a panel containing two USB 2.0 ports, two USB 3.0 ports and an IEEE 1394a (FireWire) port, as well as headphone and microphone jacks with jack retasking. The panel also includes a round power button, bright-white LED power indicator, blue hard drive light, and a small reset button. The topmost bay houses a 20X dual layer DVD +/- RW drive, while the second bay remains available. The sides of the 7.0x19.5x17.5-in. (WxDxH) tower case have removable black aluminum panels, while the top continues the brushed aluminum finish.

The rear panel provides six more USB 2.0 ports, two additional USB 3.0 ports, and an antenna for the built-in Bluetooth 2.1. There's also an eSATA port, six audio connectors (separate microphone and line-in jacks, as well as jacks for front, center/subwoofer, side and rear output channels), an optical S/PDIF port, a RJ45 network connection, and DVI-D, HDMI and VGA video ports for the built-in Intel graphics processor that are separate from the NVIDIA Quadro 2000 graphics accelerator installed in our evaluation unit.

Smart Response Technology

The panels on either side of the case are held in place with captive thumbscrews. Removing the panel on the left reveals a spacious interior. The ASUSTek P8Z68-V Pro motherboard, based on an Intel Z68 chipset, takes up just a bit more than half of the case. Above this is a 620-watt Seasonic power supply. An Asetek liquid cooling module covers the single CPU, with its hoses routed to a front panel-mounted fan and radiator. A second front panel-mounted fan cools the rest of the interior.

Removing the panel on the right reveals the hard drives, which mount to the rear of the panel supporting the motherboard. Here we found what made this BOXX workstation unique: The 3DBOXX 3970 XTREME is the first workstation we've reviewed to come equipped with an Intel solid state drive (SSD) taking advantage of Intel's new Smart Response Technology. The 3DBOXX 3970 XTREME comes standard with a 20GB Intel SSD 311 series drive, which is used as a cache for frequently accessed operations. Coupled with a standard hard drive, the addition of this inexpensive (around $120) SSD speeds up hard drive/main memory interaction. This results in faster apparent hard drive speeds, reduced load and wait times, and maximized storage utilization. Overall system power consumption also goes down by reducing unnecessary hard drive spin.

Our evaluation unit also came with a 1TB, 7,200rpm Western Digital SATA drive with a 64MB cache. This speedy 3.5-in. drive features 4.2-millisecond nominal latency and a 128MB/second maximum transfer rate to help the 3DBOXX 3970 XTREME deliver excellent performance. The combination of the SSD and HD appear as a single drive, however, so that you only have to deal with a single drive identifier. The system automatically learns which files are accessed frequently and copies them from the HD to the SSD. The next time you access these files, the system loads

Single-Socket Workstations Compared

		BOXX 3DBOXX 3970 EXTREME workstation (one 3.4GHz Intel Core i7-2600K quad-core CPU over-clocked to 4.5GHz, NVIDIA Quadro 4000, 8GB RAM)		**Dell Precision T1600** workstation (one 3.4GHz Intel Xeon E3-1270 quad-core CPU, NVIDIA Quadro 2000, 4GB RAM)		**@Xi Computer MTower** workstation (one 3.4GHz Intel Core i7 2600K quad-core CPU over-clocked to 4.1GHz, NVIDIA Quadro 5000, 16GB RAM)		**Digital Storm PROTUS 226060** workstation (one 3.33GHz Intel i7-X980 six-core CPU, NVIDIA Quadro FX 3800, 12GB RAM)		**BOXX 3DBOXX 4860 Extreme** workstation (one 3.33GHz Intel i7-X980 six-core CPU over-clocked to 4.15GHz, NVIDIA Quadro 5000, 12GB RAM)		**BOXX 3DBOXX 8550XTREME** workstation (two 3.33GHz Intel Xeon X5680 six-core CPUs over-clocked to 4.2GHz, NVIDIA Quadro 5000, 24GB RAM)		**Dell T5500** workstation (two 3.33GHz Intel Xeon X5680 six-core CPUs, NVIDIA Quadro 5000, 6GB RAM)	
Price as tested		$4,048		$1,875		$4,465		$6,545		$6,325		$11,396		$9,242	
Date tested		10/12/11		9/11/11		4/30/11		12/13/10		11/14/10		3/20/11		1/14/11	
Operating System		Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit
SPECviewperf	higher														
3dsmax-04		n/a	99.03[1]	83.61	81.72	n/a	89.36	88.15	87.07	n/a	90.25	95.97	95.44[1]	76.05	78.72
catia-02		n/a	124.75[1]	96.38	93.28	n/a	121.7[1]	75.35	84.85	n/a	115.36	120.44	121.1[1]	98.48	100.25
ensight-03		n/a	109.56[1]	76.62	74.16	n/a	131.19[1]	62.22	58.33	n/a	120.41	132.41	130.13[1]	118.29	121.70
maya-02		n/a	399.43[1]	297.27	270.53	n/a	465.88	174.45	218.33	n/a	458.21	529.89	476.95[1]	490.95	435.44
proe-04		n/a	120.33[1]	89.24	85.86	n/a	128.25	83.16	77.29	n/a	114.34	113.84	113.24	92.19	90.61
SW-01		n/a	231.44[1]	169.31	160.61[1]	n/a	239.78	174.74	157.70	n/a	233.03	221.31	214.06	180.49	169.75
tcvis-01		n/a	79.05[1]	56.76	54.24	n/a	97.45	40.16	37.36	n/a	95.26	98.58	94.17	93.99	90.34
ugnx-01		n/a	65.91[1]	43.40	42.47	n/a	88.87[1]	37.46	35.49	n/a	88.75	89.32	86.90	89.31	87.95
SPECapc SolidWorks	lower														
Score	seconds	n/a	n/a	106.63[1]	n/a	n/a	n/a	106.51[1]	n/a	n/a	n/a	106.56[1]	n/a	146.86	n/a
Graphics	seconds	n/a	n/a	34.24[1]	n/a	n/a	n/a	32.17[1]	n/a	n/a	n/a	35.33[1]	n/a	58.42	n/a
CPU	seconds	n/a	26.44[1]	25.05[1]	n/a	n/a	27.48[1]	26.87[1]	n/a	n/a	31.63	25.99[1]	n/a	32.27	n/a
I/O	seconds	n/a	47.01[1]	48.26[1]	n/a	n/a	49.48[1]	47.99[1]	n/a	n/a	54.68	46.51[1]	n/a	60.76	n/a
SPECapc SolidWorks	higher														
Score	ratio	n/a	n/a	8.04[1]	n/a	n/a	n/a	8.04[1]	n/a	n/a	n/a	8.23[1]	n/a	5.32	n/a
Graphics	ratio	n/a	n/a	5.74[1]	n/a	n/a	n/a	6.07[1]	n/a	n/a	n/a	6.08[1]	n/a	3.23	n/a
CPU	ratio	n/a	12.20[1]	12.88[1]	n/a	n/a	11.74[1]	12.01[1]	n/a	n/a	10.20	12.61[1]	n/a	10.00	n/a
I/O	ratio	n/a	6.73[1]	6.56[1]	n/a	n/a	6.40[1]	6.60[1]	n/a	n/a	5.79	6.81[1]	n/a	5.21	n/a
Autodesk Render Test	lower														
Time	seconds	n/a	45.6[1]	82.2[1]	60.5[1]	n/a	49.8[1]	53.5[1]	46.3[1]	n/a	39.6[1]	34.0[1]	19.0[1]	42.0[1]	28.0[1]

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

them from the fast SSD rather than the slower hard drive.

The mounting panel provides a total of six drive bays, with power cables already in place. BOXX includes a bag full of additional power cables, as well as one more SATA cable, so you can easily add another hard drive. The company offers drives ranging from 250GB to 3TB, and will preconfigure systems with multiple drives and redundant arrays of independent disks (RAID).

Boosting Performance

The Intel Core i7-2600K CPU in our evaluation unit was also somewhat unique. While the Xi MTower workstation we reviewed in August also came equipped with this same processor, BOXX over-clocked its CPU to 4.5GHz. But over-clocking this quad-core "Sandy Bridge" processor works a bit differently than what we've seen in the past. The 2600K CPU, which is based on a 32nm process technology and has a maximum thermal design power (TDP) of 95 watts, has a clock speed of 3.4GHz and a rated maximum turbo frequency of 3.8GHz. The "K" designation in the processor name indicates that the CPU can be over-clocked. Thanks to the way BOXX has configured the basic input-output system (BIOS) of its 3DBOXX 3970 EXTREME workstation, the Intel Core i7 CPU runs at 3.4GHz when not subject to significant computational loads—what Intel refers to as the idle, or C-state. But when pressed to do work, the processor shifts into a P-state, increasing both the voltage and frequency, so that all four

cores—and with hyper-threading enabled, all eight threads—reach a maximum frequency of 4.5GHz. We confirmed this by running CPU monitoring software while performing some of our benchmark tests. In addition, when the system is truly idle, the CPU shifts into higher C-states, allowing the processor to turn off unused components to reduce power consumption.

Our evaluation unit came equipped with 8GB of RAM, installed as a pair of 4GB DDR3 dual in-line memory modules (DIMMs). The ASUS motherboard can support up to 32GB of memory using 8GB memory modules. The motherboard also provides a total of seven expansion slots—three PCIe 2.0 x16 slots, two PCIe 2.0 x1 slots, and two PCI slots— and supports both NVIDIA SLI and ATI CrossFireX technology. There's also on-board SATA, LAN, Bluetooth, Realtek audio, FireWire, and USB controllers.

Although the Intel Core i7-2600K processor includes built-in HD Graphics 2000 with Intel InTru 3D technology, BOXX equipped our evaluation unit with an NVIDIA Quadro 4000 GPU. This mid-range graphics accelerator has 256 CUDA cores and a 2GB GDDR5 frame buffer; it provides two DisplayPort connectors and one dual-link DVI-I port. Although it's a single-slot board, BOXX included the optional three-pin mini DIN stereo connector, which occupied a second rear panel slot. The board also requires an auxiliary power connection.

Incredible Results

Because the 3DBOXX 3970 XTREME was equipped with just a single quad-core CPU, albeit one that was tweaked for very fast performance, we weren't expecting it to set any records—particularly when compared to other systems we've recently reviewed that utilized one or even two six-core CPUs. But then again, we weren't quite sure what to expect with the addition of the SSD and Smart Response Technology.

To say that we were impressed with the performance of the 3970 XTREME would be an understatement.

On the SPECviewperf test, the 3DBOXX 3970 XTREME equipped with the NVIDIA Quadro 4000 turned in some of the best results we've ever recorded, surpassing even dual-socket systems equipped with more expensive graphics boards on some of the Viewperf datasets.

Unfortunately, the system came with only Windows 7 installed. This meant we were not able to obtain a complete set of meaningful results from our SPECapc SolidWorks benchmark, because this benchmark only runs effectively under Windows XP. That said, the CPU and I/O performance scores were excellent, and we'd expect actual performance when running SolidWorks or any other CAD application to be quite fast.

On our own AutoCAD rendering test, however, which clearly shows the advantages of hyper-threading, the 3DBOXX 3970 XTREME proved to be faster than any other single CPU-based system we've ever tested. It rivaled the performance of some workstations equipped with two processors. In addition, the system ran nearly silent, except when accessing the DVD drive.

BOXX rounded out its workstation with a Logitech K120 104-key keyboard and a Logitech M500 laser mouse. Windows Professional 64-bit came pre-installed. BOXX Technologies backs its systems with a three-year limited warranty, which includes phone and email tech support Monday through Friday from 7 a.m. to 6 p.m. CST, and free return shipment if necessary during the first year of ownership.

Even more amazingly, the incredible performance of the 3DBOXX 3970 XTREME doesn't cost as much as you'd think. All 3970 XTREME workstations include the Intel Core i7-2600K CPU and 20GB Intel SSD. Prices start at $2,862 for a system equipped with 4GB of memory, a 250GB hard drive, and an NVIDIA Quadro 600 graphics card. The NVIDIA 4000 adds $816; doubling the memory raises the price another $222; and moving up to the 1TB hard drive brought the total cost of our evaluation unit to $4,048. Of course, you could add even more memory and a higher-end graphics card, but for most applications, that seems a bit too extreme. As configured, our 3DBOXX 3970 XTREME should more than meet the needs of most users—delivering one of the fastest systems available today without breaking the bank. 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. Contact him via email at david@dscohn.com or visit DSCohn.com.*

INFO ➜ BOXX Technologies Inc.: BOXXtech.com

BOXX 3DBOXX 3970 XTREME

Price: $4,048 as tested ($2,862 base price)

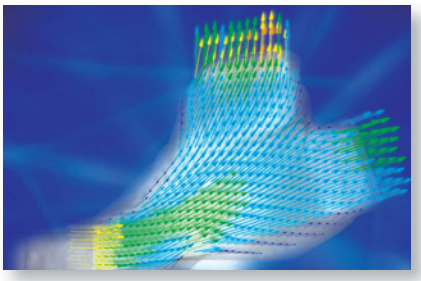
System Requirements:

- **Size:** 7.00x19.50x17.50-in. (WxDxH, w/handle) tower
- **Weight:** 27 lbs.
- **CPU:** one Intel Core i7-2600K (quad-core) 3.4GHz (over-clocked to 4.5GHz)
- **Memory:** 8GB DDR3 at 1,333MHz (up to 32GB supported)
- **Graphics:** NVIDIA Quadro 4000
- **Hard Disk:** Western Digital 1TB SATA 7,200rpm drive plus Intel 20GB SSD
- **Optical:** Pioneer 20X DVD+/-RW Dual-Layer
- **Audio:** onboard integrated high-definition audio (microphone and headphone on front panel; microphone, line-in, front, center/subwoofer, side and rear speakers on rear panel)
- **Network:** integrated 10/100/1000 LAN with RJ45 socket
- **Keyboard:** 104-key Logitech K120 USB keyboard
- **Pointing device:** Logitiech M500 laser mouse
- **Other:** Two USB 2.0, two USB 3.0 and one 1394a (FireWire) on front panel; six USB 2.0, two USB 3.0, one eSATA, optical S/PDIF, DVI-D, HDMI and VGA on rear panel

by Anthony J. Lockwood

Editor's Picks

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.



Optimization Technologies for FEM and CFD Upgraded

FE-DESIGN releases new versions of TOSCA Structure system design software and TOSCA Fluid topology optimization software for channel flow.

TOSCA Structure provides topology, shape, and bead optimization. Its been updated with support for the latest solver versions such as Abaqus 6.11 and to work more tightly with Siemens NX CAD. It also supports MSC Software's MD Nastran.

TOSCA Fluid works with your CFD simulation solution at the conceptual design phase of industrial internal turbulent flow systems and during optimization processes for existing designs. An interface for STAR-CCM+ versions 5 and 6 and upgraded support for ANSYS FLUENT version 12.1 are among the key enhancements in the latest version.

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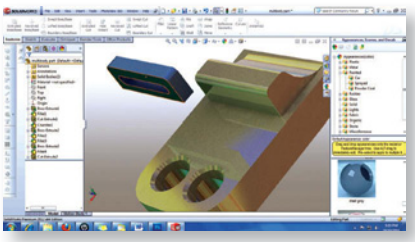

SolidWorks 2012 Unveiled

20th release of CAD software enhanced with more than 200 new functions.

SolidWorks just came out in its 20th iteration, and what do you know? SolidWorks 2012 offers more than 200 new functions—and something like 90% of them are based on feedback from engineers in the trenches.

The skinny on SolidWorks 2012 is that the new functions, enhancements to existing features, and, I'm sure, the quiet undercover thing that maybe fixes a bug or vastly speeds throughput are ubiquitous throughout the system. Assemblies and drawings, simulation, design costing, sheet metal, animation, and product data management have all seen additions and improvements.

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Design Aid Shows Resins and Materials Interacting

3D model demonstrates how finishes vary with resin choice.

Proto Labs is an online service provider that manufactures your CNC-machined and injection-molded parts for purposes such as prototyping or short-run production.

The company's Protomold division has a new design aid called Protogami. As you might guess, Protogami is a fold-together gizmo. It shows off the types of resins and and finishes (and quality) that Protomold offers. But that's not the Protogami's true coolness. Every time you turn the Protogami, it displays six different resins side-by-side in one of four finishes. You can see that the look of a particular finish can vary depending on which resin you apply it to.

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New BOXX Workstation Boosts Processing Speeds

Liquid-cooled workstation features an Intel Core i7 quad-core processor.

The 3970 XTREME has the option of Intel Smart Response Technology. This technology automatically copies your frequently used files from the 3970 XTREME's hard disk drive to its solid-state drive. What this is means for you is that those files on the SSD boot up quickly and applications like SolidWorks load a lot faster.

Plus, the second-generation Intel Core i7 quad-core processor can crank up to 4.5 GHz. You can add up to 32GB of memory to the 3970 XTREME, select your graphics accelerator (ATI, Intel, or NVIDIA), increase storage, and so forth. And the system comes with the expansion slots, ports, drive bays, etc. that you need.

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Tools of the Month

Noise, Vibration and Harshness Testing

From the annoying squeak in a car's dashboard to the loudness of a dishwasher, noise, vibration and harshness (NVH) testing is a critical step in many engineering processes. Products must meet consumer demand for quiet operation as well as, in many cases, government regulations to prevent noise pollution.

"There are national noise control laws in every country and government agencies have defined 'acceptable' noise level ranges for various sources of noise," according to a market report by Frost & Sullivan, an industry research and consulting firm.

At presstime, the firm was planning to release an update of its "World NVH Test Equipment Market" report. It says government regulations and new technologies—such as electric vehicles and the trend toward portable consumer electronics—are driving growth in the NVH test equipment market.

A number of products are available to help engineers acquire NVH data from sensors, condition that data via filtering and/or amplification, and pass it to a workstation via data acquisition hardware. Once collected, the data can be analyzed by specialized NVH software. The products listed here can help you measure and correct NVH so you can meet regulatory and consumer requirements for quiet operation of the prototypes you design and test.

1 Sound Probe Interfaces with IEPE Input Devices

G.R.A.S Sound and Vibration (gras.dk) has released the 50GI sound intensity probe for direct connection to signal analyzers or data acqusition devices with IEPE inputs. The probe includes a pair of phase-matched prepolarized precision microphones, which the company says meet the requirements in IEC standard 61043* for a class-1 intensity probe. The ¼-in. CCP preamplifiers are designed to ensure minimum disturbances to the sound field for accurate measurements in the full frequency range.

Microflown Releases Scout 422 DAQ

The Scout 422 is a 24-bit resolution USB data acquisition device from Microflown Technologies (microflown.com). It is developed for noise and vibration measurements with Microflown probe based solutions. The Scout 422 has four inputs, one output, an amplified output, tacho input and a external trigger channel. It also supports other sensors like microphones, accelerometers, IEPE sensors and tachometers.

2 NI Releases Sound and Vibration Measurement Suite 2011

National Instruments (ni.com/soundandvibration) has announced the latest version of its NI Sound and Vibration Measurement Suite software, which provides a collection of analysis and signal processing tools for noise, vibration and harshness (NVH) testing, machine condition monitoring (MCM) and audio test applications. Engineers can use the suite as stand-alone software or combine it with NI hardware and NI LabVIEW system design software to help simplify test system development and control. With its new vibration data-logging functionality and other enhancements, the Sound and Vibration Measurement Suite 2011 is said to help engineers more easily customize and automate any MCM or NVH test or monitoring application.

Accelerometer Kits Designed for Gas Turbines

IMI Sensors (imi-sensors.com), a division of PCB Piezotronics, Inc., (pcb.com) has launched the 600B13/B14 high temperature accelerometer kits for vibration measurement in gas turbines. These kits include a side-exit charge mode sensor, 10-ft. integral hermetically sealed hard-line cable, and integral ICP charge amplifier for multiple power generation monitoring applications, including placement on turbines, exhaust systems, and piping in extreme heat environments of +900°F/+482°C.

3 Measure Sound from 35 to 130 dB

Omega Engineering's (omega.com) Handheld Sound Level Meter has an electret condenser microphone with a Lo range of 35 to 90 dB and a Hi range of 75 to 130 dB. The handheld device has a liquid crystal display with a maximum reading of 1999, an accuracy of +/- 1.5 dB and a dynamic range of 55 dB. It features a maximum hold function, slow and fast frequency weighting and AC and DC output functions.

Data Acquisition and Process Monitoring Software

Coda is m+p international's (mpihome.com) new software platform for measurement, data acquisition, signal anal-

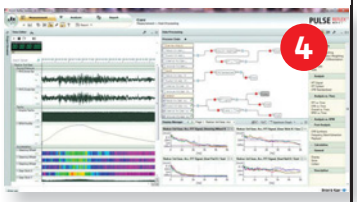
ysis and process monitoring. According to the company, it provides quicker time to test by eliminating costly application programming and long learning curves through out-of-the box functionality. High-channel count applications using hundreds of channels can be configured within a short time, according to the company, and are handled safely and efficiently. Coda supports a range of VXIbus and LXIbus frontends.

Signal.X Technologies Announces MajX Shield

Signal.X Technologies' (signalxtech.com) MajX Shield helps engineers design and deploy NVH metrics for use in machine condition monitoring (MCM) applications, automated production NVH tests, and laboratory test stand automation. Metric formulations developed in Shield are deployed using the company's MajX NVH Controller, which operates at the direction of a test stand control system. The MajX Data Manager retrieves data produced by one or more NVH controllers and can schedule delivery of automated reports based on storable database queries and "what if" metric calculations.

4 PULSE 16 Analyzer Released

PULSE is Brüel & Kjær's (bksv.com) platform for noise and vibration analysis. The platform consists of PULSE Reflex, Acoustics and Structural Dynamics components. New functionality includes a module for the Desktop NVH Simulator suite used for auralising the exterior sound that would be experienced by a pedestrian, updates to the latest required standards such as



ISO 3744 and IEC 60704-2-4, and the ability to listen to your SPC results, turn paths on and off, listen over a time or RPM range, compare different sets of results back-to-back or apply filters. Engineers can create "what-if" scenarios, and listen to what the product could sound like if certain modifications were made. DE

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Tools of the Month

New Products for Engineers

1 SuperWorkstations Showcased

Supermicro (supermicro.com) premiered its lineup of SuperWorkstation solutions at Autodesk University. The application-optimized, server-grade systems are designed to run 24/7. They incorporate hot-swappable HDDs or SSDs, optical drives and cooling subsystems. Systems range from the Ultra High Performance 4 GPU SuperWorkstation (SS7046TG-TRF) to the entry-level SuperWorkstation SW5037A-T.

OriginLab Releases Origin 8.6 and OriginPro 8.6

OriginLab (originlab.com) has released Origin and OriginPro version 8.6. OriginLab now offers a native 64-bit version of the software, which will support customers as they work with large datasets. In addition to increased data storage, version 8.6 also features three new gadgets: Vertical Cursor, Sigmoidal Fit, and Curve Intersection. OriginPro includes all the new Origin features as well as advanced statistical tools in the area of Principal Component Analysis and Cluster and Discriminant Analysis.

2 Luxion Releases KeyShot 3

Luxion (keyshot.com) has announced KeyShot 3, the next generation of the company's rendering solution. KeyShot 3 includes an animation system that makes product and camera animations easier than before, according to the company. In addition, the solution includes improved asset management and part interaction. KeyShot's import pipeline has been expanded to now support Parasolid-based file formats such as NX, Solid Edge and SolidWorks on both PC and Mac, and also includes more than 400 new materials and more than 40 new lighting environments. Luxion also announced KeyShot 3 will support Autodesk 3ds Max and Autodesk Maya.

Remcom Releases XFdtd 7.2.2

Recom (remcom.com) has released an update to its electromagnetic simulation software, XFdtd Release 7

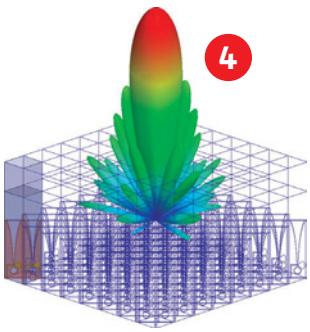
(XF7), with expanded import functionality and specialized options for biological EM applications. This update, Release 7.2.2, also features enhanced functionality for Remcom s CAD Merge capability, according to the company, with support for printed circuit board (PCB) models now included.

New 3D Printer Material for the ProJet 6000

3D Systems (3Dsystems.com) has announced VisiJet Black, a new black print material for its ProJet 6000 3D printer, which the company says produces functional and snap-fit plastic parts. The high-performance, VisiJet Black print material will be available for purchase during the first quarter 2012. 3D Systems says VisiJet Black is designed to print functional snap-fit parts that deliver visual impact with exceptional surface finish and high definition accuracy.

3 NCG CAM Updates Stand-Alone CAM Solution

NCG CAM Solutions UK (ncgcam.com) has released NCG CAM v11, the latest version of its stand-alone CAM solution, which includes a new true surface machining option, new analysis functions, improvements to along curve passes (2D geometry), the ability to create "clean" curves from the surfaces, and improvements to the folder management for databases with a large number of folders. New analysis functions have also been added.



Mentor Graphics Announces FloEFD

Mentor Graphics (mentor.com) has announced the next generation of the FloEFD concurrent computational fluid dynamics (CFD) simulation product, which it says addresses a broader range of real-world challenges such as radiation, combustion and hypersonic flows. FloEFD is available with two new optional modules: FloEFD with Advanced Module for Combustion and Hypersonic Flows, and FloEFD with HVAC Module for Radiation Flow and Comfort.

4 ANSYS 14.0 Released

ANSYS (ansys.com) has launched the newest release of its engineering simulation technology suite, ANSYS 14.0. The company says ANSYS 14.0 includes hundreds of new features that make it easier, faster and less costly for organizations to bring new products to market. The new benefits fall into three areas: 1) amplifying engineering, 2) simulating complex systems and 3) driving innovation with high-performance computing. The company says ANSYS 14.0 automates many user-intensive operations, which helps product developers minimize time spent setting up problems. The ANSYS suite is said to capture the interaction of multiple physics—structural, fluid dynamics, electromechanics and systems interactions—with deep physics and from within a single simulation system.

5 3Dconnexion Announces 3D SpaceMouse Pro

3Dconnexion's (3dconnexion.com) SpaceMouse Pro, combines the company's six-degrees-of-freedom (6DoF) sensor for 3D navigation with an ergonomic design and on-screen display, according to the company. Four customizable function keys provide fingertip access to frequently used application commands, while the new on-screen display provides visual feedback on function key assignment. DE

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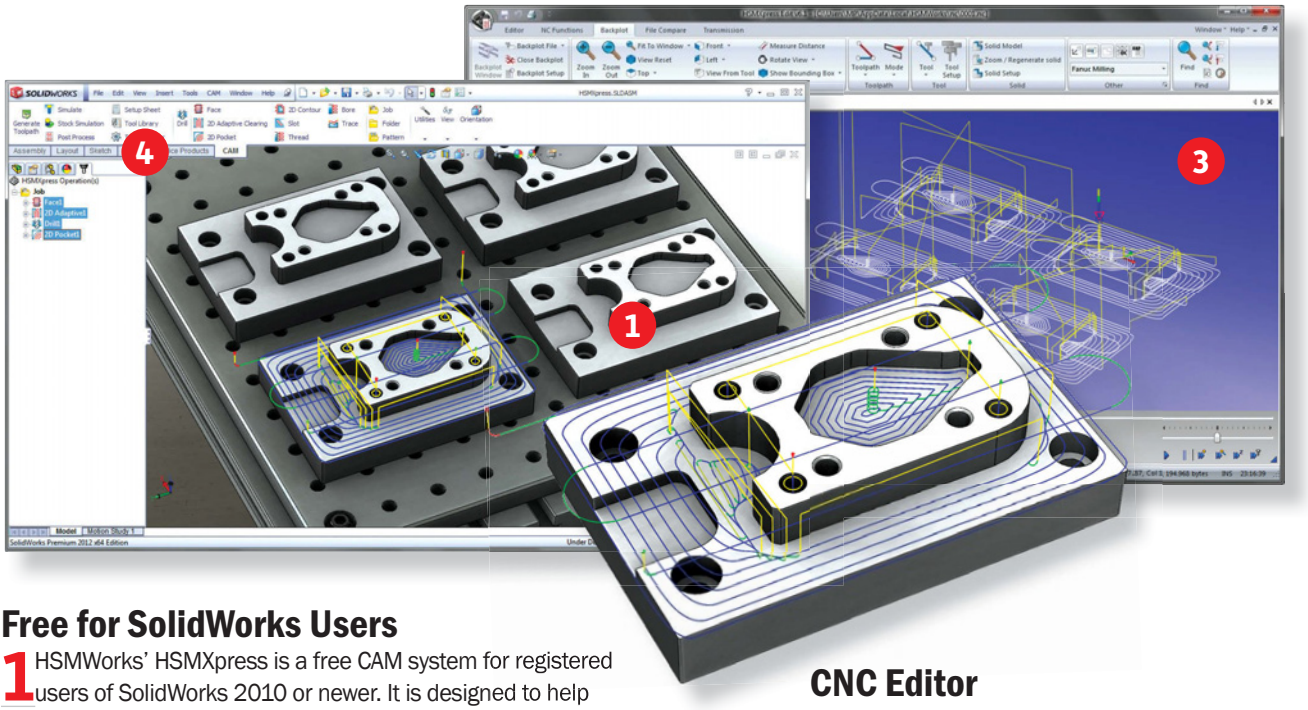
HSMWorks' HSMXpress CAM System



Free for SolidWorks Users

1 HSMWorks' HSMXpress is a free CAM system for registered users of SolidWorks 2010 or newer. It is designed to help designers and engineers begin machining prototypes and short production runs using computer numerical control (CNC) machines, and to help smaller manufacturers affordably implement a workstation-based CAD/CAM solution.

CAM Features

2 HSMXpress is built on the same 64-bit, multi-core CAM kernel as HSMWorks, the company's flagship CAM product. HSMXpress offers 2D and 2.5D machining strategies including: face, 2D pocket, contour, slot, thread, bore, and trace. It also features 2D Adaptive Clearing, a strategy for high-speed roughing and material removal. It includes an HTML Setup Sheet generator, user-configurable Javascript-based Post Processor System, and CNC program editor with file compare, NC-functions, backplotter, and 1-port DNC.

SolidWorks Integration

3 HSMXpress offers users the same user-interface integration as HSMWorks, including use of the SolidWorks Command Manager, SolidWorks Feature and Property Manager, and viewport workspace. All toolpath data is stored in the SolidWorks Part and Assembly files facilitating PDM and PLM integration, according to the company.

➜ DO YOU HAVE A COOL TOOL? *Desktop Engineering* editors are always on the hunt for great tools to share with our readers. Send us your ideas at de-editors@deskeng.com.

CNC Editor

4 HSMXpress includes HSMXpress Edit, a CNC program editor with side-by-side file compare, NC-functions, backplotter, and 1-port DNC. HSMXpress Edit allows users to make modifications to CNC programs such as offsets, line numbering/re-numbering, mirroring, and editing of comments—tasks that can be handled quickly without having to regenerate or repost programs where the original geometry has not changed. HSMXpress Edit also supports DNC or drip-feed serial communications with standard serial machine tool interfaces, according to HSMWorks.

TECH SPECS

- Microsoft Windows XP, Windows Vista or Windows 7. (64-bit versions supported).
- SolidWorks 2010 or newer.
- 1GB of main memory. 2GB or more is recommended, especially if working with complex parts.
- Intel or AMD CPU. Multi-processor and dual/quad/six-core CPUs will be used when calculating toolpaths.

For more information, visit hsmxpress.com

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