DE’s Digital Edition

by Steve Robbins

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Sincerely,

Steve Robbins, Executive Editor

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by Jamie J. Gooch

Intel Goes Sci-Fi in San Fran

I've been a fan of science fiction ever since watching reruns of *Lost in Space* and the original *Star Trek* after school. That led me to Ray Bradbury, Frank Herbert, Douglas Adams and many more. I've always been amazed how many gadgets and concepts from science fiction have become science fact, from radar to satellite communications to smart phones, and on and on.

Apparently, I'm not alone. At the Intel Developer Forum (IDF) San Francisco 2012 last month, the company debuted *Imagining the Future and Building It*. The collection of science fiction stories (download them here: tp-idf.com) begins with a quote from Intel's CTO, Justin Rattner: "Science and technology have progressed to the point where what we build is only constrained by the limits of our own imaginations."

That sets the tone for the introduction by Intel's official futurist, Brian David Johnson, and the short stories written by modern science fiction writers. Johnson goes on to explain that Intel has a "futurecasting lab" where it predicts what living in the future will be like.

Design engineers are in a great position to make sci-fi dreams become reality.

This isn't just highly paid geeks playing make believe, Johnson says the lab's models are used to help determine what Intel's technology needs to be capable of in the future. They've completed the model for 2019, and 2020 is looking pretty amazing. If the predictions are correct, in eight years "the size of meaningful computational power approaches zero," according to Johnson. That means we will have gone from 1940s computers that took up as much square footage as my house to computers so small they can be incorporated into just about anything you can imagine.

Let's Not Get Carried Away

This isn't the first time someone from a major corporation has tried to predict the future. Walt Disney shared his optimistic vision of the future, including monorails linking a planned community of tomorrow. The last time I road a monorail was at Disney World when it dropped me off at EPCOT the theme park, not the Experimental Prototype Community of Tomorrow, complete with 20,000 residents that Disney had envisioned. I have yet to strap on a jet pack and the only robot I ever owned took an awfully long time to sweep my floors before finally breaking down with a series of sad beeps that would have annoyed R2-D2.

It's tough to predict the future, but the task may be a bit easier when your company is a big part of creating that future. For example, both Microsoft and Google have predicted real-time translation that allows people speaking different languages to have a conversation in their native tongues. A slickly produced viral video (goo.gl/xrr7u) showcasing Microsoft's vision of the future last year highlighted desks that served as both displays and input devices, as well as 3D interactivity that would make any CAD user sit up and take notice. Google's driverless cars are already being testing on the road, and Google Glass, the eyeglasses that incorporate smartphone functionality, is slated to be released next year.

A Big Difference

The difference between today's predictions from Intel, Google and Microsoft and the predictions of Walt Disney is that Disney was more akin to the science fiction writers Intel is tying its vision of the future to. He was the guy with the big imagination. Technology companies, however, are in a position to make the products that allow those dreams to come true.

There are always hurdles to clear, of course. Disney's vision for EPCOT was delayed beyond the point of no return largely by beuracratic red tape. Cultural norms and the fear of change also need to be overcome. There are plenty of people imagining a darker future where technology destroys our privacy, turns us into screen-staring zombies, breaks down after we have become overly reliant on it, or simply destroys us. But the fact is that technology marches on, and the guys out in front are asking us where we want to go.

A Good Question

Intel's Johnson ends the introduction to *Imagining the Future and Building It* by asking "What kind of futures are you imagining?"

As the people on the front lines of creating new products that make use of new technological innovations, design engineers are in a great position to answer that question. Does the mere possibility of tiny computers in 2020 bring visions of in-ear advertisements or cancer-killing nanobots?

I'm hoping you imagine a vision more like Walt Disney's and less like Philip K. Dick's *Minority Report* or *Blade Runner*. The future could be incredibly bright. DE

Jamie Gooch *is the managing editor of* Desktop Engineering. *Contact him at de-editors@deskeng.com.*

DE October 2012 VOLUME 18/ISSUE 2

DESIGN

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SIMULATE

COVER STORY

Simulate and Test

ON THE COVER: Frontal crash test with the Volvo V40 at 40 mph. Its overall result is the best ever recorded by the European New Car Assessment Programme (NCAP). Simulations run as part of the car's development included those for the car's new pedestrian airbag technology. *Image courtesy of Volvo Car Corporation.*

FOCUS ON TEST & MEASUREMENT

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by Kenneth Wong

Computational Fluid Dynamics Makes Waves in Olympic Swimming (Again)

Stephen Silvester, a consulting services engineer working for ANSYS, has not personally met the U.S. Olympic swim team, but he knows many of them inside-out, in a manner of speaking. He certainly knows how they would fit inside a Speedo swimsuit.

Because of his involvement with Speedo's efforts to refine its professional swimwear line, Silvester has access to about 50 athletes' body scans, saved in STL format. He can, upon request, initiate a lap in a virtual pool using a digitized version of Michael Phelps. The technology he uses is part of ANSYS CFD, the same simulation software aerospace and automotive manufacturers routinely use to improve their products' performance in the air and on the road.

Reducing Drag

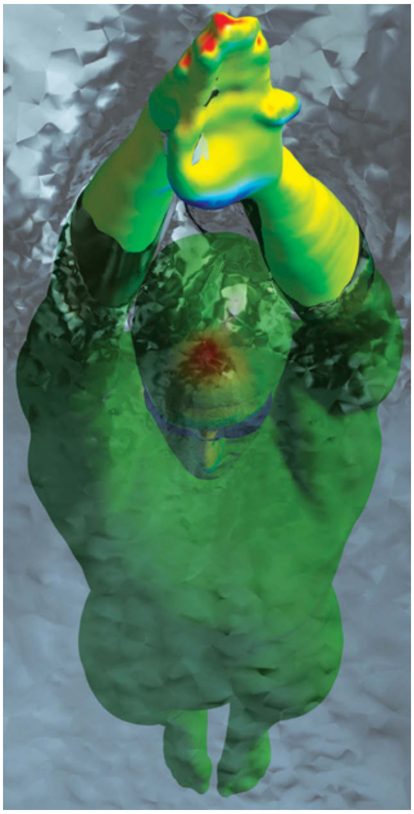
The use of computational fluid dynamics (CFD) to simulate the airflow around a vehicle is an established practice. It's a useful method to identify geometry in the car that increases drag. Based on CFD results, automotive designers can make subtle changes in the styling of the hood, windshield and bumpers to reduce drag. Recognizing the same principle could be used to improve swimwear, Speedo began employing CFD in its apparel design, as far back as 2004.

"First, we use simulation to understand how the suite performs, so Speedo knows how to improve the suit. Then we use it to evaluate the design ideas they had in how to modify the suit," Silvester explains.

There is one glaring difference in how CFD is used in traditional engineering projects and how it's used by Speedo. "Design optimization for SUV version 1 will be still applicable for SUV 2, for the most part," Silvester says. "With swimmers, no two swimmers are alike. You're optimizing for an organic shape."

With swimmers, each swimmer has a unique style—mathematically recreating Michael Phelps' strokes and paddles in the water, for example, is a lot more complex.

The Speedo-ANSYS partnership produced an ultra-lightweight, water-repellent suit called LZR Racer. According to Speedo, the product has 10% less passive drag than the Fastskin launched before the 2004 Olympics. Phelps described the feel of LZR Racer as "like a spacesuit" ("New suit set to make big splash for Michael Phelps," February 2008, *USA Today*).



To take its swimwear a step further, Speedo now enlists ANSYS to improve the entire line of swim gear, comprising caps, goggles and suits.

ANSYS performed roughly 1,200 simulation exercises, featuring hundreds of swim gear designs with a few millimeters' difference among them.

Simulation Opens Up Possibilities

"We cannot possibly test out all these ideas in real life," says Silvester. "In the real world, without simulation, we'd have to accept that we cannot test out all the designs."

But in CFD software running on computing clusters with 12 to 24 cores, it is, in fact, possible to test and prove hundreds of design variations in parallel. All details that seem to make a difference in swim performance—from the seam's location on the suit to the corner of the goggles and the way the swimmer tucks his or her hair into the cap—were carefully studied for possible refinement.

The project resulted in the Fastskin3 cap, the Fastskin3 Super Elite goggle, and the Fastskin3 Super Elite swimsuit [that] ANSYS says can deliver a full-body passive drag reduction of up to 16.6%, an 11% improvement in the swimmer's oxygen economy, enabling them to swim stronger for longer, and a 5.2% reduction in body active drag.

Silvester, who spent many hours recreating Olympic swim champions' laps inside the computer, reveals swimming isn't his preferred hobby. "You'd be lucky to find me in a swimming pool," he says. When not running CFD jobs, he likes to fly as a private pilot.

Autodesk Cuts Here, Grows There

Autodesk is shedding weight in one area, but also gaining in another. The design software titan is trimming 7% of its workforce, which works out to approximately 500 positions. But according to Noah Cole, the company's senior PR manager, "We are planning to hire approximately the same number of positions as will be eliminated."

The cutbacks follow the announcement of lower-than-expected Q2 results on Aug. 23.

"Our own execution challenges, combined with an uneven global economy, resulted in disappointing revenue results for the quarter," says Autodesk CEO Carl Bass. "Organizational changes we made within the company earlier this year slowed us down during the quarter."

Cole says the reductions are "across the company and will impact all levels and all parts of the organization." As part of the company's profit-margin improvement plan, Bass says he has "taken a prudent approach to spending in fiscal 2013."

Just as pinks slips were being delivered, Autodesk did spend an undisclosed amount to acquire a new company: Inforbix, co-founded by product lifecycle management (PLM) analyst and blogger Oleg Shilovitsky. The transaction is a clear signal that, even as the company trims fat in its operations related to traditional software, it continues to invest in cloud-hosted products and services.

Focusing on Mobile

Bass describes Autodesk's restructuring as "continued transformation and shift to more cloud and mobile computing." Cole says the new positions created will be to support "Autodesk 360 services, mobile service and future products and services that will be mobile- and cloud-based."

Inforbix, a cloud-hosted product data management system, fits squarely into Autodesk's shift. With an emphasis on web-based search technology and mobile apps, Inforbix adds to what Autodesk plans to offer through its Autodesk PLM 360, a comprehensive series of browser-based apps.

Joining Autodesk as the senior director of PLM and data management, Shilovitsky will report to Buzz Kross, Autodesk's senior vice president of design, product lifecycle and simulation. The acquisition puts Shilovitsky, who once worked for Autodesk's rival Dassault Systèmes, in charge of Autodesk's PLM initiatives. At press time, it was not yet clear what role Inforbix's other co-founder, Vic Sanchez, would play after the acquisition.

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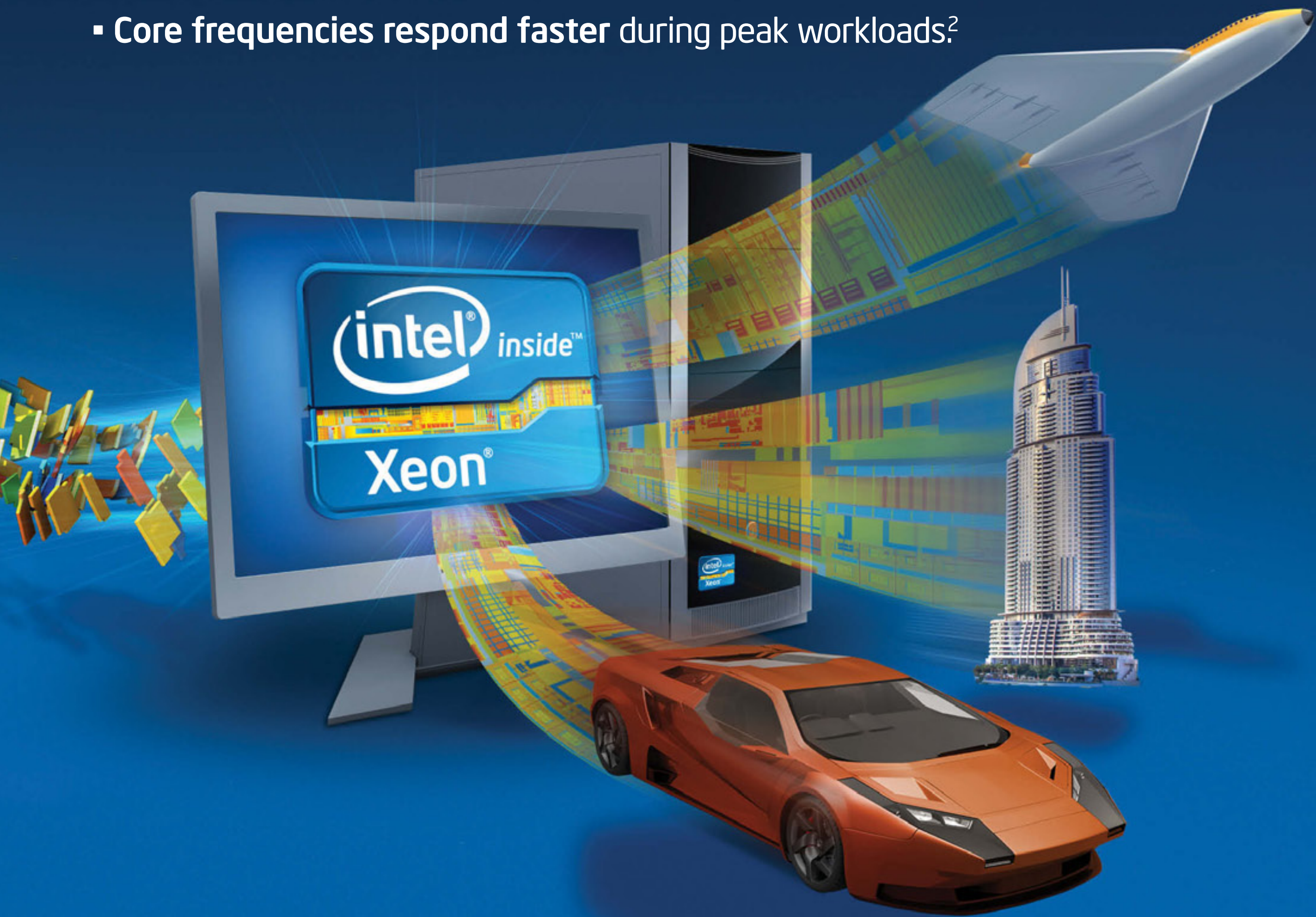

[1]Intel measurements of average time for an I/O device read to local system memory under idle conditions. Improvement compares Intel® Xeon® processor E5-2600 product family (230 ns) vs. Intel® Xeon® processor 5500 series (340 ns). Baseline Configuration: Green City system with two Intel® Xeon processor E5520 (2.26GHz, 4C), 12GB memory @ 1333, C-States Disabled, Turbo Disabled, SMT Disabled, Rubicon* PCIe* 2.0 x8. New Configuration: Meridian system with two Intel Xeon processor E5-2665 (C0 stepping, 2.4GHz, 8C), 32GB memory @1600 MHz, C-States Enabled, Turbo Enabled. The measurements were taken with a LeCroy* PCIe* protocol analyzer using Intel internal Rubicon (PCIe* 2.0) and Florin (PCIe* 3.0) test cards running under Windows* 2008 R2 w/SP1.

[2]Requires a system with Intel® Turbo Boost Technology capability. Intel Turbo Boost Technology 2.0 is the next generation of Turbo Boost Technology and is only available on select Intel® processors. Consult your PC manufacturer. Performance varies depending on hardware, software, and system configuration. For more information, visit http://www.intel.com/go/turbo.

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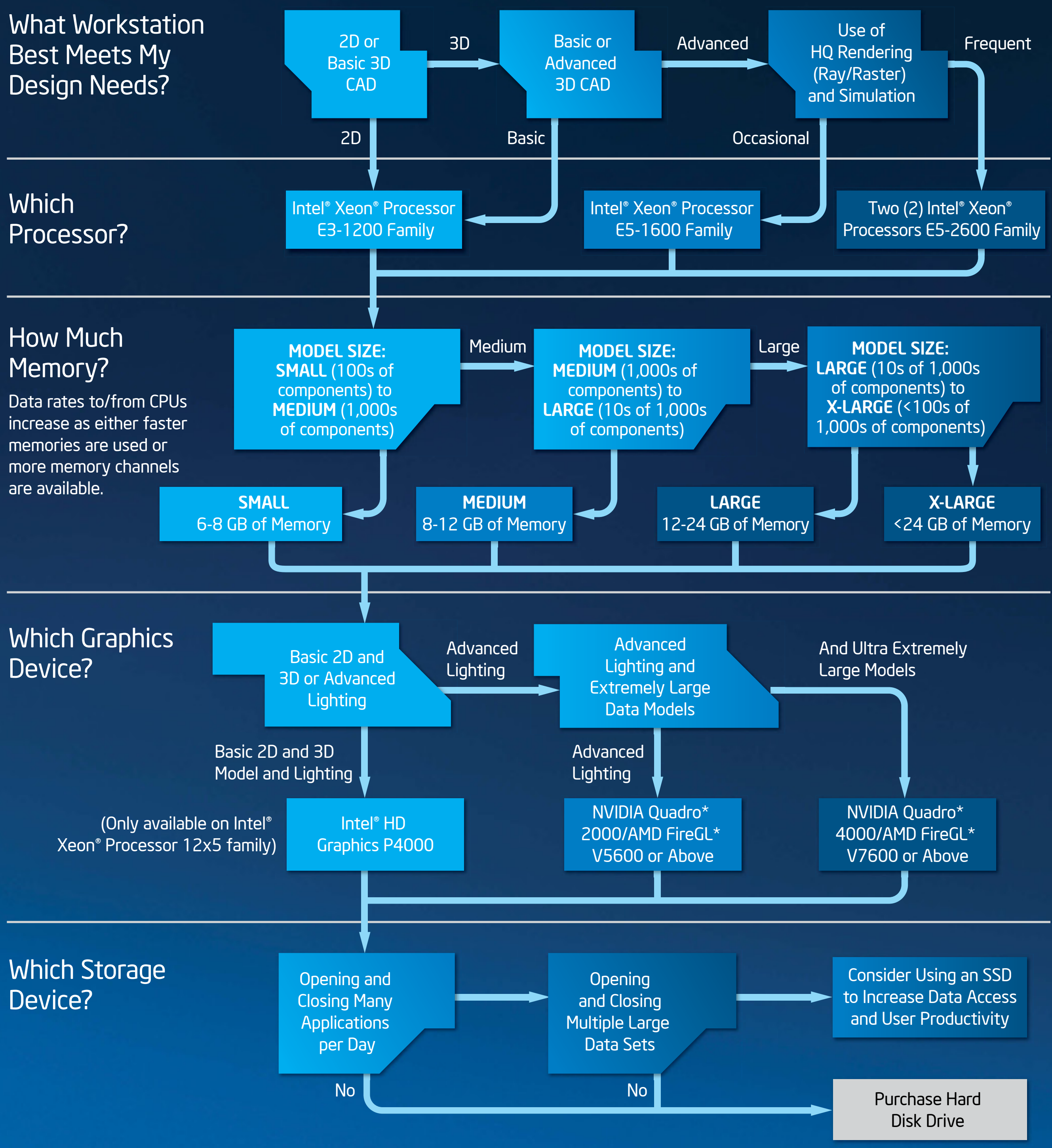

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by Kenneth Wong

Luxion, Sabertooth Kick up LuSt in Cloud

A new offering launched by Luxion, makers of the CPU-based renderer KeyShot, and its partner Sabertooth, a digital production house, is targeting an emerging market—driven by advertising agencies and corporate marketing divisions that want to let clients and consumers configure their products online and instantly preview the results.

LuSt, delivered by the Luxion-Sabertooth partnership, is described as an "interactive 3D rendering web service platform." Because web-hosted software has successfully branded itself as software as a service (SaaS), Luxion is pitching its web-hosted rendering option as rendering as a service (RaaS).

According to Luxion, "product designers and marketers want to show every possible option to the potential customer; however, the costs of creating multiple versions of the assets becomes very labor-intensive and expensive … [With LuSt,] product variations are created by the user through selection of product options and the environments they want the client to experience. The image is then created on demand and delivered to the user."

LuSt is available for desktop, server or cloud-hosted setups, according to the company. Luxion expects LuSt to be adopted by merchants who want to deliver showroom kiosks and websites with interactive product configurators and viewers. (This market is also pursued by Bunkspeed, which develops and markets the GPU-based renderer Bunkspeed SHOT, and Mackevision, which offers the online rendering platform F_BOX Picture Shooter. For more, read "Rendering on Someone Else's Server Farms," June 2011, *DE*.)

"Pricing will vary based on the implementation approach the client chooses (server-based or hosted), as well as on the number of simultaneous users the solution should be able to handle," Luxion said in its announcement.

Moving 3D Online

In another push for the cloud, Luxion released KeyShotVR, which lets users publish web-viewable 3D objects and scenes. "KeyShotVR is an integrated add-on to KeyShot Pro that automatically generates the code to be embedded into any website or company intranet, making it a turnkey solution for web content creation," the company says.

KeyShotVR is touch-responsive. Those who view KeyShotVR scenes from multi-touch devices (like iPhone and iPad) may use fingertip navigation to interact with published scenes. The plug-in is offered for $1,000. At press time, the product was under beta testing.

A product configurator with multiple color options — an example of how Luxion and Sabertooth's LuSt can be deployed.


TREK
BONTRAGER
aeolus 3

by Kenneth Wong

How Daniel Got His Pinchy

Daniel Wilson, a dinosaur-obsessed Indiana boy, has a name for his arm. He calls it Pinchy. It isn't the arm he was born with; it was custom-designed for him by two biomedical engineering students from the Rose-Hulman Institute of Technology.

Pinchy straps onto Daniel's original arm. Outfitted with Pinchy, he can do something kids usually take for granted: He can ride a bicycle.

Daniel, like his great-great uncle, was born with an arm that's shorter and smaller than yours or mine. He suffers from what's medically called "longitudinal deficiency." Because he has only limited reach and grip, he cannot do what comes naturally to other children, like dangling from a monkey bar or swinging a baseball bat.

One day, Daniel's mom, Emily, caught sight of a headline in the newspaper: "Rose-Hulman Students Developed Prosthetic Arm." With Daniel's consent, she contacted the school. A few weeks later, in September 2011, two Rose-Hulman students, Mark Calhoun and Jacob Price, came knocking on the Wilsons' door.

"[Disability] is not a subject you want to bring out as soon as you first meet someone. We weren't sure how to approach it. So we were being gentle with the subject," Price recalls. But Daniel's sense of humor broke the ice. The boy demonstrated how easy it was for him to slip out of a standard pair handcuffs with his slim arm. "See, I could never get arrested," he proclaimed.

At Rose-Hulman, senior-year bioengineering students traditionally undertake a real-world design project. Like Price and Calhoun, many of them participate in the initiative that pairs them up with someone in need of a prosthetic. Rose-Hulman's corporate supporters include Siemens PLM Software. The school received $27.8 millions worth of software donation from Siemens last year, according to Bill Boswell, senior director of partner strategy at Siemens PLM Software.

Daniel Wilson received an artificial arm (he calls it Pinchy), designed by biomedical engineering students Mark (left) and Jacob (right).

Custom Designed with Solid Edge

In their freshman year, both Calhoun and Price were introduced to Siemens' Solid Edge CAD software, part of Siemens' Velocity Series. Pinchy was designed in Solid Edge with input from Daniel. The boy specified red as his favorite color. The strap-on attachment was his idea, too. He rejected design concepts with a claw-like gripper and a three-finger gripper. Instead, he chose a dual-hook gripper.

"A lot of the printing of the part [on 3D printing machines] was made easy because we could make what we wanted to make in Solid Edge and save it as an STL file for the rapid-prototyping machine," Price says.

The use of 3D digital prototyping allowed the students to make sure they had sufficient clearances in their design to accommodate the electrical subsystems that would drive Pinchy's movements. In the design process, they had to experiment with the placements of several fasteners. In one early prototype, the protruding edges of the fasteners left visible marks on Daniel's arm, leading the students to conclude placing the fasteners at an angle was a better choice.

The flexibility of Solid Edge's Synchronous Technology allowed such changes to be made swiftly. "We were able to revise [the fasteners]. We placed them at an angle, with counterbore holes. That made it much more comfortable for him," Calhoun says.

The prototypes were sent to a 3D printing technician at school, who helped produce them as ABS plastic parts. Though Pinchy was custom-made for Daniel, Calhoun and Price believe that, with minor adjustments in the harness' fit and the buttons' placement, the same design could be used for patients with similar limbs.

Daniel received his robotic arm in May. His latest photos emailed to the Rose-Hulman students show him proudly wearing his arm. **DE**

Kenneth Wong *is* Desktop Engineering's *resident blogger and senior editor. Email him at kennethwong@deskeng.com or share your thoughts on this article at deskeng.com/facebook.*

Rethinking Automotive Design

American design firm Lovaro is recognized at the Renault 4 competition.

BY BRETT DUESING

Car culture accumulates unwritten design rules that, over time, become rote. For instance, although vehicle forms vary, they invariably communicate the same thing—either that the car can go fast, or that the truck has muscular power. The exterior must be reflective, generally with a metallic finish and chrome edging. Particularly in the U.S. market, vehicles are careful to stay within a narrow band of emotional expression, with personalities that vary from flatly serious to moderately aggressive.

The design of a suitcase, on the other hand, doesn't carry nearly so much baggage.

To free themselves from conventional thinking, Allen Zadeh and his partner Robert Foote approached the Renault 4EVER challenge like it was a suitcase design.

"There's no rule that says luggage has to be intimidating," says Zadeh, who is co-founder of the Brooklyn-based design group Lovaro. Like a car, a suitcase is a companion that travels with you, and the best designs strike a balance between fashion and practicality.

Can a car be designed just like other consumer products? Zadeh and Foote decided to find out.

Paris meets Brooklyn

Last fall, French automaker Renault gave out three awards in a contest to redesign its iconic hatchback model of the 1960s, the Renault 4. Lovaro was one of three winners, and the only American team recognized out of 3,000 entries worldwide.

Its award-winning submission is called the Eleve, meaning "student" in French. While it borrows on the form of the original Renault 4, it advances several progressive ideas like a removable roof, interchangeable components, recycled materials, and an interior concept that finds its roots closer to furniture showrooms than car dealerships.

"At the ceremony in Paris, the head design director at Renault asked me if this is the American take on the Renault 4," Zadeh recalls. "Is this what you envision fitting into the New York City market?" **DE**

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Wormbot Wriggles Along

Scientists from the Massachusetts Institute of Technology, Harvard and Seoul National University have created an autonomous robot that looks and moves like a worm. The group has dubbed their new creation the "Meshworm," after the nickel and titanium mesh material that forms its body.

Drawing inspiration from nature, Meshworm mimics the movement of a worm by contracting and expanding parts of its body. This inching along is thanks to a shape-memory alloy wire that is wound around the mesh body. Locomotion is driven by a small current applied to the wire, which squeezes the mesh.

The Meshworm is tough as well as squishy, surviving attacks with a hammer and being stepped on.

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GM Invests in NanoSteel

General Motors, via its GM Ventures arm, is investing in Providence, RI-based NanoSteel, a nano-structured steel provider that offers higher-strength steels that can help reduce vehicle weight.

NanoSteel offers an iron-based alloy that has been modified through nano-structuring. Sheet metals with tensile strengths of 950, 1,200 and 1,600 MPa will be available for automotive production next year.

According to NanoSteel, its material can be formed into component parts using room-temperature metal stamping processes on existing manufacturing equipment (cold forming); other types of advanced high-strength steels require elevated temperatures for part forming.

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100,000-dpi Nanoprinting

Scientists in Singapore have developed a nanoprinting technology that can achieve a record-high color resolution of 100,000 dots per inch (dpi), without inks or dyes.

Researchers at the Institute of Materials Research and Engineering were able to achieve bright-field color prints with resolutions up to the optical diffraction limit by encoding the information in metal nanostructures, then applying a uniform metal (silver, in this case) on top to produce the colors. By tuning their plasmon resonance, the researchers could determine the color of pixels.

According to the researchers, the color-mapping strategy produces sharp color changes and tonal variations, and can be used in large-volume color printing via nanoimprint lithography. It could be "useful in making microimages for security, steganography, nanoscale optical filters and high-density spectrally encoded optical data storage."

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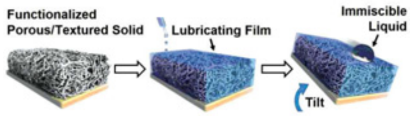
The Slippery Slope of Liquid Repellency



Unwanted contact between liquids and solids can create a variety of problems, in everything from biomedical devices to fuel tankers. Some researchers at Harvard, inspired by the slippery surface of the carnivorous Nepenthes pitcher plant, have developed a new liquid-repellent surface technology that is transparent, self-healing—and can repel blood, oil and brine, among other things.

The Slippery Liquid-Infused Porous Surface (SLIPS) combines a lubricated film on a porous solid using nano/microstructured substrates. The team says the technology can easily scale, because just about any porous material and a variety of liquids can be used in its manufacture. According to the Harvard website, SLIPS are "manufactured by wicking a chemically inert, high-density liquid coating onto a roughened solid surface featuring micro and nanoscale topographies."

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NASA's Mighty Eagle Robotic Lander Hits the Mark

NASA is conducting test flights of its autonomous robotic lander, the Mighty Eagle (named after a character in the Angry Birds video game). The new lander is part of a program to develop affordable landing systems for all manner of space exploration, including trips to the moon, asteroids and other celestial bodies.

Mighty Eagle runs on 90% pure hydrogen peroxide, earning itself the green label. The lander is 4 ft. tall, 8 ft. in diameter and weighs 700 lbs. fully fueled.

Recent test flights were intended to test the Mighty Eagle's autonomous rendezvous and capture capabilities. It uses a camera and onboard computer to visually navigate to a specified landing target. NASA says the most recent test flight was a success, with the Mighty Eagle flying to an altitude of 100 ft. The lander successfully identified its landing target and safely touched down.

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Company Profile: ExOne

The company that would become ExOne was originally part of Extrude Hone, supplier and developer of nontraditional machining processes and automated systems. The owner of Extrude Hone and ExOne, Larry Rhoades, was interested by the possibilities offered by additive manufacturing (AM).

Today, ExOne offers five different AM systems. The technologies can be divided into the M (metal) and S (sand casting) lines. ExOne refers to its process as "Digital Part Materialization" (or what the ASTM might call binder jetting). According to the company, ExOne offers the largest 3D printers on the planet in both lines.

MORE ➜ rapidreadytech.com/?p=2051

U.S. AM Initiative Update

In April, President Obama announced a plan for a National Network for Manufacturing Innovation. A call for proposals went out in May with a June 14 deadline. Now, the President has launched the "We Can't Wait" initiative through executive action.

The first city to reap the bounty of this decision is Youngstown, OH. The public-private funded project goes by the moniker of the National Additive Manufacturing Innovation Institute (NAMII). It will focus on the development of additive manufacturing (AM), including infrastructure, technology and end-use products. This is the first of 15 such institutes the Administration intends to create as part of a national network. The total investment by the federal government is expected to reach $1 billion.

MORE ➜ rapidreadytech.com/?p=2103

3D Systems' ProJet 5000

3D Systems has released a new high-capacity, professional 3D printer: the ProJet 5000. According to the company, the new system is capable of 24/7 production and can run unattended for more than 80 hours. 3D Systems is backing the new printer with a five-year manufacturer's printhead warranty.

"With the ProJet 5000, our customers can economically print larger, single-piece, high-definition parts in-house," says Buddy Byrum, vice president, Product & Channel Management for 3D Systems. "With faster print speed and higher resolution, the new ProJet 5000 delivers even more value for automotive, aerospace, footwear, appliances and packaging design and manufacturing applications."

The ProJet 5000 leverages 3D Systems' multi-jet technology (ASTM material jetting) and offers and uses VisiJet MX plastic. Eight different material delivery modules are intended to allow the user to control materials management.

MORE ➜ rapidreadytech.com/?p=2149

3D Printing Helps Amputee Climber

C.J. Howard's osteosarcoma disease led to the amputation of his left leg just below the knee. He credits Mandy Ott with introducing him to rock climbing. The only problem was his prosthesis: Climbers rely on specialized footwear for climbing, and Howard's artificial foot quickly wore through the shoes.

Ott, an environmental/aerospace engineer, thought about the problem and decided she could design an improved prosthetic foot, specifically for Howard's climbing excursions.

Ott contacted service bureau Morris Technologies to print the design using an EOS 3D printer and direct metal laser sintering (DMLS). Morris engineers selected commercial-grade titanium (Ti64) to build the prosthesis. Total build time for the 6x3x2 in. prosthetic foot took about 40 hours.

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3D Printing on the Frontline

The Army's Rapid Equipping Force's (REF) Expeditionary Lab – Mobile includes standard workshop equipment such as plasma cutters, welders, magnetic-mounted drill presses, hacksaws, routers, circular saws and jigsaws. The lab also boasts more high-tech equipment in the form of a computer numerically controlled (CNC) machine and a 3D printer, along with engineers to operate it all.

Each lab is housed in a 20-ft. shipping container with workstations that can be rolled out. The lab also contains satellite communications equipment to allow the scientists in the field to communicate with REF officials and engineers off-site. The lab costs around $2.8 million to build. The first one was deployed at Regional Command South near Kandahar. Other labs are being constructed, with one intended to remain in reserve to assist with future disaster relief efforts.

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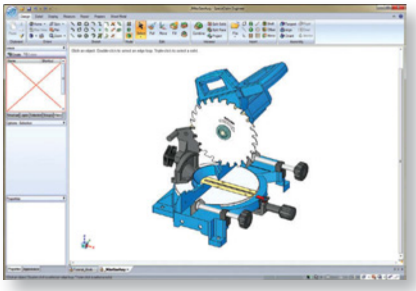
➜ For more coverage of rapid technologies, visit RapidReadyTech.com

Editor's Picks

by Anthony J. Lockwood

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.



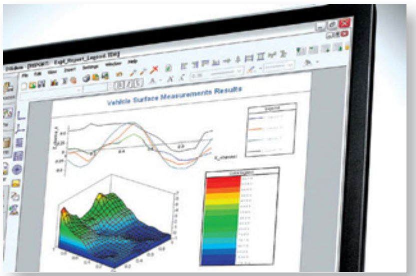
CADRA Integrates with SpaceClaim Engineer

Collaboration creates 2D/3D design, drafting, and solid modeling environment.

SofTech and SpaceClaim have jointly introduced the CADRA for SpaceClaim Engineer Integrator. The Integrator is an add-on for CADRA Design Drafting, which is a standalone application that's part of the CADRA mechanical design and drafting system. And then there's SpaceClaim. It has pushed and pulled direct modeling onto center stage and, in the process, added an entirely new dimension to the definition of 3D mechanical CAD.

The CADRA Design Drafting and SpaceClaim solid modeling combination gives you quite the CAD/CAM setup for a reasonable investment that allows you to flow between 2D and 3D as the moment requires.

MORE ➔ deskeng.com/articles/aabfxk.htm



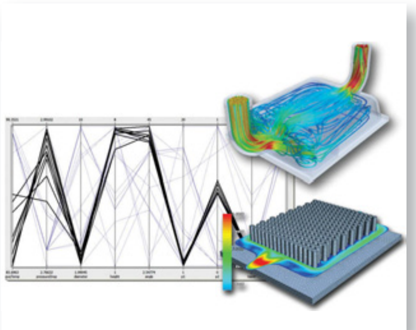
DIAdem 2012 Simplifies Data Analysis, Reporting

Load data from any file format and locate files using search engine functionality.

Managing the data that you've gathered monitoring a system no matter the stage — design, test, construction, operational, or all four — is a bear. Using a business application dragooned into engineering to mine and analyze large volumes of data in all sorts of formats eats up time, frays nerves, and depresses the bottom line. If that's you, take a good, long look at DIAdem from National Instruments. It could be what you need.

What DIAdem does is help you find, load, visualize, analyze, and report measurement data acquired from data acquisition processes as well as data generated during process simulations.

MORE ➔ deskeng.com/articles/aabfyt.htm



Add-Ons Extend Design Exploration and Optimization

Optimate and Optimate+ add-ons said to eliminate CFD-based optimization barriers.

Recently, CD-adapco and Red Cedar Technology partnered to offer a solution for CFD-based design optimization. The solution is called Optimate.

Optimate and Optimate+ are add-on modules for CD-adapco's STAR-CCM+ integrated engineering physics simulation system. Optimate leverages HEEDs and enables you to set up, execute, and post-process design exploration studies such as parameter sweeps and DOEs (design of experiments) easily. Optimate+ adds the capability to perform automated design optimization studies using the SHERPA optimization/search algorithm from Red Cedar.

MORE ➔ deskeng.com/articles/aabgbf.htm

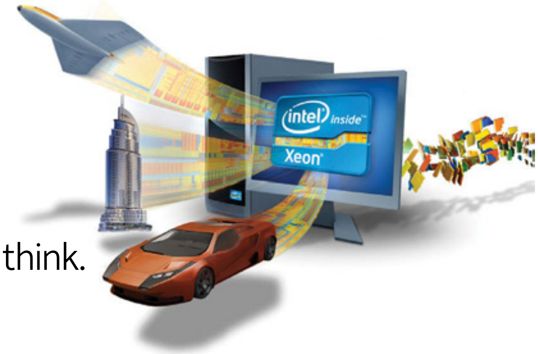
Dell Announces New Mobile Engineering Workstations

Precision mobile workstations designed for engineering and design professionals.

The Dell Precision M4700, the M6700, and the M6700 Covet Edition enable you to take a fixed workstation's power with you. They're built around Intel Core i5, i7, and Extreme Edition processors with Turbo Boost Technology. Dell offers them with an assortment of pro-level graphics subsystems, including the NVIDIA Quadro K-series GPUs and AMD FirePro graphics. Dell also reports that the M6700 is "the first and only to offer AMD FirePro M6000 with PCIe x16 Gen 3." That means really fast data throughput. These mobile workstations have lots of ports: two USB 3.0, two USB 2.0, one eSATA / USB combination, and integrated VGA, HDMI, and DisplayPort 1.2 video ports.

MORE ➔ deskeng.com/articles/aabgdy.htm

When Do You Fill the Second Slot?



You may need another processor sooner than you think.

BY PETER VARHOL

Engineering workstations typically provide engineers with the opportunity to populate two Intel® Xeon® processor "slots." With each Xeon processor running four, six, or eight cores, some may think that a single processor is sufficient for their design and simulation work. They could not be more wrong.

A recent study by CATi, A SolidWorks reseller, found that an ideal workstation for CAD-only users demanded between 4 and 6 cores – leaving only two cores for simulation (deskeng.com/articles/aabfsr.htm). While it is true that Intel Xeon processor based workstations perform as well as a supercomputer from only a couple of generations ago, having only two cores for simulation might be asking a bit much.

Depending on your workload and style of working, that single Xeon processor may be satisfactory for your design needs. But you have to look at everything you do before you make that determination. The CATi study found that while most CAD work is single-threaded, users do not just do CAD; they search the web for answers to questions, write email, use spreadsheets, and engage in IM chat or Skype conversations; concurrently other applications are protecting their workstation from viruses, security attacks and much more. And if you're like most engineers, you're doing several of these tasks at the same time. If each uses a core on a single processor workstation, those cores are going to be in short supply. Ultimately, having only a single processor may make you less productive than you could be.

But there's more. If you're creating designs, you're probably analyzing them too. Analysis and simulation will often times use several processor cores, even on a single workstation. In fact, the more cores you have for highly parallelized applications, the faster they will likely execute. This includes relatively straightforward computations like Monte Carlo simulations, as well as finite element analysis and computational fluid dynamics.

Return on Investment

The cost of an additional Xeon processor is low compared to the value of engineering time, so if there is any sort of analysis being done, it's clear that dual processors will be more effective. That's especially true if time-to-market considerations are important. If products must hit a specific market window, engineering productivity is one of the key drivers to success. The second processor can speed up activities such as analysis significantly, and enable it to be performed while still working on the design itself.

Further, the second Xeon processor can more than pay for itself by enabling certain types of analysis and simulation to be done on the workstation itself. If you always offload any sort of FEA or CFD computations to a cluster, the ability to do at least some of this work using your own computing resources saves substantial time and money.

Choosing the Right Configuration

So it's important to look at your workload and your applications before deciding on the number of processors your workstation needs. If you spend long hours doing little beyond design and rendering using traditional CAD software, a single Xeon processor may be able to support your needs. The remaining cores can support occasional use of collateral applications.

But most engineers multitask between design, analysis and simulation, Web research, interaction with other team members and management, writing documents, and a myriad of other professional activities. A working style that incorporates many different activities, some interactive, and some occurring in the background, favors multiple cores on dual processor based workstations.

Even graphics can make use of a core, if computations leading to rendering are done using the CPU. It's likely that some computations that end up as contributing to one or more images are done on the Xeon processor.

A combination of two eight-core Intel Xeon processors, with two gigabytes of memory for each core will go a long way to accelerating your innovation. The CATi study mentioned above noted three other things worth repeating.

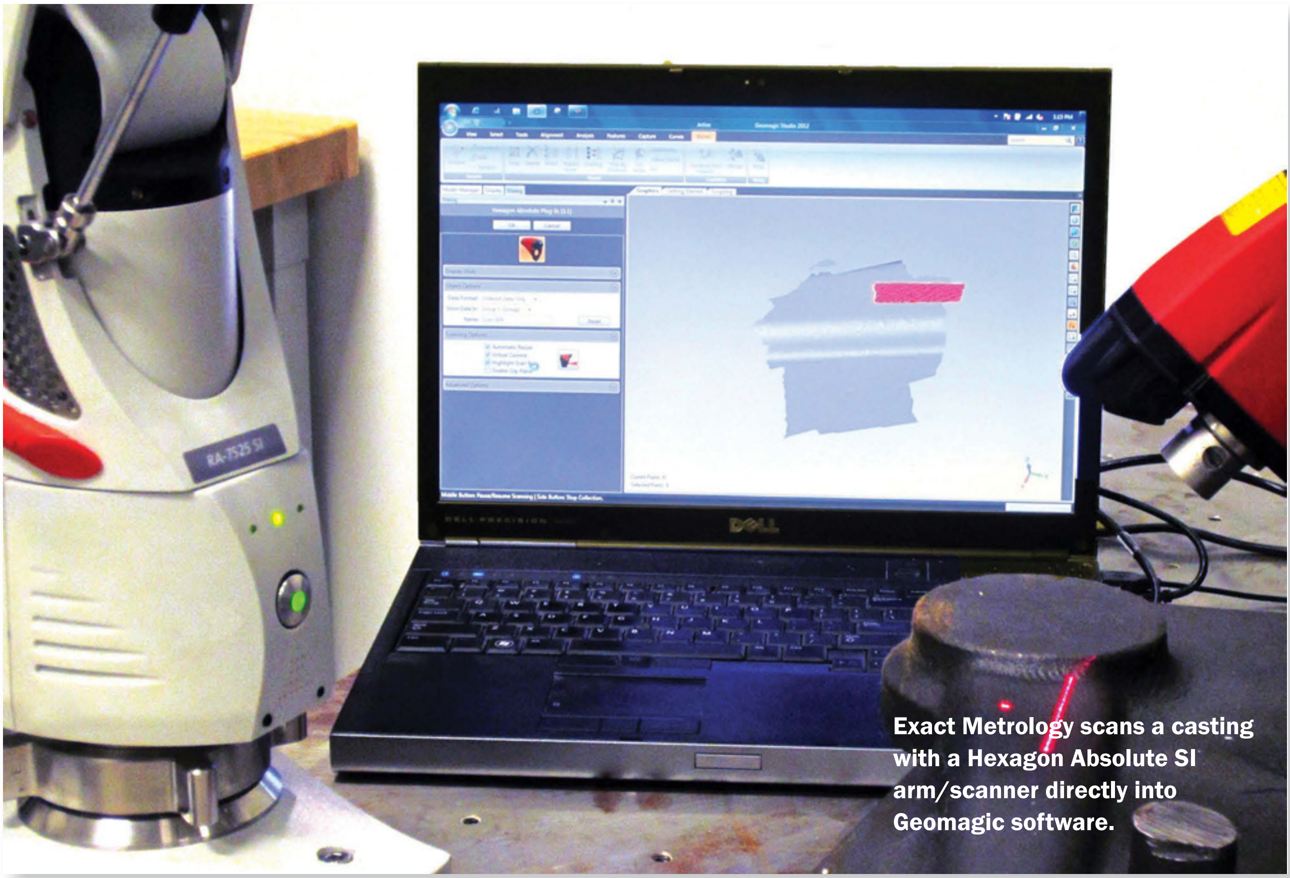
1. Do not under invest in memory — it can reduce your performance by more than 2X.
2. Consider using SSDs — you can more than triple your productivity.
3. Make sure you buy the right graphics card — more than likely your workload will perform the same with either an entry-level or mid-range graphics adapter. DE

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

Heading Toward Truly *Seamless* CAD Integration

As the 3D scanning industry matures, inspecting and creating designs becomes easier.

BY DEBBIE SNIDERMAN



Exact Metrology scans a casting with a Hexagon Absolute SI arm/scanner directly into Geomagic software.

Not so long ago, 3D scanning hardware systems contained proprietary hardware and software packages that made it difficult and time-consuming to integrate the scanned points with CAD software. But over the last five years, as the 3D scanning industry has matured, producers have responded to user needs—and are partnering together to improve integration with CAD packages.

DE spoke with a metrology service provider, a 3D scanning hardware vendor and a bridge software producer to find out more about the concept of seamless integration.

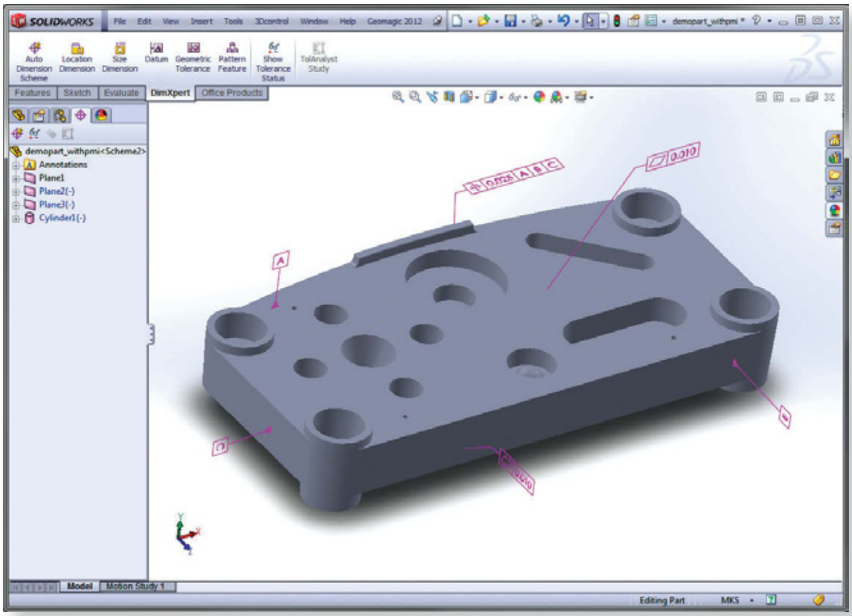
Better Bridge Software

The majority of Exact Metrology's service business is scanning parts and creating CAD models for overloaded customers. Some send 3D scan data from X-ray or computed tomography (CT) scanners, requesting CAD files. The company uses many different scanning and 3D technologies for creating models of small-scale parts—up to buildings or city blocks.

"While scanner manufacturers have their own proprietary software to con-

The Edge ScanArm allows me to quickly scan prototypes for comparison to CAD, so I know they're right.

Plus, with FARO's class-leading customer support, I trust they're behind me every step of the way.



A SolidWorks CAD model ready for export with model-based datums (MBD), product manufacturing information (PMI) or Geometric Dimensions and Tolerances (GD&T) callouts defined.

trol the scanner and collect data, more are getting out of the software business," says Greg Groth, Exact Metrology's Milwaukee service manager. Groth adds that hardware manufacturers are allowing third-party software packages to develop plug-ins to integrate with scanners and control data gathering: "They're taking the attitude of 'we'll handle the hardware and let someone else handle the software.'"

He describes this third-party software as "bridge software," a connection platform to get from Point A (scan data) to Point C (a CAD model). This bridging software is sometimes called digital shape sampling and processing (DSSP) software, point cloud software, or generically, middleware. According to Groth, "It eliminates the need to rely on the software supplied by the hardware manufacturers. It's plug-and-play."

Bridge software can accept data from any 3D scanning capability, whether a few hundred points from a coordinate measuring machine (CMM) or multi-gigabyte data sets from long-range scans. It acts as a filter.

"We haven't found a successful CAD package that can open heavy data sets, so bridging software takes them and uses logical, formula-based filtering to remove unnecessary data, keeping enough data that is still workable," Groth explains.

The software removes redundancies and overlaps in scan data. It also allows you to change the sensitivity or spacing of the points before bringing it into CAD. Instead of importing millions of points that describe a flat surface, you can filter down a lot of that data.

Bridge software also allows you to manipulate the scanned data, removing imperfections or cracks if they aren't desired as part of the CAD model.

"You can remove these in CAD, but not with the accuracy," Groth points out. "Any time you go from 3D data to a parametric CAD surface, you lose some accuracy. This ability is good because in CAD, processing can be data-intense. If your part is 0.75363 in. in the real world and the design is 0.75 in., the software allows you to whittle away the imperfections or correct dimensions that may be off."

Groth says that without bridge software packages, there is no efficient way to get scan data into CAD. They are a necessity because CAD packages can't handle huge data sets.

"It has a CAD-like structure and builds parametric features on top of the 3D data sets," he says. "It converts the millions of points and triangles into a format that can be brought into most CAD platforms. It also provides good rendering points, giving a visual aid before exporting. Before, you hoped that you got everything. Now, it's easy to verify ahead of time."

The process for getting scan data into CAD used to involve three different software packages: scanner software, data processing software and CAD software. Now, it usually only involves two.

"I can plug scanning hardware into bridge software and scan natively inside that program to collect data. It is becoming much faster," Groth says. "Years ago, it could take a week to scan something the size of an automobile, read the data into older bridge software that had limited tools, and create a CAD file. Now, a scanning tech and software tech can scan the same part in a couple hours, and have a workable CAD file by the end of the day. The time savings from better bridge software are huge."

While bridge software transfers data to CAD faster, and the data making it into CAD is getting more accurate, Groth says he believes much more could be done on the CAD side.

"Hopefully the CAD packages will follow suit and begin to accept 3D scan data better," he says. "Unfortunately, we don't see many CAD manufacturers looking into plug-ins for scanning efficiently. 3D scanning has been around for more than 15 years. It's amazing that a minimal amount has changed on the CAD side as far as accepting huge data sets."

Open Hardware for Scan-To-Design Applications

Alex Lucas, business development manager of Nikon Metrology's Scanning Products, agrees that it is becoming easier to gather and process point cloud data for copying a part, building a descriptive database to archive, or for finite element analysis (FEA) customers who want to develop a CAD model.

For workflows that start with a "clean slate," or no model already developed in CAD, Nikon Metrology's application programming interfaces (APIs) allow scanning hardware to accurately and reliably interface with software that can control and fully manage point cloud acquisition. They also allow parameter modification and qualification or calibration routines.

"We used to develop our own software, but it makes more sense to align and partner with those who have spent the time and effort developing this software for the industry," Lucas says. "We've partnered with half-a-dozen third-party software providers who can take point cloud data and generate a CAD model. All of our laser scanners now integrate with third-party software."

As laser scanning has become more popular, he says, there are fewer hardware providers and more software providers.

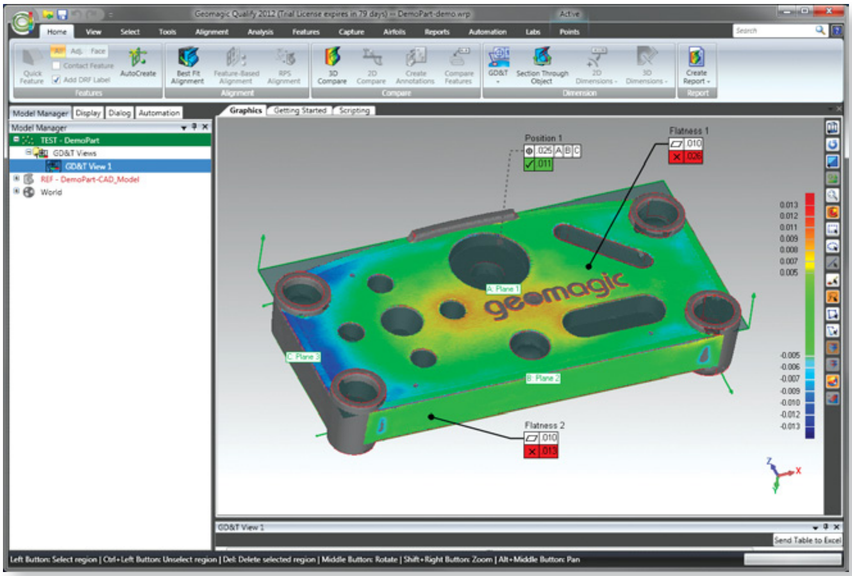
"Five to eight years ago, we wouldn't find any point cloud software packages offering direct links to CAD that were able to output a native file format," he adds. "Now, quite a few software developers offer that ability, so designers can very quickly export their data and apply even greater tools."

Retaining Control During Inspections

On the inspection side, Lucas says, the integration story is different. Inspection workflows involve scanning a manufactured shape and comparing that to an as-designed shape. This process also involves one or two software packages in addition to CAD.

For the scanning step, Lucas says Nikon Metrology prefers that customers use Nikon's own proprietary software, such as the stand-alone FOCUS API, for handheld inspections.

"Part of the point cloud inspection process is dictated by the features and surfaces that a user wants to check," he explains. "Our specialty is controlling the scanners and the entire inspection process, so we want to control what data goes into it by integrating with the data brought in from CAD directly, rather than allow third-party control of that data."



The GD&T callouts from the CAD model are automatically analyzed and reported after being imported.

The next step involves software that accepts user-input scan data, stitches together a 3D model, and compares it against a definition. This could be accomplished with a manufacturer's standalone package or third-party bridge software. Most of the time, 3D geometry or shape data provided into that software comes from a CAD model—but it's not the complete file, and it contains limited "dumb" geometry information without feature, history or product manufacturing information (PMI).

"Even though our software for inspection scanning is proprietary, our hardware provides industry-standard formats for transferring data," Lucas says, offering discrete ASCII x, y and z data in column or .csv format, and polygonal mesh .stl files as examples. "We also output in several proprietary file formats, which may lock a user into a certain software company's file extension."

'Perfect Integration'

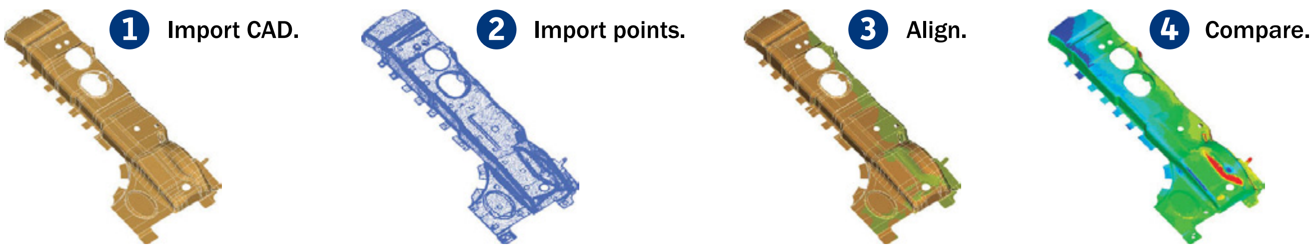
Geomagic is an example of bridge software that is used for both types of scanning applications mentioned above. Kevin Scofield, Geomagic's senior product manager for metrology and modeling applications, says he sees requests to include more information from CAD models during inspections, such as dimensions, freeform geometry-like features, or other metadata that accompanies the geometry.

"In the future, better integration between CAD and portable metrology software, our specialty area, happens with model-based definitions, or MBD," he says. "The world is getting away from defining a model with 2D drawings and paper, and is including everything inside—the geometry, the material, and even information about how it's built.

"Geomagic and our competitors are pushing in the direction of absorbing and using that data now," Scofield continues. "Our charter is to keep up with that pace, and push toward perfect integration. Ideally, a part that is fully defined in CAD will be imported into Geomagic. A user can scan and inspect without having to set up any dimensional parameters. They should be able to read more data from CAD. There's no reason to think that we can't reach this dream scenario. We're striving toward that now."

Scofield maintains that extra data from PMI and MBD will make the inspection process move faster, because users won't have to redo the work.

"Importing expected dimensions when you import the model will save time by getting rid of the need for typing or entering redundant dimen-



The inspection workflow using Nikon Metrology's Proprietary Focus Software involves scanning a part, importing its CAD data and the scanned points, and aligning and comparing the two datasets.

sions on a screen, when the designer has already stored that information with the model," he adds.

Improving Relationships

On the hardware side, Scofield says Geomagic has strategic relationships with more than a dozen major manufacturers of digitizers and scanners that have unlocked their hardware and released APIs to use their software. "Manufacturers often release new hardware devices and versions, so we're constantly keeping up with their latest developments," he says.

On the CAD side, Geomagic licenses third-party CAD importing libraries that allow it to read in and offer native CAD file formats. It builds these libraries into its software. Scofield says Geomagic used to charge as much as $2,500 per CAD importer, but the company has since recognized the value it is adding and now provides them for free.

"There is a lot of upkeep on this end, too, as CAD companies revise their software versions. We're always getting and testing new libraries. Between the hardware companies and the CAD companies, there's a lot to keep our eye on," he says.

Scofield points out that it's rarely asked why CAD programs don't interact directly with hardware, or why software like Geomagic can't work inside of CAD. But he knows the answer.

"Because rendering time and memory requirements are extremely high for millions of discrete points, no one cares to do it. There's more stress handling large files and memory. It doesn't mean that it's not the right thing to do, but it's a reason the big CAD companies haven't done it.

"But that is another possibility for the future," he says. **DE**

Debbie Sniderman *is an engineer, writer and consultant in manufacturing and R&D. Contact her at VIVLLC.com.*

INFO ➜ Exact Metrology: ExactMetrology.com

➜ Geomagic: Geomagic.com/en

➜ Nikon Metrology: NikonMetrology.com

➜ Nikon Metrology Point Cloud Software API: goo.gl/DByc2

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

Striving for *Excel-lence*

How to use Excel to avoid writing code for test instruments.

BY NEIL FORCIER, AGILENT TECHNOLOGIES

When you are working on your bench and you need to create an arbitrary waveform, or you need to post-process measurement data, it usually means you need to write some code or buy a software package. Both these approaches can be costly and time-consuming, however, and can cause your design momentum to evaporate abruptly.

In the benchtop test environment, you often can avoid the interruption by simply combining the capabilities of Microsoft Excel with the easy data transfer capabilities found in modern test-and-measurement instruments, and free test-and-measurement software packages that are readily available. Let's look at some common bench test situations where Excel makes an easy-to-use substitute for writing a custom program or using purchased software.

Most engineers who use Excel view it as a tool for tracking parts, managing design budgets or creating plots of data for test reports. In all these cases, just the general functionality of Excel is used: organizing data in rows and columns, basic arithmetic operations and plotting. But Excel also offers built-in advanced mathematical tools, such as sine and random number functions, as well as the ability to do Fast Fourier transforms (FFTs).

Creating Waveforms and Signals in Excel

Let's start with a common situation: creating an arbitrary waveform and getting it onto an arbitrary waveform generator. For our example, let's say we need to create a quadrature phase-shift-keyed (QPSK) signal for doing a power line communication (PLC) test. For our example PLC signal, we will use a carrier frequency of 135 KHz. The bit rate of the data is 20 Kb/s, and we want the signal to run for 15 ms. If we choose to have 250 points in each carrier frequency cycle, our waveform will consist of 506,250 points. See the equation for a QPSK signal in Figure 1.

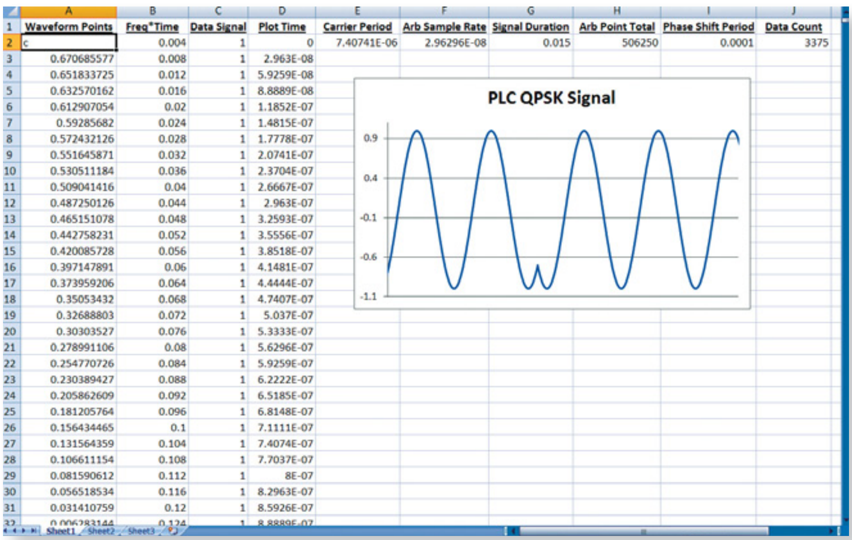
$$s_n(t)=\sqrt{\frac{2E_s}{T_s}}\cos\left(2\pi f_c t+(2n-1)\frac{\pi}{4}\right),\quad n=1,2,3,4.$$

FIGURE 1: QPSK signal equation.

Figure 2 shows the QPSK signal waveform created using Excel. The data points for the finished waveform that we will upload are in column A. The equation used to calculate each data point at A2 is =COS((2*PI()*B2+((2*C2-1)*(PI()/4))), which was entered into Excel's data entry box.

Excel has a library of built-in functions, like cosine and standard deviation. To apply a function or any mathematical operation to a highlighted cell, simply start with an "=" in the data entry box. If you do not know the Excel "command" for the built-in function you want to use, simply press the "fx" button next to the data entry box to search for a specific function.

If you examine the function of the QPSK signal that was typed into Excel's data entry box — =COS((2*PI()*B2+((2*C2-1)*(PI()/4))) — besides the cosine function, numbers, and mathematical operators, you will notice some non-number variables like "PI()," "B2" and "C2." PI() is simply a built-in function that represents the number pi. B2 and C2 are variables



	A	B	C	D	E	F	G	H	I	J
1	Waveform Points	Freq*Time	Data Signal	Plot Time	Carrier Period	Arb Sample Rate	Signal Duration	Arb Point Total	Phase Shift Period	Data Count
2	c	0.004	1	0	7.40741E-06	2.96296E-08	0.015	506250	0.0001	3375
3	0.670685577	0.008	1	2.963E-08						
4	0.651833725	0.012	1	5.9259E-08						
5	0.632570162	0.016	1	8.8889E-08						
6	0.612907054	0.02	1	1.1852E-07						
7	0.59285682	0.024	1	1.4815E-07						
8	0.572432126	0.028	1	1.7778E-07						
9	0.551645871	0.032	1	2.0741E-07						
10	0.530511184	0.036	1	2.3704E-07						
11	0.509041416	0.04	1	2.6667E-07						
12	0.487250126	0.044	1	2.963E-07						
13	0.465151078	0.048	1	3.2593E-07						
14	0.442758231	0.052	1	3.5556E-07						
15	0.420085728	0.056	1	3.8518E-07						
16	0.397147891	0.06	1	4.1481E-07						
17	0.373959206	0.064	1	4.4444E-07						
18	0.35053432	0.068	1	4.7407E-07						
19	0.32688803	0.072	1	5.037E-07						
20	0.30303527	0.076	1	5.3333E-07						
21	0.278991106	0.08	1	5.6296E-07						
22	0.254770726	0.084	1	5.9259E-07						
23	0.230389427	0.088	1	6.2222E-07						
24	0.205862609	0.092	1	6.5185E-07						
25	0.181205764	0.096	1	6.8148E-07						
26	0.156434465	0.1	1	7.1111E-07						
27	0.131564359	0.104	1	7.4074E-07						
28	0.106611154	0.108	1	7.7037E-07						
29	0.081590612	0.112	1	8E-07						
30	0.056518534	0.116	1	8.2963E-07						
31	0.031410759	0.12	1	8.5926E-07						
32	0.006283144	0.124	1	8.8889E-07						

FIGURE 2: QPSK signal in Excel.

representing the number values in those corresponding cells on the spreadsheet. Column B contains the multiple to create a full cycle every 250 points. In column C is the data signal that can take on four different values, 1 through 4; each value represents two bits of data.

To create the timing data in column B, we used a simple formula to increment the value in the proceeding cell by 0.004. To build the baseband data in column C, we used Excel's built-in RANDBETWEEN() function. It allowed us to randomly generate numbers between 1 and 4.

Copy and Paste

Now that you understand how the calculations were made, let's look at how to make more than 500,000 copies of the calculations and data. To move the function that was created for cell A2, to the other cells in the A column, we can simply copy and paste. Excel is smart enough to know that if you use B2 and C2 in a function for A2, and you paste that same function into A126, it will increment the variables to B126 and C126.

Because we are working with a large amount of data, it is not possible to individually paste to each cell or even highlight drag and paste. Excel provides multiple ways to handle large amounts of data. One way to jump to different cells is to type the cell you want selected into the cell box to the left of the data entry box near the top of the Excel window. To select or highlight a large number of cells to paste a function, say, 506,249 times, simply start at A3, press "Select," and then type A506251 in the cell box.

At this point, we are ready to move the QPSK signal waveform to an arbitrary waveform generator. To do this, first save the Excel file (file type .xlsx) to a comma-separated value (CSV) file (file type .csv), which is the file type modern arbs can read. For this example, we used an Agilent 33521A function/arbitrary waveform generator. We put the QPSK CSV file on a memory stick, which we plugged into the 33521A's front-panel USB slot. The QPSK signal waveform was then uploaded and outputted by the 33521A.

A scope screen capture of a portion of the QPSK signal waveform can be seen in Figure 3 on page 28.

Post-processing Data

Let's look at an example of the reverse case, where we want to pull data off a measurement instrument and post-process it in some way for

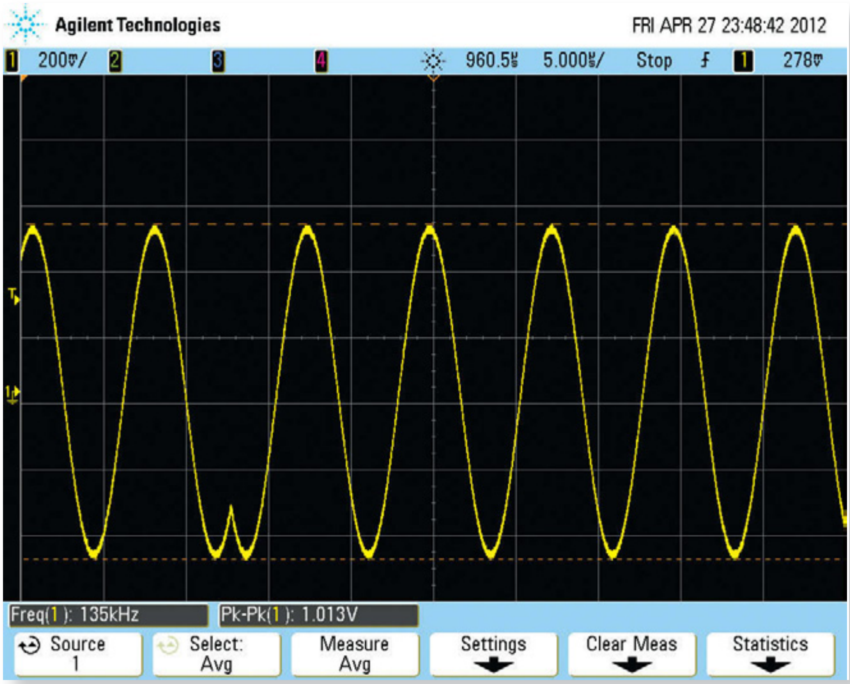


FIGURE 3: QPSK signal created in Excel.

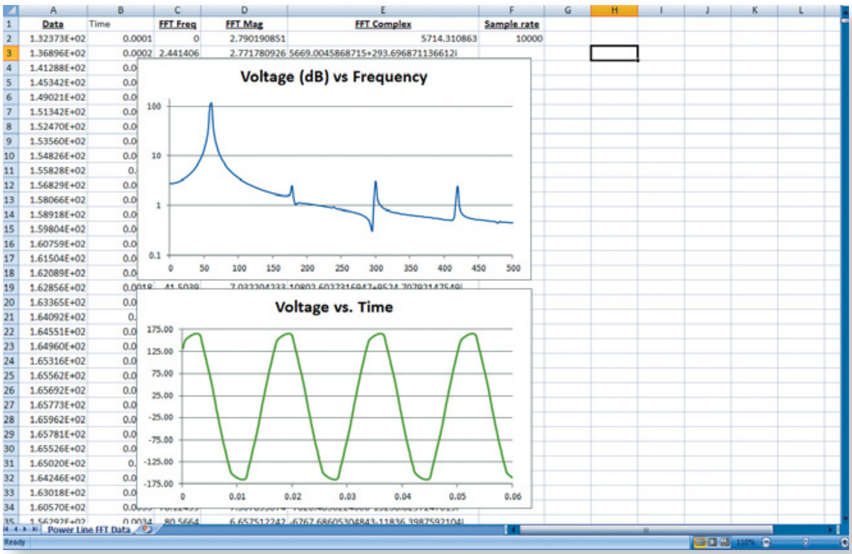


FIGURE 4: Screen shot of Excel FFT.

further analysis. For this example, we want to digitize a 60-Hz power line signal and then perform an FFT to analyze its harmonic distortion.

We used an Agilent 34411A digital multimeter (DMM) for this measurement. The 34411A has a built-in low-frequency digitizer capability—and because it is a DMM, it has high resolution for detailed insight into the measured signal. We made 4,096 measurements on the power line signal at a sample rate of 10 KS/s. To get from the DMM to Excel without any code, we used the 34411A's LXI Web interface. The built-in Web interface allows you to control and fetch readings from the instrument via a Web browser. To transfer the readings from the text field of the Web interface, we copied them and pasted them into Notepad. We then saved the Notepad file as a CSV file and opened it in Excel.

To do the FFT, we used Excel's data analysis tool set, which guides you through performing an FFT on a data set—and also includes various other engineering and statistical tools. For step-by-step instruction on performing an FFT in Excel, simply search the Web for "Excel FFT" and plenty of tutorials will show up. Figure 4 shows the captured power line signal data, with both a frequency-domain plot (using the FFT data) and a time-domain plot.

Create Test Scripts on the Cheap

Free software is available for creating test scripts or sequences in Excel that allow you to connect and control instruments without writing code. For this example, we used a free software package called Command Expert. When you download Command Expert, it creates a plug-in to Excel that allows you to easily build instrument control scripts with, of course, no programming required. Figure 5 shows a screen shot from a script created with Command Expert that connects to a signal analyzer, makes a series of frequency and power measurements based on a user-defined frequency range, and displays the resulting data.

Combing software packages like Command Expert with Excel is a great way to create simple automated tests with no programming and no added cost.

Putting it All Together

In this article, we looked at how you can combine Excel with modern instrument features and free software packages to provide an alternative to time-consuming programming and costly software. We looked at Excel's built-in advanced mathematical and

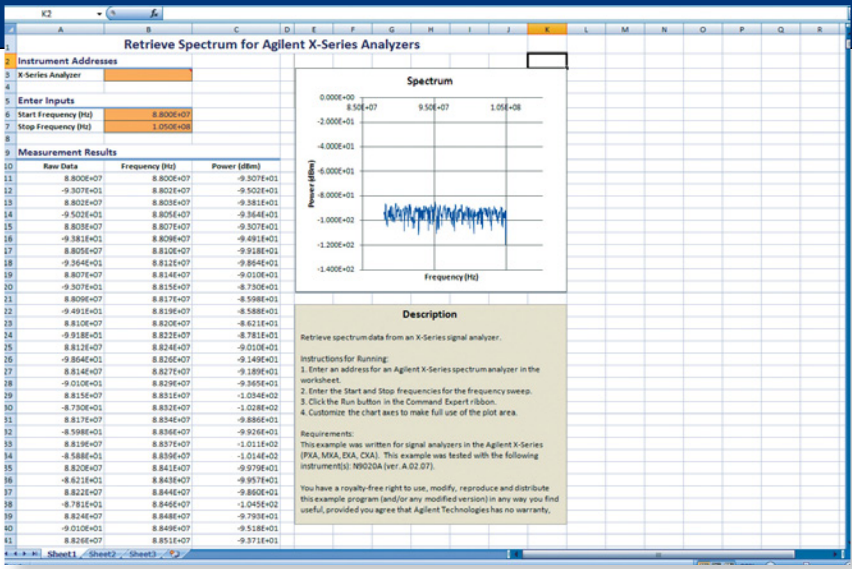


FIGURE 5: Excel test script created with Command Expert.

data analysis tools for processing or post-processing data that we want to push onto an instrument (in the case of the QPSK waveform), or pull from an instrument (in the case of the signal data). Modern instrument features, such as Web interfaces and USB drives, allow us to easily move data between Excel and the instrument. Finally, we looked at how free software packages, like Command Expert, can be used with Excel to create simple automated tests without writing code.

While it's not ideal for every situation, there are a number of applications in the benchtop test environment where using Excel can avoid delays. **DE**

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Template for Efficiency

NI LabVIEW 2012 focuses on user productivity.

BY ANTHONY J. LOCKWOOD

National Instruments unveiled the 2012 version of LabVIEW in August at its annual user event, and I've been poking around trying to learn what LabVIEW 2012 means for you do-bees designing ways to connect signals for measurement, control and embedded systems. It appears that the *modus operandi* behind the new stuff in LabVIEW 2012 boils down to a single, easy-to-grasp idea: Improve your efficiency and productivity while reducing development time and costs.

In broad terms, LabVIEW 2012 sees major enhancements across all of its operation areas, as well as its ecosystem of third-party software and hardware creators, certified developers, system integrators and service partners. Problems with earlier versions reported by users and discovered in-house have been fixed. Overall system stability is said to have been enhanced after the previous releases saw a dramatic decline in corrective action requests.

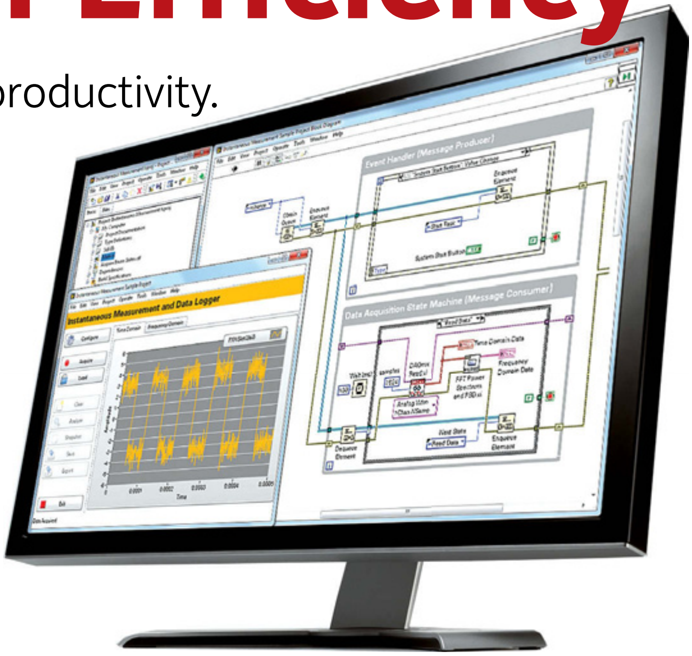
LabVIEW 2012 also incorporates some user-inspired enhancements to the operating environment and for block diagramming. By press time, NI should be introducing an update to its Data Dashboard for LabVIEW, the mobile app for Apple iOS and Android mobile devices for viewing measurement data from NI LabVIEW programs running on a desktop or an embedded system.

Self-paced Training

One of the new major features hitting the limelight with LabVIEW 2012 is self-paced online training. These courses appear to be a boon for old hands learning new tricks or getting a refresher, as well as for tyros just getting up to snuff with LabVIEW.

LabVIEW 2012 already had instructor-based online, regional and on-site training initiatives. The new self-paced training courses are low-cost on-demand sessions, the likes of which were previously only available to holders of certain software service contracts.

As you no doubt figured out, you can access the self-paced online training 24/7. At present, two of the three courses available are for users who are new or almost new to LabVIEW, while the third is for engineers needing to learn best practices for application and project design. Each course has multimedia training modules, interactive quizzes, and exercises and their solutions.



In August, National Instruments introduced the 2012 version of its LabVIEW graphical system design environment during NI Week.

Templates and Sample Projects

Templates and sample projects are intriguing new productivity enhancements making their debut in LabVIEW 2012. The basic idea here is that you can use these features to make sure you design a scalable system that meets your quality requirements—and learn best practices while you're at it.

Templates and sample projects do that by recommending how and where to start designing your system architecture. They come with documentation explaining how their code operates, and they are open source, meaning that you can build new LabVIEW projects with them. The documentation also provides details on best practices for adding or modifying functionality.

Templates represent the elementary building blocks of most LabVIEW applications. Currently, NI offers templates for a simple state machine, a queued message handler, and actor framework. The last is described as an advanced framework for creating LabVIEW applications, with many independent tasks that need to communicate with one another.

Sample projects show you how to use a template in desktop-based measurement applications. They provide many common application needs, such as user interface and dialogs, data logging, and error handling. Among the available sample projects are finite measurement and continuous measurement and logging.

NI also offers sample projects for its LabVIEW Real-Time and LabVIEW FPGA modules for developing embedded control and monitoring systems. Areas of interest here include data communication, network connectivity, control routines and data logging with NI's CompactRIO reconfigurable control/monitoring system and NI's PXI Express data acquisition modules.

Data Management

The biggest enhancements to the technical data management (TDM) technologies in LabVIEW 2012 can be found in the TDM Streaming (TDMS) file format for data storage and DIAdem data processing software. However, from a wider audience point of view, the really big news might be that LabVIEW 2012 also adds new built-in TDMS standard and advanced applications programming interface (API) support for Mac and Linux platforms—a much-requested feature.

TDMS has a new functionality called the LabVIEW External Data Value Reference (EDVR). EDVR lets you access a portion of a driver's DMA (direct memory access) buffer directly. That means you can log data from reconfigurable I/O (RIO)-based hardware directly to disk without any memory copies. I/O throughput can be as high as 3.2 GB/s. New asynchronous I/O palettes are said to improve total memory bandwidth and lessen CPU utilization. All of this makes everything run faster, because it frees your RIO-based hardware to process more data.

The 2012 version of DIAdem for data visualization, analysis and reporting data offers several new built-in engineering functions, ranging from basic math to signal processing. All are intended to make data processing faster and easier. A new Characterize Oscillation function determines the oscillation with the largest amplitude in a signal with different oscillations, while the new Calculate Peaks function determines the minimum or maximum signal values by adjusting a quadratic function sectionwise. Also new is the Differentiate function, which calculates the derivative over a central difference quotient.

FPGA Enhancements

The NI LabVIEW FPGA module lets you develop LabVIEW programs for NI's line reconfigurable I/O hardware. That is, you can create and deploy to the market or the field-customized hardware. NI LabVIEW FPGA 2012 has new features for shortening your development time and improving application performance, such as the templates and sample projects mentioned above, improved testing times, single-precision floating-point support, and a new tool for designing LabVIEW FPGA algorithms.

The trustworthiness of the execution time when testing the logic of an FPGA virtual instrument (VI) on your development PC before you compile it, as compared to its compiled execution time, has been improved with LabVIEW FPGA 2012.

LabVIEW FPGA 2012 now supports single-precision floating-point data types natively. NI reports that this lets you retrieve floating-point data from DMA first in, first out (FIFO) buffers directly, eliminating time-consuming and expensive conversions from fixed-point to floating-point. Boolean, numeric and comparison operations within single-cycle timed loops now support cluster and array data types.

Additional features in LabVIEW FPGA 2012 include the new Register construct, which lets you write lightweight, reusable code for communication between loops executing in parallel; new Linux-based FPGA compilation options; high-throughput math node support for fixed-size array inputs; and improvements to the DMA FIFO and peer-to-peer FIFO that enable you to pack small data size elements into a 64-bit array before sending to a host, which results in higher transfer rates.

New Analysis Tools

Key enhancements to LabVIEW's analysis tools can be found in the LabVIEW Multicore Analysis and Sparse Matrix Toolkit, LabVIEW GPU Analysis Toolkit, and the NI Vision Development Module.

The LabVIEW Multicore Analysis and Sparse Matrix Toolkit now offers more optimal core linear algebra and Fast Fourier transform (FFT) algorithms based on the multithreading capabilities of the Intel Math Kernel Library (MKL) on Windows platforms. More linear algebra functions that leverage the sequential Intel MKL are now available for LabVIEW Real-Time (ETS) systems. The toolkit also has new classes, VIs and graphs for working with real and complex sparse matrices on both Windows and LabVIEW Real-Time (ETS) targets. All of the toolkit's new libraries operate on both double- and single-precision floating-point data.

The LabVIEW graphics processing unit (GPU) Analysis Toolkit establishes communications between LabVIEW desktop applications and NVIDIA compute unified device architecture (CUDA) GPU hardware. With it, you can execute a set of signal processing and linear algebra functions on the GPU, or call your own GPU applications from LabVIEW.

NI LabVIEW 2012's Vision Development Module now provides binocular stereoscopic vision functions. This means that you can extract and take advantage of 3D information in LabVIEW applications.

Something for Everyone

Ideas seem to fly out of National Instruments like streamers from a Tesla coil. With all the new features and improvements, NI LabVIEW 2012 surely has something to spark the interest of any engineer designing and deploying measurement and control systems.

NI LabVIEW 2012 runs on Linux, Mac and Windows platforms. Pricing begins at $1,249. **DE**

Anthony J. Lockwood *is Editor-at-Large for* Desktop Engineering. *He may be contacted via de-editors@deskeng.com.*

INFO → LabVIEW 2012 Product Page:
NI.com/labview/whatsnew

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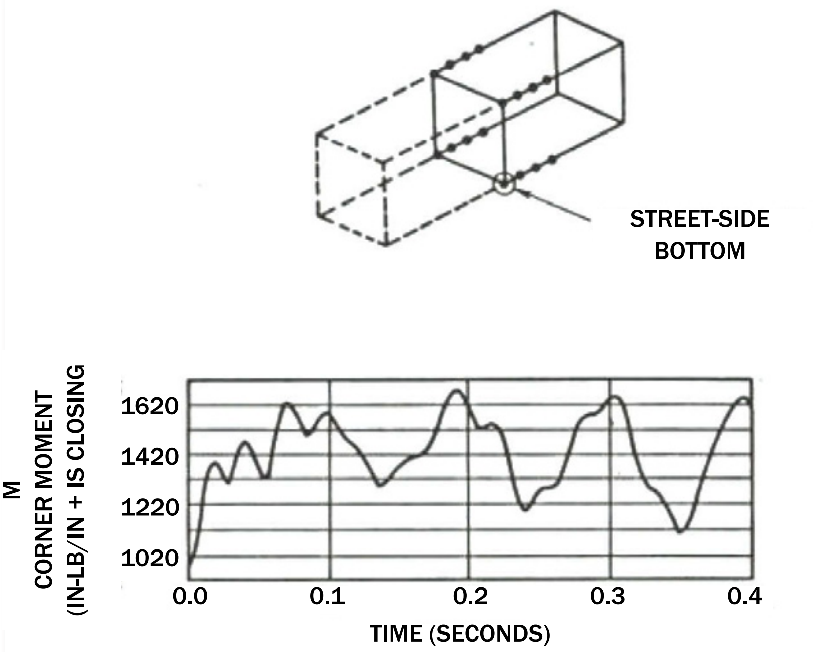
Physical Testing is *Still* Vitally Important

While simulation has an increasingly large role, real-world tests at the right points can save time and money—while minimizing problems.

BY BILL SCHWEBER



When validating a military command, control, communications and intelligence system shelter design for nuclear blast survivability, testing proved the corner welds would remain intact at their weakest point on the long side of the shelter.

Today's advanced simulation capabilities can eliminate the need for many physical tests. But they can also lead to overconfidence and grossly incorrect results, which add to cost, schedule and performance issues.

This is not a new situation; it's really an updated embodiment of the "garbage in, garbage out" (GIGO) software principle. The numerical precision for which computers and algorithms are so well suited is not a substitute for verifying critical assumptions and parameter values of the simulation, and in fact, such precision can induce false confidence and unpleasant surprises. Looking at it another way, it's like having 10 significant figures on your results, although your raw experimental data was only accurate to two digits.

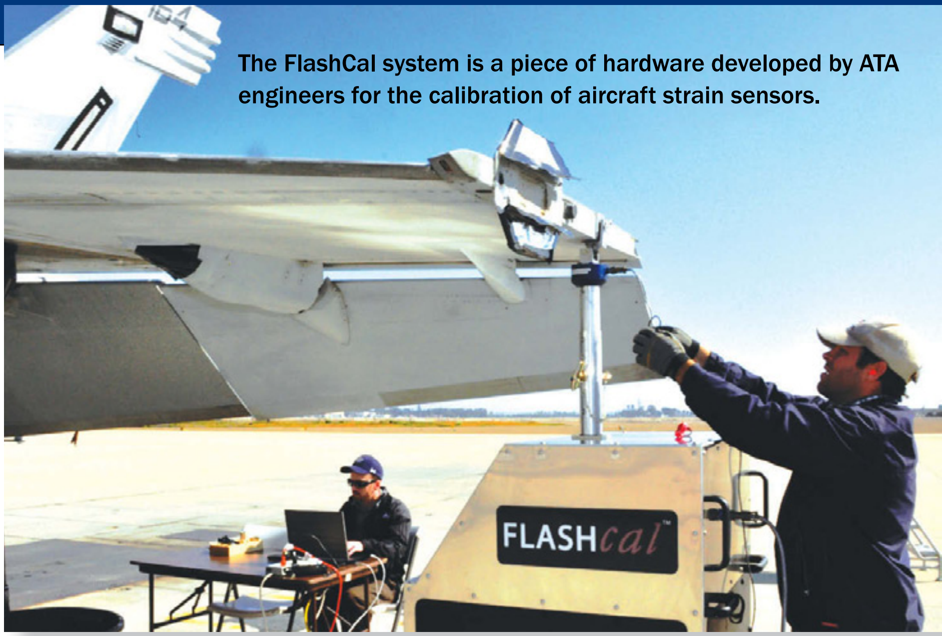
What's driving the emphasis on simulation? The obvious answers are cost and time, along with design complexity. Clearly, a properly structured, well-executed simulation can enhance those critical aspects of success, while allowing exploration of "what if?" design variations and tolerance assessment.

Organizations such as NASA have put an extreme emphasis on simulation in place of test, because the challenges of system-level test are so formidable, while the quality of the simulations has improved dramatically, notes Dr. Mary Baker, president and technical director at ATA Engineering Inc., San Diego. She maintains there's a mindset asking, even demanding, "can we save some money by avoiding those test costs?"

Even in the earliest stages of your design process, don't assume there is nothing yet to be tested. You may have a previous product that you are using as a starting point for an improved, next-generation design. Perhaps there are material samples, configurations or partial prototypes that you need to characterize more fully before you start on what may be a wrong path.

Driving Better Design

There's a downside to placing too much reliance on design by analysis and simulation, without the right injections of

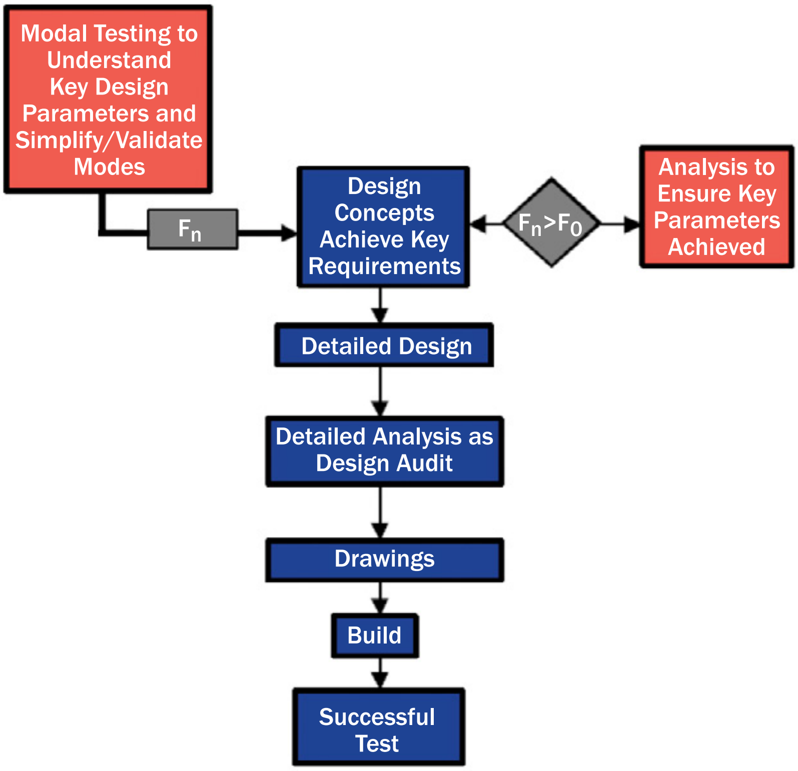


The FlashCal system is a piece of hardware developed by ATA engineers for the calibration of aircraft strain sensors.

design by test at critical junctions in the program. Every analysis and associated simulation incorporates many assumptions about system parameters and dynamics. Some of these assumptions are fairly solid, and come with a high level of confidence. But many others may be well intentioned but wrong, or little more than sophisticated guesses.

Of course, it's one thing if you are doing analysis and simulation on well-known and fully characterized materials and designs, such as metal structural elements and conventional joints, whose properties and attributes are long-established and understood. It's a very different situation when you venture into new areas such as components and complex joints made of composite materials or joining composites and metals.

For example, Baker cites a damping factor in a rocket design, where unavoidable lift-off and launch vibrations could have combined with insufficient damping and led to catastrophic failure. One area of concern was a joint composed of advanced composite materials. Based on initial analysis and designer experience, the predicted damping was around 1.5%, while the ATA team said that at least 2.5% was needed for this design. Before continuing with the simulation, the ATA team set up a test for this joint



By testing specific areas of uncertainty first, you can direct component-design specifications toward outcomes with a higher likelihood of success. In this example of satellite testing on a shake-table, Fn = Shaker system's lowest natural frequency; Fo= Satellite target mode frequencies.

alone, which showed the actual damping was 0.2%, an order of magnitude less than what was needed.

Even in the case of standard materials, it may be necessary to set up localized, specific tests to ensure the design's critical points. Baker gives the example of a military command, control, communications and intelligence (C3I) system shelter, designed to be deployed via truck, ship or airdropped into service. It also had to withstand the overpressure of a nuclear blast. The concern was whether the structure, built of standard materials, could survive the transport, delivery and blast conditions.

Not only was relevant blast-related test data inadequate, but setting up a full test to prove overall performance was obviously impractical under any sort of realistic cost and time budget. The major points of uncertainty were the complex joints of the corner welds: One analysis showed they would crack, another pointed to the opposite conclusion; but all these analyses were admittedly burdened by severe modeling uncertainties of the assembly of aluminum skin panels, corner extrusions, welds and rivets. Any weld failure would have mechanical consequences, of course, but also degrade the shelter's electromagnetic interference (EMI) integrity and electronic performance.

Designers were fairly confident that the greatest stress and resultant corner mo-

Targeting the Cost of Testing a Design

You hear it over and over: Simulation saves money, and doing design by analysis and simulation is cheaper and quicker than doing it via developmental tests.

Well, yes and no. Certainly, for some project areas, such as in aerospace, testing is a major undertaking. But as simulation advances in capabilities and corresponding expectations, and increasingly employs multiphysics to combine disciplines into one overall model (electrical, mechanical and thermal aspects, for example), the cost and time of such analytical cycles and runs increases as well.

Further, the model is charged with integrating so many functions and roles that it can become unwieldy in construction, degrees of freedom, and implementation. At the same time, such models embed a large number of assumptions, all of which will have a ripple effect as they propagate through the simulation.

That's why a carefully targeted developmental test can be a vital part of the design, simulation and modeling process. It can both simplify some aspects of the model—replacing complex equations with simplified ones or actual data—and it can reduce the uncertainties that accompany many assumptions, thus increasing overall level of confidence.

ments would be at the corner welds along the mid-span of the long side of the shelter (see Fig. 1). The solution was to build a test fixture representing the corner welds alone, a process that took just three days. Tests and data confirmed (via penetrating dye and other techniques) that the corner welds would remain intact. With this information, the shelter design team could proceed with confidence with the remainder of the analysis and simulation.

Tests can also drive design in the right direction. In another case described by Baker, an improved shake-table test fixture was needed so that both modal and qualification testing could be combined for a satellite, to reduce overall test time (see "Shaken, Not Stirred," page 36).

Can We Talk?

It's important for the analysis and test teams to talk early and often. While this may seem obvious, Baker notes than in many companies, they are actually separate and isolated groups. As a result, the analysis group may not cite the areas where they are making assumptions for which they do not have a firm basis or high confidence. In contrast, when there is team overlap and integration, the test engineers can question assumptions early in the cycle—and also suggest specific, limited-scope tests to verify these assumptions, or provide better data so the simulation can continue with a higher degree of confidence.

The role of test is not to replace simulation, but to support it. In fact, Baker says it's a recursive process, where the project goes from analysis to test, back to analysis, and even back to test as needed. She also points out that it is critical to get testing to happen sooner in the cycle, before it costs too much to set up or to correct problems.

Test is not just a blind trial-and-error experiment; you focus it to understand what you are doing. In crude terms, you build it, and then try to break it. Doing this will validate your underlying assumptions for critical points of the design and inflection points in the project timeline, where the impact of changes rapidly escalates once you cross those points and start filling your bill of materials (BOM), ordering long-lead items, and committing to tooling, documentation, fixtures and more.

Get the tests to happen sooner, when they don't cost too much, and you'll minimize the need for tests at the end of the project, when it's too late and very costly to change the design approach. That final test should be for approval and sign-off, not for developing additional insight into the design's real parameters and characteristics. It makes more sense to test at points where incorrect assumptions, subtle

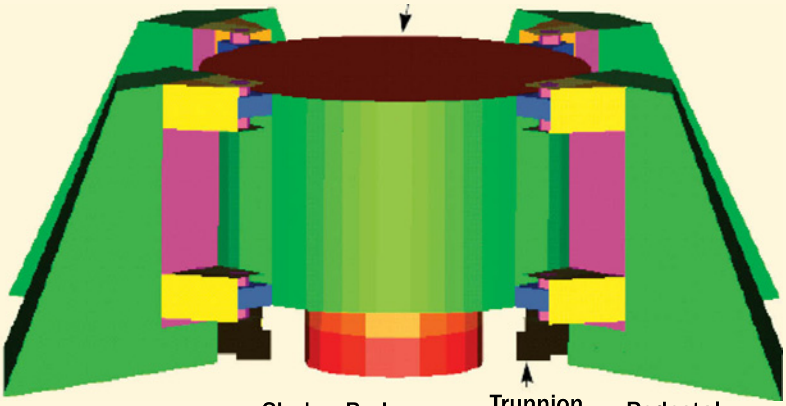
Shaken, Not Stirred

To properly evaluate the satellite in a combined modal and qualification test, the first natural frequency of the shake table (shaker) must be higher than the target-mode natural frequencies of the satellite itself. In addition, the shaker's cross-axis coupling and need for uniform excitation level dictate a very light, yet stiff shaker structure.

The standard approach of design, analyze, build and test would eventually work, but likely require many iterations. At the same time, using this procedure may have other negative consequences. Developing the detailed finite element analysis (FEA) models takes time, which is counter to investigating design change and larger innovations.

Rather than begin the new design, in this application, engineers first did a modal test on the existing system, and a simple FEA model to represent the dynamics of the primary modes. The test verified the simple model, and the results were used to direct the new design by providing bearing stiffness data that was hard to predict by analytical means alone. Fig. 2 on page 34 shows this design approach, which differs from the usual design/test/redesign approach.

The tests also showed that the head expander of the shaker controlled the lowest natural frequency and cross-axis coupling. As a consequence, designers realized that this head expander would need a high stiffness-to mass ratio. To achieve this, they used a magnesium weldment, which allows the head expander to move vertically via eight bearings (see image above). The outsides of the bearings, in turn, are supported by steel "pedestals" for stiffness, but because these pedestals are static and not part of the moving structure, their weight is not a concern.



Testing and analysis of the shaker design showed that an innovative head expander would produce a high stiffness-to-mass ratio.

unknowns, and perhaps an excess of sophisticated guesswork will have major negative consequences, as the test results can be used to refine and enhance the simulation-centered analysis.

While simulation can provide overall performance verification, a well defined and focused, properly constructed physical test has its own virtues. In blunt terms, test provides more credibility than analysis alone.

"For almost any complex design, analysis may appear to be less costly than test, but test has much more credibility," Baker points out. "Strategic test is well worth the cost." DE

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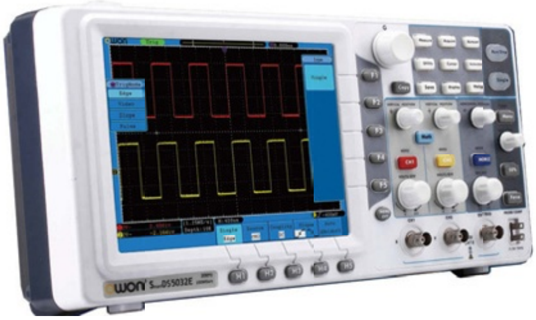

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1 New 30MHz Oscilloscope

Saelig's (saelig.com) SDS5032E two-channel oscilloscope includes external and video-capable triggering, auto-measurements, auto-scaling, an 8-in. high-resolution full color LCD, XY mode, auto-set, averaging, math functions, USB output, waveform storage, pass/fail output, and a 3-year warranty. FFT functionality is included for frequency spectrum display, in addition to a built-in six-digit frequency meter, which can measure frequencies from 2Hz to 30MHz.

New Multi-Model Simulation Platform can be used for HiL

IFP Energies Nouvelles (ifpenergiesnouvelles.fr) and D2T Powertrain Engineering (d2t.com) have launched xMOD, a new model integration software platform. The product allows models from different tools to work together in a single environment. It can be used with Hardware in the Loop (HiL) test benches for engine control units (ECUs) and, for some components, on engine or powertrain test benches.

2 Compact Non-Contact IR Temperature Transmitter

Omega's (omega.com) new OS151-USB series of non-contact infrared temperature transmitters features max, min, average and instantaneous readings; peak or valley hold; reflected energy compensation; OPC server capabilities; and a response time 240 mS to 90%. The 4 to 20 mA output is compatible with most indicators, controllers, recorders, data loggers, etc., without the need for special interfacing or signal conditioning.

NI TestStand 2012 Increases Automated Test Throughput

National Instruments' (ni.com) NI TestStand 2012 automated test management software has a new modular process architecture. It features asynchronous result processing, which makes it possible to continue testing devices while simultaneously generating reports or data logging; a plug-in architecture that facilitates advanced customizations, including multiple report formats, with minimal code changes; and features that reduce development time.

3 SMART Position Sensor, Rotary Configuration

Honeywell (honeywell.com) has a new addition to its SMART position sensor portfolio with the Rotary Configuration that provides 360°, non-contact angular position sensing. According to the company, the new sensor is durable, accurate, and cost-effective, enabling design engineers to replace an optical encoder, or to use a sensor instead of a resolver.

Piezoelectric Force Sensors and Accelerometers

Kistler's (kistler.com) three-component force sensors and piezoelectric accelerometers are designed to meet the demands of satellite and spacecraft force limited vibration testing (FLV). To simulate in-flight conditions, FLV uses a slip table for structural excitation; a dynamometer to measure slip-table-to-payload interface forces; and piezoelectric accelerometers to measure the input vibration levels used for shaker control.

4 PXI Vector Signal Generator

Agilent Technologies' (agilent.com) M9381A is a 1-MHz to 3- or 6-GHz VSG in a PXI form factor that combines fast switching and RF parametric performance, high output power, linearity and improved level accuracy, adjacent channel power ratio performance and wide modulation bandwidth for testing RF devices. DE

A New Era for **PLM**

Product lifecycle management braces for expected impacts as users embrace social business collaboration.

BY PETER A. BILELLO

Three powerful trends are converging in the digital enterprise: the "consumerization" of information technology (IT); the availability of massive amounts of information on mobile devices; and social media-savvy newcomers entering the workforce.

This convergence is forcing companies to implement new product lifecycle management (PLM)-related business processes and technologies that allow and enable social business collaboration. Ultimately, these trends will profoundly affect the ways we work, and even the way we live.

Collaboration will be changed forever, and much to the good. This upheaval has profound implications for PLM.

At the heart of social business collaboration is an explosion—the nearly universal adoption of social media by those who recently started their careers. These workers are often referred to as the "millennials" or Generation Y—roughly speaking, those born since 1983.

Gen-Y, now hiring in or achieving their first promotions, view the world around themselves differently from their predecessors. For Gen-Y, "work" is an impatient blend of information gathering and bottom-up decision-making. All their lives, they have dwelled in a digital world that is always on, always connected. They demand to be able to work—to connect—from anywhere, anytime.

Right before our eyes, social business collaboration is revolutionizing the digital notion of top-down management of information, which until now has stood the test of time. Here's a quick look at why this is changing:

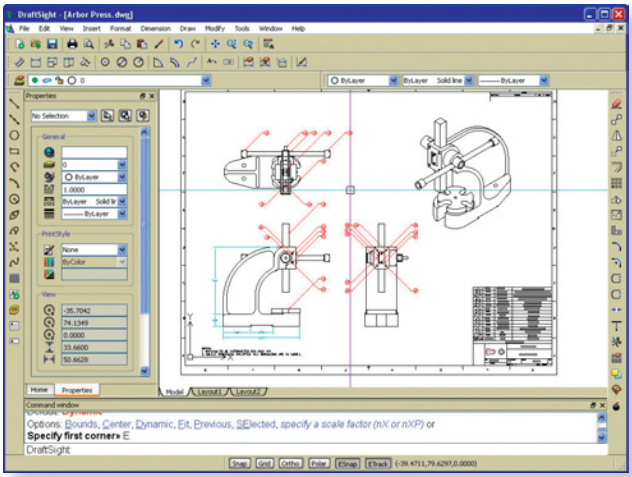
- **Top-down—**For decades, the accepted structure, hierarchy and architecture of information have been top-down. Tech-savvy Gen-Ys are frustrated by top-down, and sometimes rigid, information structures. These structures are a legacy of the post-World War II Baby Boom generation, which accounts for most of today's senior managers.
- **Management—**The management of information is no longer the exclusive prerogative of IT departments. In parts of some enterprises, the accustomed authority over information flows, contents and formats is already slipping away. Because of the overwhelming impact of social media, day-to-day control is migrating to those who understand it best.
- **Information—**Big Data and the so-called data tsunami have been exhaustively analyzed. Information volumes grow at never-before-seen rates. Volumes double every few years, and even the best analyses are hard pressed to keep up. That is one reason why there are so few meaningful numbers about Big Data.

The ENOVIA Collaborative Innovation community is a place to interact and collaborate with ENOVIA users and members of teams with resources dedicated to the project.

Information challenges also include variety, velocity and variability. New formats seem to appear daily. Gigabit speeds require faster, more powerful processors. Growing bandwidth means more online content, especially video and computer simulations.

As for variability, in the digital world, nothing has ever stayed the same for long. The once-ubiquitous MS-DOS and floppy drives are long gone, and CDs are becoming scarce. Paul Ottellini, president and CEO of silicon powerhouse Intel Corp., Santa Clara, CA, regards devices like personal computers as "form factors," a milepost on the move "from the era of the personal computer to the era of personal computing."

It often goes unremarked that volume, variety, velocity and variability reinforce one another, which makes it easy to underestimate the looming impact of social busi-



Mechanical assembly drawing of an arbor press in Dassault Systèmes DraftSight.

ness collaboration. The word "dynamic" cannot begin to describe what is happening, as social media collaboration becomes the new baseline of PLM.

Putting New Technologies to Work

Social business collaboration puts these technologies to work for the millennials now—and soon for the rest of us. This is most apparent in the consumerization of IT, which is the nearly universal availability of information on wireless mobile devices such as tablets and smartphones. These devices and the skill with which today's workforce newcomers wield them are changing the ways workers collaborate—profoundly and in ways that are not yet predictable.

The importance of wireless and mobile are hard to overstate. According to Juniper Research in Basingstoke, England, "the current total of 150 million employee-owned devices now being deployed in enterprises will balloon to 350 million by 2014. And that's not even counting the hybrid tablet/smartphone devices that are on the horizon."

This is Bring Your Own Device (BYOD): BlackBerrys, iPhones, various Android devices and iPads connect to Facebook, YouTube, Twitter, Salesforce, etc., as well as an increasing number of everyday product development and associated supporting applications.

In manufacturing enterprises, the convergence of these three trends is already obvious. Ramifications are being felt by users and PLM solution providers, from the biggest Fortune 500 corporations all the way down the size scale to mom-and-pop businesses.

IT departments are affected in countless ways. Longstanding relationships among IT, product-development and lifecycle management—as well as the ways they share information—are dramatically changing, thanks to the emergence of social business collaboration.

Social business collaboration is becoming the cartilage and central nervous system of the extended enterprise. This is because PLM, and the data and processes enabled within those solutions, touch every part of the extended enterprise.

"The uncomfortable reality for IT and business executives," wrote industry analyst Galen Gruman in a January article for InfoWorld.com, "is that most are operating in a fool's paradise when it comes to the [IT] consumerization trend."

Getting Down to Business

Established PLM solution providers—systems integrators, consultants, software developers and others—are catching on, and quickly catching up. Examples include Teamcenter Community from Siemens PLM Software; StreamWork and CubeTree from SAP for "ideation," collaboration and community management; Windchill SocialLink from PTC; Oracle's Agile PLM links to YouTube Channels; and ENOVIA SwYm ("See what You mean") and the DraftSight community, both from Dassault Systèmes.

Some or most of their connectivity comes from Microsoft SharePoint, IBM's Lotus Quickr, Microsoft Office, Novell's GroupWise, Facebook Business Pages, LinkedIn, WebEx, GoToMeeting, and YouTube. Google' Drive is another good examples of simple social collaboration enablers.

Newcomers to PLM are offering tools such as online business-application suites that enable social business collaboration's flexibility, transparency and interactivity. This group includes newcomers such as Nuage, with its Café platform for document management within social business media environments; the Vuuch collaborative product development network that connects company communities, project teams and industry forums; and others such as Atlassian, Box, Huddle, Mzinga, Quirky, Telligent and Tasktop.

All of these software developers offer mobile, online/cloud-based social media interaction with add-on capabilities for real-time collaboration. All of this enhances PLM as a strategic business approach.

PLM itself is a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise. It spans from product concept to end-of-life (EOL)—integrating people, processes, business systems and information.

INFO ➜ **Atlassian:** Atlassian.com
- ➜ **Box:** Box.com
- ➜ **CIM Data:** CIMdata.com
- ➜ **Dassault Systèmes:** 3DS.com
- ➜ **Facebook:** Facebook.com
- ➜ **Google:** Google.com
- ➜ **GoToMeeting:** GoToMeeting.com
- ➜ **Huddle:** Huddle.com
- ➜ **IBM:** IBM.com
- ➜ **Intel Corp.:** Intel.com
- ➜ **LinkedIn:** LinkedIn.com
- ➜ **Microsoft:** Microsoft.com
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- ➜ **Nuage:** Go-Nuage.com
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- ➜ **Quirky:** Quirky.com
- ➜ **Salesforce:** Salesforce.com
- ➜ **SAP:** SAP.com
- ➜ **Siemens PLM Software:** PLM.automation.siemens.com
- ➜ **Tasktop:** Tasktop.com
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- ➜ **Vuuch:** Vuuch.com
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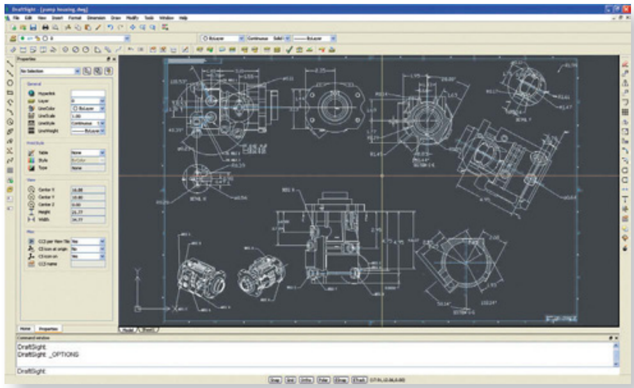


Mechanical detail drawing of a pump housing in DraftSight, which has an online collaboration community.

PLM forms the product information backbone for a company and its extended enterprise.

Whether bolt-on or third-party, this myriad of PLM enhancements includes analytics, smoother integration among users of dissimilar applications, file sharing, video conferencing and online meetings. Also emerging are tracking and management of cumbersome tasks such as requirements, open issues, documents, configurations and workflows. All of this is rapidly evolving.

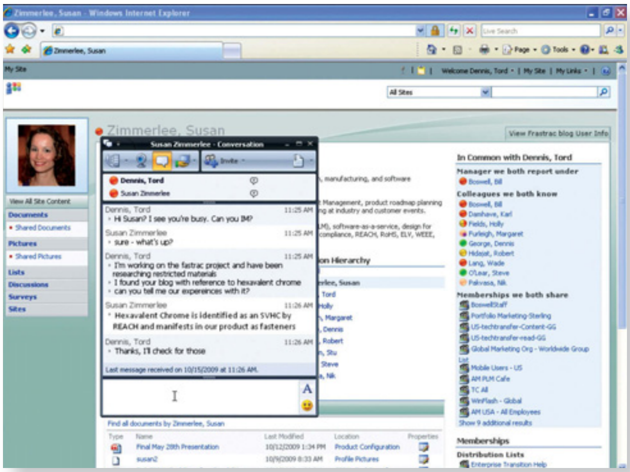
Traditionally, these tasks have been managed with e-mail; interoperability among CAD systems such as IGES and STEP; FTP; and, of course, the telephone. But compared with social media collaboration, these older technologies are costly and complex.

PLM solution providers have common goals in social business collaboration. They want to give PLM users the same extraordinary experience that product developers strive to give their customers. Specific PLM capabilities aside, all three groups are striving to see that PLM makes the development of new products straightforward, more intuitive, and eventually more transparent. Ultimately, engineers, technicians and managers will spend less time searching for information, for support, on managing information, and more time on the projects and decisions for which they are paid.

Regardless of strategy specifics, user interface looks-and-feels, and functionality details, PLM is rapidly gaining new capabilities. These include:

- Rapid identification of individuals who can help with specific tasks.
- Support for the free flow of ideas in an open environment.
- Always available, always on, always connected, anywhere, and at any time, on individual personal mobile devices.
- Intuitive, natural and personal forms—flexible, ad hoc—that empower Gen-Y.
- Balancing data access and corporate security without interfering with any of the above.

The benefits of such an approach in the PLM context are significant. Everyone in the organization, not just Gen-Y new



Teamcenter for community collaboration leverages familiar capabilities from Microsoft Office such as Presence, Instant Messaging and My Site (Sharepoint) to make corporate social networking personal, timely and productive.

hires, will be better connected to the individuals and data that they need—when they need it, in the form needed. This type of connectivity was long ago proven to speed decision-making, improve the processes, enhance product quality, shorten time to market, and increase organizational efficiencies.

Connecting the Dots

Social business collaboration goes far beyond overhauling user interfaces. For PLM solution providers as well as for their customers, the essentials include dedicated investments in facilities, equipment, processes and people; systematic, purpose-driven efforts by everyone in the extended enterprise to share knowledge; and building relationships of trust everywhere.

This becomes, then, a very big job. Collaboration in new-product design has always included choosing materials, analyzing designs, locating resources and allocating them, gearing up supply chains, developing and simulating myriad production systems, and establishing launch schedules. Add to that the drawing up of bills of materials (BOMs), determining warranty coverage/out-of-warranty service, refining the logistics in-bound supply chains and out-bound distribution networks, supporting sales teams, keeping business partners in sync, ensuring that marketing is effective, and protecting the intellectual property/assets, with sometimes hundreds of patent applications.

With the widespread use of "intelligent" electro-mechanical devices (mechatronics), new-product engineering also includes the coding of embedded software, writing control algorithms and debugging them. That has meant inserting new decision points and "phase gates" into traditional product-development processes. Moreover, product development encompasses regulatory approvals, ongoing compliance verification, and the EOL challenges—ecologically sustainable recycling and environmentally safe disposal of anything that remains.

The point of this recitation is to make clear how many steps and processes are involved. Simply stating "all of them" makes it too easy to gloss over the challenges, and miss the opportunities. This is also why truly connecting the dots is nearly impossible, except for very short periods of time, with informational snapshots that quickly outdate.

Social media collaboration is here to stay, despite the potential for information overloads. Without it, many new products would never reach today's global marketplace. The power, so to speak, of social business collaboration is that it can help generate better products in less time, get those products to markets and showrooms at lower cost, and manage them better throughout their lifecycles.

Good solutions are emerging, and even better ones are in development. Ultimately, social business collaboration will become part of the users' lives on and off the job. Meanwhile, new-product development is being recapitalized intellectually, and this new leverage is already transforming PLM. Laggard adopters will struggle to keep up, and some may find themselves leveraged out of the marketplace entirely. **DE**

Peter Bilello *is president of CIMdata. Send e-mail about this article to DE-Editors@deskeng.com.*

NURBS Modeling *with Feature History*

Altair Engineering's SolidThinking Evolve 9.0 enables simulation-driven design.

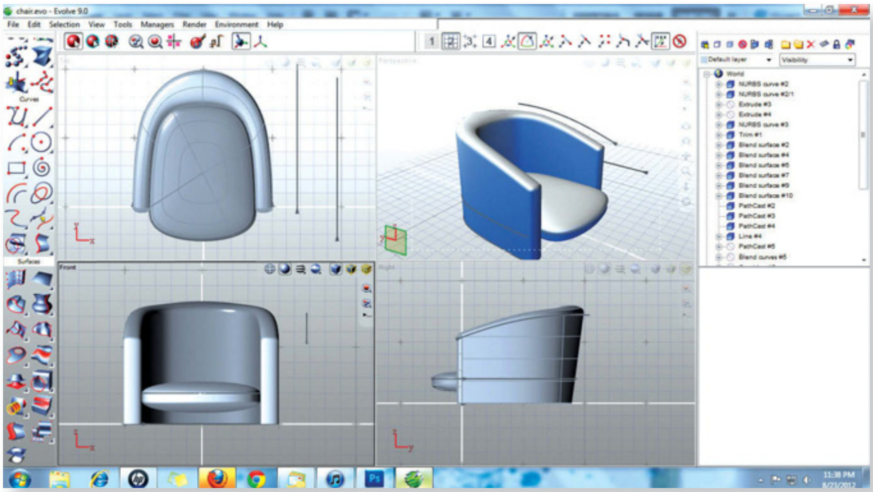
BY KENNETH WONG

***Author's Note:** A review of SolidThinking Inspire 9.0 is set to appear in a future issue. For a video demonstration of Evolve, go to deskeng.com/virtual_desktop/?p=6034.*

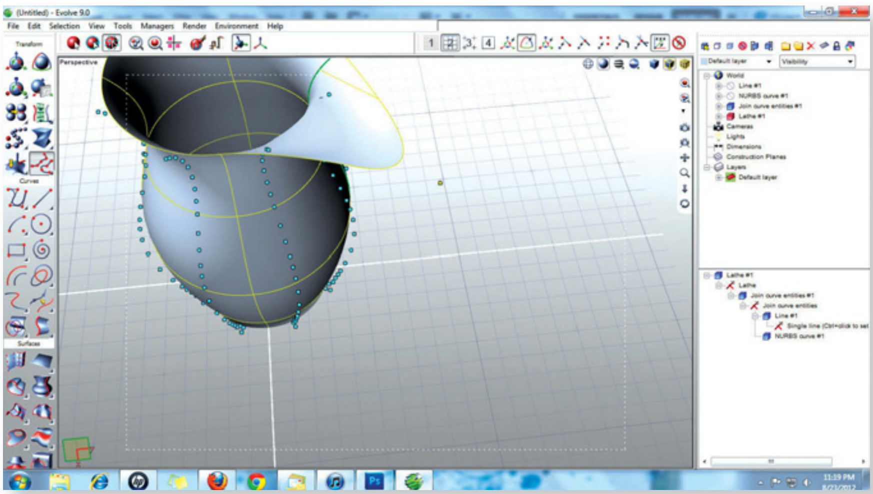
Traditionally, engineering and design firms use digital simulation to verify and test their designs after the fact. By contrast, Altair Engineering, the company behind SolidThinking, and a few others believe simulation should be the guiding force even in early phases, in concept development. In what Altair calls "simulation-driven design," idea exploration and geometry refinement go hand in hand: You sketch out an idea in 3D; you test its strength and function in simulation; you modify the design based on simulation results; then you test again.

Iterative process, by its very nature, demands swift, frequent changes to the design. This approach is often hampered by classic feature-based CAD modelers, which could be unforgiving if you attempt geometry changes that conflict with the steps you've taken to construct your design.

Altair's solution to this stumbling block is its own non-uniform rational basis spline (NURBS) modeler, SolidThinking Evolve. With a rich set of modeling tools to construct simple and complex surfaces, the software gives you a chance to break out of the mold of feature-based CAD. Because you work with spline



The four-view setup in SolidThinking Evolve offers a way to observe your design changes and its effects from multiple perspectives.



By pulling and pushing on spline control points, you edit the underlying curve and the associated geometry (in this case, the volume of the vase). The windows in the far right offers the content of your scene (far right, top); and the historical steps involved in creating a feature (far right, bottom).

curves in SolidThinking, you can get the flowing, swirly profiles not easily attainable in mechanical CAD programs. Perhaps most important, the software gives you a record of the steps you've taken to build your NURBS objects, so if you need to retrace your feature history for subsequent changes, you can.

SolidThinking comes in two variations: SolidThinking Evolve, the modeling program; and SolidThinking Inspire, the simulation and optimization program. The latter is intended to help you identify the best shape, or the optimal form, that can satisfy your design requirements (pressure, stress, load and other anticipated conditions). Together, SolidThinking Evolve and Inspire make a powerful combo for the iterative process Altair envisions and advocates. This article focuses on Evolve 9.0. the latest version. A review of Inspire is set to follow soon.

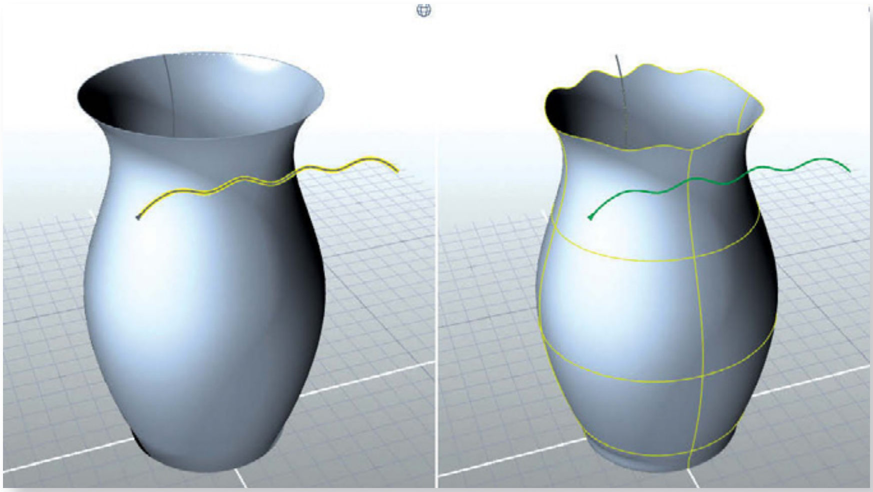
General Interface

By default, SolidThinking Evolve launches with a four-view setup: top, front, right and perspective views. You may change the display mode in any of the views. You can, for instance, turn on zebra stripes in one view to check surface quality, wireframe in another to check edges and corners; and shading in another to see shadows and volume. The mix-and-match possibilities give you a way to observe your design in multiple modes simultaneously. Furthermore, as you refine the geometry in one view, corresponding changes occur in other views. So if you extrude the back of a chair in your perspective view, you see the effects of your changes in the top view and the side view as well. At any moment, you may turn one of the views into a full window to start detailed work.

The scrollable left pane gives you access to groups of tools: 2D sketching commands, surfacing commands, movement and translation commands (zoom, pan, scale, etc.), mesh tools, dimensioning tools and more. Once drawn, splines can be edited and modified through point handles. Both in 2D and 3D, the splines are extremely responsive to push-pull input, creating a stretchable feel to the models.

The far right corner gives you access to the world view, or the content of your scene. You can use this window to select the different components that make up your design, such as the spline you used to create the initial profile and the surfaces generated through extrusions and trimmings. Right below the world view, you get a list of the steps you took to create a specific feature: for example, a NURBS curve, followed by an extrusion. By selecting a specific step in the stack of operations, you may modify the outcome after the fact, by altering the underlying curve or the numeric input (say, the height of an extrusion)—similar to the way you would edit models in a feature-based CAD program's history tree.

Dimensions in Evolve can be static or associative. A static dimension is no more than a visual note of a value: say, the height of a vase. An associative dimension changes and updates when you alter your design. If you reduce the height of a vase by modifying its extrusion, the associative dimension will update to reflect the new height. But you cannot use a dimension edit to generate a geometry change. For instance, you cannot change the numeric value in the dimension from 3 to 2 in., and expect the height of the vase to automatically adjust itself. Such changes must be made from the world view by selecting the extruded object and modifying the extrusion input field.



Left: Setting up a trim operation using a spline to trim a surface. Right: Trimmed surface resulting from the operation.

Surfaces and Splines

In addition to customary surface-creation methods (such as extruding a curve-enclosed profile), you may also use curves in other creative ways. With PathCast, you can project a curve onto another surface. Drawing a straight line or a simple arc on a flat surface is easy enough, but there will be occasions where you need to draw a curve on a complex surface with rolling angles. This is where PathCast can come in handy. Similarly, you may use curves to trim complex surfaces. When dealing with complex design, especially imported models, the Surface Extract tool gives you an easy way to identify a region, then generate a surface corresponding to this region.

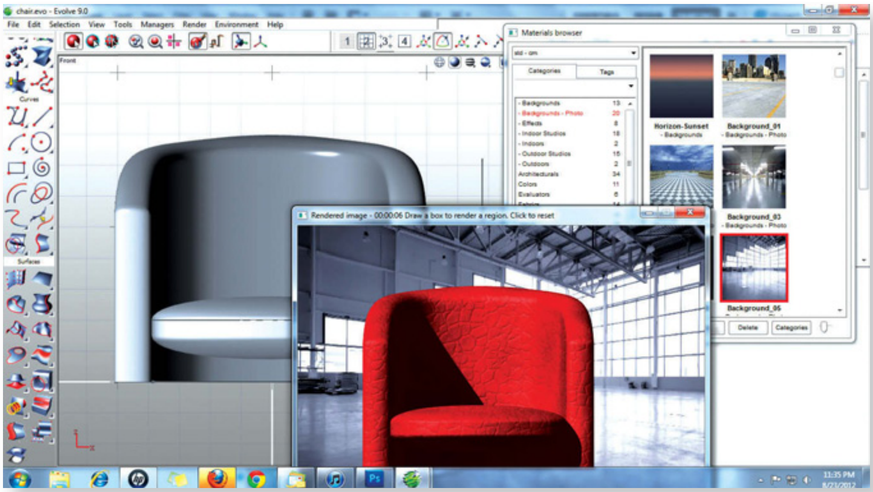
The power of a NURBS modeler is not only in how easy it is to create surfaces, but also in how good it is at automatically connecting adjacent surfaces in a logical fashion. When you use a command like Blend Surfaces in Evolve to join two (or more) surfaces, you're bypassing the need to manually create an intermediary surface to fill the gap; instead, you're relying on the software's ability to detect the shapes of nearby surfaces and come up with a surface that connects them in an uninterrupted flow. SolidThinking works extremely well in blending surfaces in a way that preserves curvature continuity.

Editing Imported Designs

Evolve accepts imported files in neutral formats, such as IGES, STEP, OBJ, STL and DWG. However, the point-and-vertice editing style may prove a challenge in editing designs containing geometric symmetry. With point and vertice controls, it's not easy to, for example, select a flat surface or an edge in an imported model to increase the thickness of a wall or the radius of a rounded corner. According to Darren Chilton, program manager for

SolidThinking, Evolve's companion piece Inspire 9.0 (in beta at press time) is expected to offer direct-modeling operations.

Evolve comes with a rendering app, complete with panoramic environments, background plates and materials. With this option, you can instantly apply materials to your geometry, select a background, and produce a photorealistic image of your design, complete with shadows and reflective surfaces.



The rendering tool in SolidThinking is preloaded with materials, environments and background plates.

Evolve as a Companion to Inspire

In direct modeling CAD packages (such as Siemens PLM Software's Solid Edge with Synchronous Technology, Autodesk Inventor Fusion, or PTC's Creo Direct), you edit geometry by pushing and pulling on edges and surfaces. In a NURBS modeler like Evolve, you edit by pushing and pulling on points, vertices, meshes and polygons.

The two approaches are significantly different. The first is a better choice for creating and editing clean, symmetrical geometry, made up primarily of perfect arcs, straight lines and rectangles (like an engine block or a desktop computer's chassis). The latter is a better choice for constructing organic shapes with asymmetrical profiles and curves (like a leaf-shaped perfume bottle or the hood of a vehicle).

On its own, SolidThinking Evolve is a powerful concept modeler. A generous collection of video tutorials that come with the installation reduces the learning curve to just a few hours to master the basics. Under Altair Engineering's strategy, Evolve offers more value as a companion to SolidThinking Inspire, a program aimed at identifying optimal shapes.

The optimization exercises in Inspire often reveal that the best shapes that satisfy the anticipated load in your design are not always a shapes you can arrive at intuitively. Though traditional CAD programs place an emphasis on creating symmetrical designs, and when most designers have, over time, developed a bias for symmetry in profiles, mathematical calculations may reveal that the best shape for a product is asymmetrical. (For more on this topic, read "The New Frontier in Digital Design: Automating Optimization," *Virtual Desktop* blog, July 30, 2012.) This makes a NRUBS modeler like Evolve an ideal package for working with Inspire. **DE**

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Read **Between** the Layers

What does the Stratasys-Objet merger mean for design engineers?

BY JAMIE J. GOOCH

Some unions just make sense: Think Disney-Pixar, Exxon-Mobil, or Bogie and Bacall. Others seem doomed to failure from the start. Did anyone think AOL-Time Warner, Daimler Chrysler, or Kardashian and Humphries were really going to work out?

So when Stratasys and Objet announced they intended to merge to create a giant in the 3D printing arena, it was only natural for design engineers to wonder whether it was a good match—and, more importantly, "What does it mean for me?"

Adding fuel to the speculation is the spate of recent mergers in the 3D printing/additive manufacturing space, mainly driven by 3D Systems. Since 2009, 3D Systems has scooped up dozens of companies. Last year, Stratasys acquired Solidscape, a 3D printer manufacturer active largely in the jewelry, medical and dental markets, but was still much smaller than 3D Systems.

In 2011, 3D Systems reported $230.4 million in revenue, but that's before its 2012 acquisitions of Z Corp., Vidar Systems, My Robot Nation, Paramount Industries, FreshFiber, Bespoke Innovations and Viztu Technologies. Stratasys reported $155.9 million in revenue for 2011; privately held Objet's were between $160 million and $180 million. The Stratasys-Objet merger values the combined companies at about $1.4 billion.

The Bigger, the Better

Industry consultant Todd Grimm, president of T.A. Grimm & Associates, says the size of 3D Systems was likely one motivator behind the merger—but not the only one.

"I don't know if it's the main driver, but it's an obvious one," he says. "It gives them a little more mass, to be on equal footing with 3D Systems."

Terry Wohlers, president of Wohlers Associates, agrees that there is strength in numbers. "As you become larger, you can do more things and be more competitive," he says.

One of those things is taking advantage of the potential for growth in the 3D printing market. Both Objet and Stratasys saw revenue increases of more than 30% for 2011, so the merger is more likely to be a play for expansion than a cost-cutting maneuver.

"Both companies have been in a hiring mode," says Wohlers. "My guess is that they'll keep most of their people. Some casualties are inevitable, but in this case, I don't expect customers will notice much."

Complementary Product Lines

Neither consultant sees a lot of reduction in duplicate product lines, either, because the companies' technologies are more complementary than competitive with one another.

"For Stratasys, its niche is all about strength of parts," says Grimm. Stratasys' Fused Deposition Modeling (FDM) is often used for building models from thermoplastic for fit and function. "Those people are looking for durable, strong, resilient parts," Grimm says of Stratasys' customers.

But when it comes to highly-finished presentation models, Objet's PolyJet technology has the upper hand, according to Wohlers. "Aesthetically, FDM is fine, but parts from Objet systems are more visually appealing," he says. "The surface finish and feature detail are very impressive."

After the merger, Stratasys will be able to offer customers both solutions. It's a situation they've been in before.

"Another reason for the merger, I think, is if you look back to Stratasys' success about five years ago when they were a distributor of Objet technology," Grimm says. "Stratasys' sales team sold up a storm when it was selling Objet's technologies."

The difference now, of course, is that sales can flow both ways, with Stratasys' customers buying Objet's 3D printers and consumables, and vice versa.

"They'll be able to see into each others' accounts," says Wohlers. "If you have customers who have one system and not the other, it's easier to penetrate those accounts."

Grimm agrees. "A smart buyer and smart salesperson at a higher level can tell what application—stereolithography, PolyJet or FDM—is needed. There is a clear delineation," he says. "Stratasys likely saw many situations where FDM was not the best fit. Now they can walk in with a bag full of products. If you want really smooth features and high details, here's Objet. If you want strength and high detail, here's FDM."

Marriage is Tough

The new company, which retains the Stratasys name, is 55% owned by Stratasys shareholders, but is headed by Objet CEO David Reis. Stratasys CEO Scott Crump is chairman of the new company. Wohlers says Crump has been mostly focused on the big picture and business strategies over the past few years, so he expects Reis to be more hands-on with operations. Objet can appoint four people to the board of directors. Stratasys can appoint five, but the fifth must be approved by Objet.

The combined company is keeping separate offices in Rehovot, Israel, where Objet was headquartered, and in Eden Prairie, MN, where Stratasys is based. Does that mean that the companies will be run as separate entities?

"With the acquisition of Solidscape, Stratasys basically let them be," Grimm says. "My only question is, when this rolls out, is there a distinct line in the sand between Objet and Stratasys, or will they truly combine them?"

As Wohlers puts it: "The devil's in the details when it comes to people working together and sharing systems."

What It Means

The merger creates two main players in the non-metal, professional 3D printing space: Stratasys and 3D Systems. In other industries, decreased competition has led to higher prices, but neither Grimm nor Wohlers is willing to predict that will be the case in 3D printing.

"Obviously, with fewer competitors in industry, there can be some concern over prices staying high or even increasing," Grimm says. "Time will tell, but I think there are enough options out there to put downward price pressures on everyone."

Those options stem from two sides, one selling sub-$5,000 3D printers to non-professionals, and the other selling full metal-based additive manufacturing systems that can approach $1 million. Either side could expand into the middle professional market where Stratasys is focused, if given the opportunity.

"I can't see many negative consequences for end users," says Wohlers. "They may be working with a new reseller or a different tech support group; maybe some names or faces will change. But my guess is the companies will—especially in the short-term—stay focused on their strengths." DE

Jamie J. Gooch *is managing editor of* Desktop Engineering. *Send e-mail about this article to DE-Editors@deskeng.com.*

BEFORE THE MERGER

Stratasys Inc.

- **Headquarters:** Eden Prairie, MN
- **Offices:** North America, Europe, Asia-Pacific, ASEAN and India
- **Employees:** 550
- **Year founded:** 1989
- **Product lines and services:** Mojo, uPrint SE, Dimension, Fortus and RedEye digital manufacturing service
- **Materials:** Thermoplastics
- **Technologies:** Fused Deposition Modeling

Objet Ltd.

- **Headquarters:** Rehovot, Israel
- **Offices:** North America, Europe, Japan, China, Hong Kong and India
- **Employees:** 430
- **Year founded:** 1998
- **Product lines:** Objet Connex, Eden and Desktop families of 3D printers
- **Materials:** Inkjet-based photopolymers
- **Technologies:** PolyJet and PolyJet Matrix

INFO → **3D Systems:** 3Dsystems.com

→ **Stratasys Inc.:** Stratasys.com

→ **Objet Ltd.:** Objet.com

→ **T.A. Grimm and Associates:** TAgrimm.com

→ **Wohlers Associates:** WohlersAssociates.com

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HP's Flagship Raises the Bar

HP improves upon its top-of-the-line workstation, the Z820.

BY DAVID COHN

It's been more than two years since HP first showed off its Z800, the flagship of its redesigned Z-series workstations (see *DE*, January 2010). This month, we get a chance to review the Z820, the successor to the Z800.

From the outside, the Z820 looks nearly identical to its predecessor. The only visual difference we could readily see was the inclusion of a conventional 16X SuperMulti DVD+/-RW tray-loading optical drive rather than the slot-loading drive in our original Z800, as well as flat covers over the other two empty 5.25-in. front panel drive bays. A slot-loading DVD drive is available as an option, or you could opt for a tray-loading Blu-ray Disc writer.

INFO → HP: HP.com

HP Workstation Z820

- **Price:** $9,984 as tested ($2,165 base price)
- **Size:** 8.0x20.7x17.5 in. (WxDxH) tower
- **Weight:** 58.6 lbs.
- **CPU:** two Intel Xeon E5-2687W 3.1GHz eight-core with 20MB cache
- **Memory:** 32GB (512GB max) DDR3 1,600MHz (16 DIMM slots)
- **Graphics:** NVIDIA Quadro 5000
- **Hard Disk:** Seagate 300GB 15,000-rpm SAS
- **Optical:** 16X SuperMulti DVD+/-RW
- **Audio:** High-definition integrated Intel/Realtek HD ALC262 audio
- **Network:** dual integrated Intel 82579LM PCIe Gigabit LAN
- **Slots:** Three PCIe Gen3 x16, one PCIe Gen3 x16 mechanical/ x8 electrical, one PCIe Gen3 x8 mechanical/x4 electrical, one PCIe Gen 2 x8 mechanical/x4 electrical, one PCI
- **Drive Bays:** three external 5.25-in. bays; four internal 3.5-in. bays
- **Ports (Front):** one USB 2.0, two USB 3.0, one IEEE 1394a (FireWire), one microphone in, one headphone out
- **Ports (rear):** four USB 2.0, two USB 3.0, one IEEE 1394a (FireWire), one audio in, one audio out, one microphone in, PS/2 mouse, PS/2 keyboard, two RJ-45 to integrated Gb LAN, one 9-pin serial
- **Ports (internal):** six USB 2.0
- **Keyboard:** 104-key HP keyboard
- **Pointing device:** two-button optical HP scroll mouse

Other than that, a narrow vertical panel along the right front of the case still provides a power button, three USB ports, headphone and microphone jacks, and an IEEE 1394a FireWire connector, but now, two of those USB sockets are blue USB 3.0 ports. An optional front panel-mounted 22-in-1 media card reader is also available.

The rear panel adds two more USB 3.0 ports, four USB 2.0 ports, and a second FireWire connector—as well as one 9-pin serial port, separate PS/2 keyboard and mouse connectors, a pair of RJ-45 jacks for the integrated Gigabit LAN (including one that is active management technology, or AMT-enabled), and audio-in, audio-out and microphone jacks.

When we removed the large aluminum side panel, we were greeted by a modular interior, with plastic airflow guides covering all of the components so that that each receives a constant supply of air. Green touch-points indicated how to remove each component.

Four 3.5-in. drive bays located in front of the expansion card area feature special drive carriers with spring-loaded, acoustically isolated clips that hold each drive in place, while at the same time ensuring that vibrations from spinning drives are not transmitted to the case. Once mounted in the carrier, each drive simply slides into the cage and connects using blind mate connectors, eliminating the need to connect cables. In our evaluation unit, one of these drive bays was filled with a 300GB 15,000-rpm SAS hard drive. HP offers drives ranging from 7,200 rpm SATA drives of up to 3TB, 10,000- and 15,000-rpm SASA drives of up to 600GB, and solid-state drives of up to 300GB. The Z820 also supports many redundant array of independent disks (RAID) configurations.

With the I/O cover removed, we were able to grasp two more green touch-points to remove the cowl concealing the CPUs and memory sockets. In a change from the Z800, this component in the Z820 now incorporates six additional fans dedicated to cooling the processor and memory, with power to these fans supplied by another blind mate connector. A bank of four single in-line memory module (SIMM) sockets sits to either side of the CPU, for a total of 16 memory slots. Each CPU was concealed beneath its own dedicated liquid cooling module with its own radiator and fan, while two more exhaust fans push hot air out through the rear panel.

At the top, the power supply spans the full depth of the

The new HP Z820 workstation looks nearly identical to the original Z800, with brushed aluminum side panels and integrated handles. Although shown here with a single slot-loading DVD drive, our evaluation came with a more conventional tray-loading drive.

Inside, all components are concealed beneath airflow guides. Yet each component—including the power supply—can be easily removed by pulling on green "touch-points."

case. And as was true in the Z800, it too is easily removable by simply pulling on an integrated handle. But this time around, in addition to an 850-watt, 88% efficient power supply, users can opt for a larger 1,125-watt, 90% efficient model, required on systems equipped with dual CPUs.

Second-generation CPU

Our evaluation unit came equipped with two new 3.1GHz Intel Xeon E5-2687W CPUs, based on Intel's latest iteration of its "Sandy Bridge" architecture. This second-generation CPU features eight CPU cores, a 20MB cache, 40 lanes of third-generation PCIe, and a quad-channel memory controller capable of supporting DDR3-1600 memory. The processor provides a maximum turbo boost frequency of 3.8GHz while maintaining a maximum thermal design power (TDP) of 150 watts. The CPUs are backed by an Intel C602 chipset. HP offers a choice of 14 different Intel Xeon processors, including quad-core, six-core and other eight-core CPUs.

Half of the 16 dual in-line memory module (DIMM) slots in our unit were filled with 4GB, 1,600MHz DDR3 memory modules, for a total of 32GB of RAM. The Z820 can support up to 512GB of memory. The motherboard also provides expansion options, with three PCIe Generation 3 x16 slots, one PCIe Gen3 x16 slot (x8 electrically), one PCIe Gen3 x8 slot (x4 electrically), one PCIe Gen2 x8 slot (x4 electrically), and a single legacy PCI slot. There are also six USB 2.0 ports on the motherboard.

One PCIe x16 slot in our evaluation unit was filled with an NVIDIA Quadro 5000 graphics board with 352 compute unified device architecture (CUDA) cores and its own 2.5GB of dedicated GDDR5 video memory. Because of the width of this board, it blocked access to one of the other PCIe x16 slots. Other boards from both AMD and NVIDIA are also available.

Excellent Performance

Because the Z820 marked the first system we've tested based on the new eight-core Intel Xeon processors, our expectations were quite high—and we were not disappointed. On the SPECopc Viewperf graphics benchmark, the Z820 equipped with the high-end NVIDIA Quadro 5000 outperformed all systems we've tested to date, except those running over-clocked CPUs. It even managed to surpass over-clocked systems on several viewsets.

On the SPECapc SolidWorks test, which is more of a real-world test (and breaks out graphics, CPU and I/O performance separately from the overall score), the Z820 also did quite well. Because we previously tested systems using an older version of this benchmark under Windows XP and have since moved to a new release of the test under Windows 7, the ratio results are not directly comparable. Looking at the times, however, the Z820 did quite well.

And on the AutoCAD rendering test, the Z820 clearly benefited from all of those cores in the new Intel Xeon processor. Because AutoCAD's rendering engine is multi-threaded, with Hyper-Threading enabled, the pair of eight-core CPUs delivered the equivalent of 32 cores—enabling the Z820 to complete the rendering test in an average of just 41 seconds.

Our test system came with Windows 7 Professional 64-bit. Windows 7 32-bit and Windows 7 64 Ultimate, as well as several versions of Linux, are also available. Our system also came with a standard USB mouse and 104-key USB keyboard. Other keyboards and input devices are also available.

HP backs the Z820 with a standard 3-year warranty that covers parts, labor and support. Four- and five-year warranties are also available. Like other HP workstations, the Z820 is fully independent software vendor (ISV)-certified for most CAD/CAM/CAE software.

Prices for the new HP Z820s start at $2,299, but that buys you a single six-core CPU, 4GB of memory, a modest hard drive, and a midrange graphics board. As configured, our evaluation unit priced out at $12,481—but at checkout, our cost was reduced to $9,984 thanks to an automatic 20% HP online discount. While still a lofty amount, it's less than several other systems we've tested recently, and less than what we would have paid for a Z800 just two years ago.

If you need a high-end workstation that delivers excellent performance, the HP Z820 sets the new standards. DE

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

Engineering Workstations Compared

		HP Z1 workstation (one 3.5GHz Intel Xeon E3-1280 quad-core CPU [3.9GHz turbo], NVIDIA Quadro 4000M, 16GB RAM)	**Lenovo E30** workstation (one 3.2GHz Intel Xeon E3-1230 quad-core CPU [3.6GHz turbo], NVIDIA Quadro 600, 4GB RAM)		**HP Z210** workstation (one 3.36GHz Intel Xeon E3-1245 quad-core CPU [3.7GHz turbo], NVIDIA Quadro 2000, 8GB RAM)		**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)		**HP Z820** workstation (two 3.1GHz Intel Xeon eight-core CPU [3.8GHz turbo], NVIDIA Quadro 5000, 32GB RAM)	**BOXX 3DBOXX 8550XTREME** workstation (two 3.33GHz Intel Xeon X5680 six-core CPUs over-clocked to 4.2GHz, NVIDIA Quadro 5000, 24GB RAM)	
Price as tested		$5,625	$1,099		$2,269		$4,048	$1,875		$9,984	$11,396	
Date tested		6/29/12	4/21/12		2/12/12		10/12/11	9/11/11		7/16/12	3/20/11	
Operating System		Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows 7 64-bit	Windows XP	Windows 7 64-bit
SPECviewperf	higher											
3dsmax-04		82.83[1]	79.01[1]	77.43[1]	80.67	79.46	99.03[1]	83.61	81.72	82.08[1]	95.97	95.44[1]
catia-02		98.89[1]	77.80[1]	77.68[1]	94.20	91.47	124.75[1]	96.38	93.28	111.43[1]	120.44	121.1[1]
ensight-03		90.20[1]	48.20[1]	49.27[1]	75.78	73.57	109.56[1]	76.62	74.16	124.41[1]	132.41	130.13[1]
maya-02		330.32[1]	156.64[1]	157.63[1]	291.17	270.83	399.43[1]	297.27	270.53	461.72[1]	529.89	476.95[1]
proe-04		97.22[1]	60.66[1]	60.79[1]	88.48	84.83	120.33[1]	89.24	85.86	114.54[1]	113.84	113.24
SW-01		196.11[1]	94.38[1]	94.68[1]	168.06	161.45	231.44[1]	169.31	160.61[1]	236.8[1]	221.31	214.06
tcvis-01		62.98[1]	34.25[1]	34.22[1]	56.41	54.43	79.05[1]	56.76	54.24	94.77[1]	98.58	94.17
ugnx-01		44.98[1]	29.01[1]	29.16[1]	43.41	42.49	65.91[1]	43.40	42.47	86.93[1]	89.32	86.90
SPECapc SolidWorks	lower											
Score	seconds	110.61[1,2]	127.48[1]	n/a	110.91	n/a	n/a	106.63[1]	n/a	126.73[1,2]	106.56[1]	n/a
Graphics	seconds	38.31[1,2]	48.40[1]	n/a	35.71	n/a	n/a	34.24[1]	n/a	42.43[1,2]	35.33[1]	n/a
CPU	seconds	30.52[1,2]	27.90[1]	n/a	25.89	n/a	26.44[1]	25.05[1]	n/a	37.53[1,2]	25.99[1]	n/a
I/O	seconds	41.32[1,2]	55.17[1]	n/a	50.74	n/a	47.01[1]	48.26[1]	n/a	46.77[1,2]	46.51[1]	n/a
SPECapc SolidWorks	higher											
Score	ratio	4.46[1,2]	6.25[1]	n/a	7.92	n/a	n/a	8.04[1]	n/a	3.84[1,2]	8.23[1]	n/a
Graphics	ratio	5.06[1,2]	3.89[1]	n/a	5.78	n/a	n/a	5.74[1]	n/a	4.58[1,2]	6.08[1]	n/a
CPU	ratio	4.01[1,2]	11.57[1]	n/a	12.46	n/a	12.20[1]	12.88[1]	n/a	3.26[1,2]	12.61[1]	n/a
I/O	ratio	3.42[1,2]	5.74[1]	n/a	6.24	n/a	6.73[1]	6.56[1]	n/a	3.03[1,2]	6.81[1]	n/a
Autodesk Render Test	lower											
Time	seconds	87.92[1]	85.66[1]	71.75[1]	71.66[1]	62.33[1]	45.6[1]	82.2[1]	60.5[1]	41.0[1]	34.0[1]	19.0[1]

Numbers in blue indicate best recorded results. Numbers in red indicate worst recorded results. 1=Hyper-threading enabled. 2= SPECapcSW2007 benchmark. Results are shown separately for single- and dual-socket workstations.

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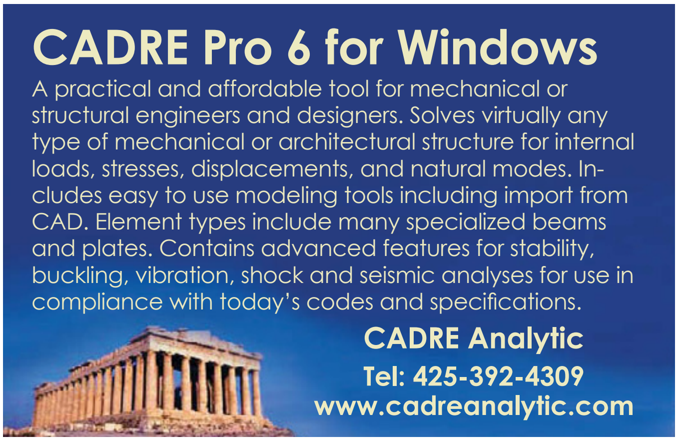

Symbolic Computing for Design Engineers

A primer to take you beyond mere number crunching.

BY DIMITRIOS KARAMANLIDIS

Author's Note: While we used a particular computer algebra system, namely Maple, every computation performed could have been done using any other system.

For someone to claim that "engineering" and "computing" are synonymous would certainly be an incorrect statement. After all, there's much more to engineering than just computing. Replace, however, "synonymous" with "like twins"—and everyone around you is nodding in agreement.

Now, more often than not, when engineers refer to computing, they mean "number crunching" of some sort or another. And nowadays, the ubiquitous tool to do that is most likely MATLAB (and to a lesser extent, perhaps, MathCAD). No reasonable person should have a problem with that. Engineering is, after all, a problem-solving profession—and at the end of the day, you need concrete numbers to build something.

But there is another angle to it, and the purpose of this article is to showcase, on the basis of some examples, that there are a good many situations during an engineer's workday in which using symbolic computations is the smarter choice. Let me explain.

What's Symbolic Computing?

Let's venture down memory lane and recall that in high school we were introduced into algebraic equations, something like:

$\boxed{3 \cdot x = 15}$ or, more generally $\boxed{a \cdot x = b}$

In both cases, we were able to solve for the unknown, x, and get, respectively:

$\boxed{x = 3}$ and $\boxed{x = b / a}$.

Little did we know back then that in the first case, we performed numerical computing ("number crunching"), and in the second case symbolic computing.

Once we mastered that subject, we were taught how to solve simultaneous algebraic equations, that is, math contraptions of the form:

$\boxed{\mathbf{A}\,\mathbf{x} = \mathbf{b}}$

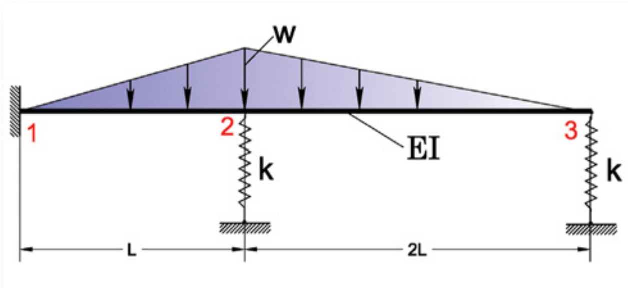

FIGURE 1: Spring-supported cantilever.

where **A** represents the coefficient matrix, **b** the vector of known terms, and **x** the vector of unknowns. Both **A** and **b** could contain numbers and/or symbols. Either way, when the solving was done longhand, it always meant lots of tedious, time-consuming work—so much so that anything with more than, say, three unknowns was not to be attempted by mere mortals.

The advent of electronic calculators and later, personal computers shook things up—in that technology made it possible for everyone to solve for many unknowns without much effort. That is, as long as **A** and **b** contained numbers and numbers only. It was that limitation that led to the creation of so-called Computer Algebra Systems (CAS): software able to handle symbolic computing in conjunction with things such as algebraic systems of equations, differential equations, integrals and differentials and so forth.

Excellent, you say, but why is that such a big deal for someone who is not a math major, but an engineer?

Bear with me!

Suppose you're working on analyzing/designing some truss structure and wish to evaluate the performance of several variants in terms of cross-sectional and material properties, loading conditions, and the like. Tackling the problem by way of numerical computations (say, standard finite element analysis, or FEA) would prove quite wasteful, for it would require a slew of computer runs to go through the various "what-if" scenarios.

Now enter symbolic computing. In that case, you treat the various design parameters (lengths, angles, areas, load magnitudes, etc.) as variables, and proceed to obtain explicit formulae for all output (displacements, stresses, internal forces, you name it).

What is the advantage? First, having these formulae in front of us makes it possible to grasp more easily which parameter(s) influences the response the most. If, due to the complexity of the problem, mere inspection is not an option, we could resort to graphical tools. Second, it requires little effort to plug into the derived formulae any amount of numerical values and obtain the respective results without the need to reanalyze.

On with the Show

With the "tell" part taken care of, let's now deal with the "show" part—and turn our attention to a couple examples. First, let's look at some mechanical part/system which, in idealized form, may be represented by the model depicted in Figure 1.

There are a number of possible scenarios that come to mind regarding this problem, including:

- How are bending stresses and deflections affected by certain variations regarding geometry, stiffness and loading?
- For a given configuration, in terms of geometry and stiffness, what is the maximum load magnitude **w** allowed if certain design criteria pertaining to maximum deflections and/or stresses are to be met?
- For a chosen configuration, in terms of loading and geometry, what is the lightest ("most economical") beam section one could select—provided that certain upper limits for stress and deflection will not be exceeded?

How do we go about solving this problem symbolically? Perhaps the most straightforward approach is to set up an FEA model whereby stiffness matrices and load vectors are expressed in terms of the variables depicted in the figure, namely **w**, **k**, **EI** and **L**. For simplicity, we choose just two standard beam elements to represent the structure, which results in a total of four degrees of freedom (DOF). In other words, we get a deflection and a rotation at each of the nodes 2 and 3.

Following standard procedure, we then arrive at the augmented stiffness matrix, **A**, and load vector, **b**, shown below:

$$\mathbf{A}=\begin{bmatrix} \frac{27}{2}\frac{EI}{L^3}+k & -\frac{9}{2}\frac{EI}{L^2} & -\frac{3}{2}\frac{EI}{L^3} & \frac{3}{2}\frac{EI}{L^2} \\ -\frac{9}{2}\frac{EI}{L^2} & \frac{6EI}{L} & -\frac{3}{2}\frac{EI}{L^2} & \frac{EI}{L} \\ -\frac{3}{2}\frac{EI}{L^3} & -\frac{3}{2}\frac{EI}{L^2} & k+\frac{3}{2}\frac{EI}{L^3} & -\frac{3}{2}\frac{EI}{L^2} \\ \frac{3}{2}\frac{EI}{L^2} & \frac{EI}{L} & -\frac{3}{2}\frac{EI}{L^2} & \frac{2EI}{L} \end{bmatrix}, \quad \mathbf{b}=\begin{bmatrix} -\frac{21}{20}wL \\ -\frac{3}{20}wL^2 \\ -\frac{3}{10}wL \\ \frac{2}{15}wL^2 \end{bmatrix}$$

Based on that, the obtained symbolic solution reads as:

$$\mathbf{x}=\begin{bmatrix} -\frac{3}{40}\frac{wL^4\left(91EI+199kL^3\right)}{9EI^2+84kL^3EI+11k^2L^6} \\ -\frac{1}{120}\frac{wL^3\left(1395EI^2+2148kL^3EI+52k^2L^6\right)}{EI\left(9EI^2+84kL^3EI+11k^2L^6\right)} \\ -\frac{1}{40}\frac{wL^4\left(1395EI+101kL^3\right)}{9EI^2+84kL^3EI+11k^2L^6} \\ -\frac{1}{40}\frac{wL^3\left(585EI^2-954kL^3EI-38k^2L^6\right)}{\left(9EI^2+84kL^3EI+11k^2L^6\right)EI} \end{bmatrix}$$

From this, all relevant system response data such as internal forces/moments, stresses, support reactions, etc., may be computed. Because we have derived explicit formulae, we could plug into them any number of numerical values. Here as a simple demo, we choose to vary the spring stiffness **k** and observe the effect it has on location and magnitude of maximum stress. It turns out that for large values of **k**, the maximum stress becomes several times smaller than the value obtained for **k**=small. Also, its location shifts from the fixed support to the first spring. The graphics in Figure 2 depict, respectively, the shear force and bending moment diagrams for **k**=large.

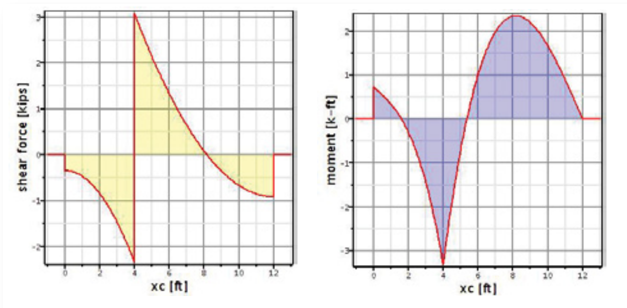

FIGURE 2 Shear and bending moment diagrams.

Now, as a second example, consider the dynamic system depicted in Figure 3.

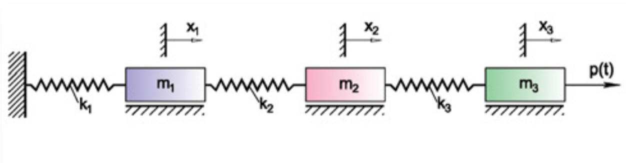

FIGURE 3 Dynamic system with three degrees of freedom.

Typically, in a situation like this, one is interested in the following:

a. eigenfrequencies and eigenvectors, which control the free vibrations of the system; and

b. steady-state response from externally applied loads.

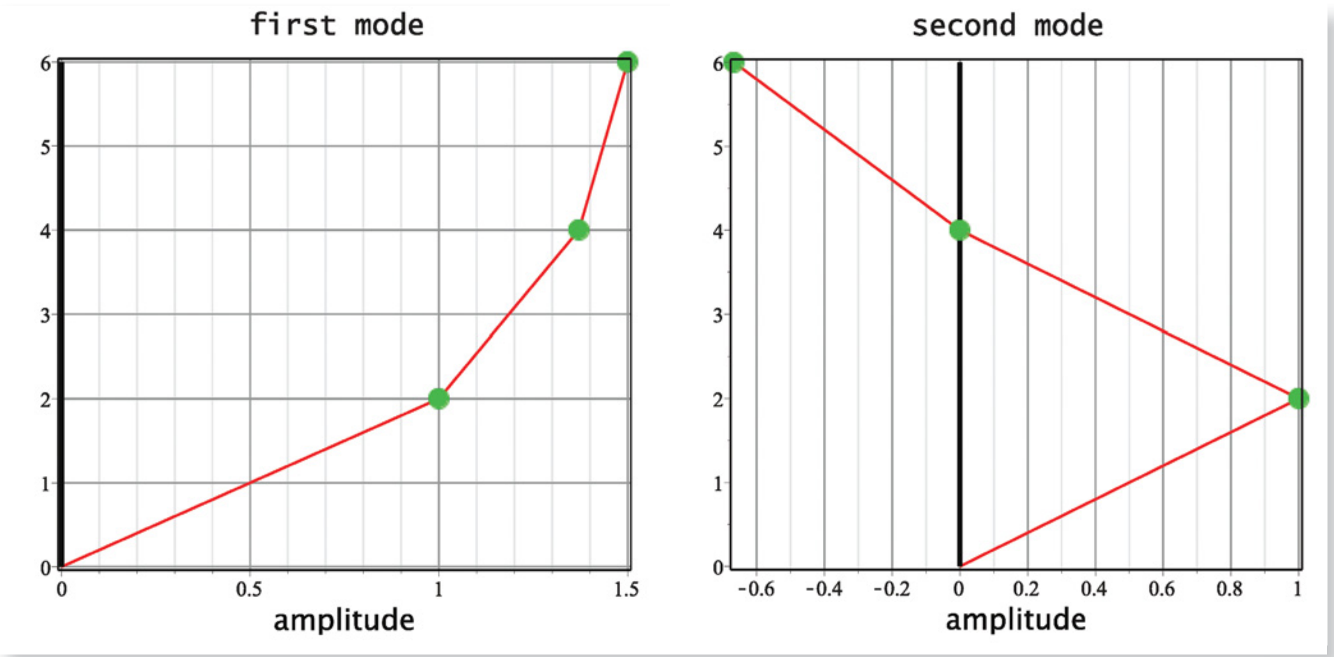

FIGURE 4: Normalized eigenvectors.

To accomplish the above, we must formulate the equations of motion of the system. One approach that works particularly well in conjunction with symbolic computing is the method of Lagrangian equations (typically covered in a basic, sophomore-level college course on "Dynamics"). This results in three ordinary differential equations, in terms of the three unknown deflections, which in compact (matrix) form read as:

$$\mathbf{M}\,\ddot{\mathbf{x}}+\mathbf{K}\,\mathbf{x}=\mathbf{p}$$

where

$$\mathbf{M}=\begin{bmatrix} m1 & 0 & 0 \\ 0 & m2 & 0 \\ 0 & 0 & m3 \end{bmatrix}, \qquad \mathbf{K}=\begin{bmatrix} k1+k2 & -k2 & 0 \\ -k2 & k2+k3 & -k3 \\ 0 & -k3 & k3 \end{bmatrix}$$

and

$$\mathbf{x}=\begin{bmatrix} x_1(t) & x_2(t) & x_3(t) \end{bmatrix}, \qquad \mathbf{p}=\begin{bmatrix} 0 & 0 & p(t) \end{bmatrix}$$

As far as notation goes, **M** and **K** are, respectively, the mass and stiffness matrix of the system, and **p** denotes the load vector. Further, an overdot denotes differentiation with respect to time, so a double overdot on **x** denotes the acceleration vector. To keep the formulae resulting from the symbolic analysis manageable, the following (arbitrary) choices were made for the system parameters:

$$\mathrm{m1}=\mathrm{m},\mathrm{m2}=\mathrm{m},\mathrm{m3}=\mathrm{m} \quad \text{and} \quad \mathrm{k1}=2\cdot k,\mathrm{k2}=3\cdot \mathrm{k},\mathrm{k3}=\mathrm{k}$$

with which the eigenfrequencies of the system were found to be:

$$\omega_1=\sqrt{4-\sqrt{14}}\cdot\omega_0, \quad \omega_2=\sqrt{3}\cdot\omega_0,$$
$$\omega_3=\sqrt{4+\sqrt{14}}\cdot\omega_0; \quad \omega_0=\sqrt{k/m}$$

The respective normalized eigenvectors are depicted in Figure 4, whereby the masses are represented by a solid circle. The distance of each mass from the y-axis (abscissa) represents the normalized amplitude of vibration for that mass.

Typically, free vibrations die out quite quickly because of the presence of some damping (either external or internal) in the system. For design purposes, what is usually more important is the system's steady-state response to externally applied loads. Here, we choose the excitation to be in form of a harmonic load (frequency **W**, amplitude **P**), acting on the third mass only. By solving symbolically the (matrix) equation of motion, the amplitude vector for the three masses is then found to be

$$\mathbf{a}=\frac{P}{k}\cdot\begin{bmatrix} -\dfrac{6}{(\eta^2-3)(\eta^4-8\eta^2-2)} \\ \dfrac{3}{\eta^4-8\eta^2+2} \\ -\dfrac{\eta^4-8\eta^2+11}{\eta^6-11\eta^4+26\eta^2-6} \end{bmatrix} \quad ; \quad \eta=\Omega/\omega_0$$

As is customary, the three amplitudes are plotted versus the excitation frequency, leading to the diagram shown in Figure 5. In this diagram, the following features are worth noting:

- When the excitation frequency matches one of the system's eigenfrequencies, resonance, that is very large amplitudes occur.

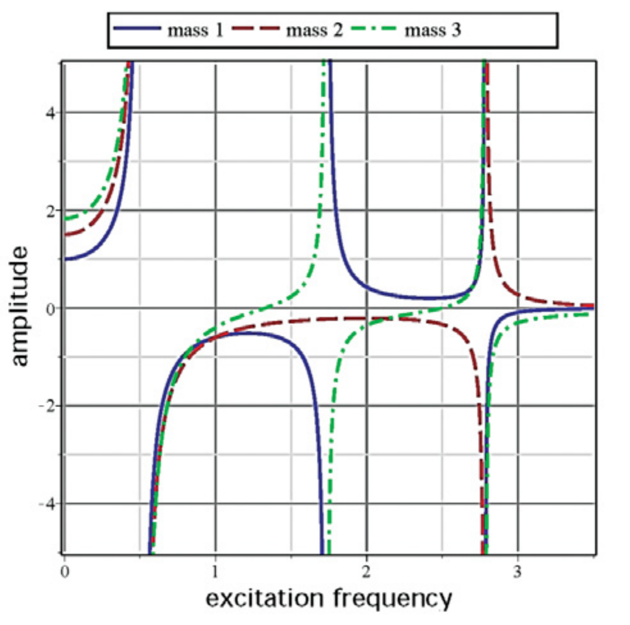

FIGURE 5: Amplitude-frequency diagram.

- When the excitation frequency reaches a value equal to the second eigenfrequency, resonance occurs only for masses 1 and 3, whereas for mass 2 the respective amplitude is rather small ("vibration isolation").
- The amplitude curve for mass 3 intersects the zero-axis at two locations, meaning that for these two frequencies, mass 3 does not vibrate at all.

In summary, we have shown on the basis of two examples how symbolic computing may be used to perform engineering-related calculations. The advantage of symbolic computing vs. number crunching lies in the fact that the obtained results are in form of general formulae, and thus do not depend on specific numerical values. **DE**

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by Detlef Schneider

Single MP Platform Efficiency

The single-platform concept has proved to be both convenient and effective all across the technology landscape, from smartphones that combine dozens of functions on a single device, to converged media that employ a single platform to allow viewing and seamless shifting of a broadcast on TV set-top boxes and other screens. For engineers, Altair has developed an approach that translates single-platform efficiency to the world of multiphysics (MP) analysis, or Smart Multiphysics simulation.

Much progress has been made on true MP simulation platforms, including Altair's HyperWorks platform, that bring together different physical disciplines for analysis in a single environment. With one platform, engineers can model, run, visualize and optimize different disciplines seamlessly. Emphasis is being placed on developing robust and scalable solutions on the analysis/solver side, but MP simulation can deliver the necessary impact in the development process only if single-discipline solutions can run robustly—

Multiphysics simulation can deliver high value in the product development cycle.

with high performance and quality results on detailed models. Therefore, by continuously enhancing single-physics components and enabling them to "talk" to each other—and including the use of optimization technology—MP simulation can deliver high value in the product development cycle.

Obtaining Quality Results

Mathematically coupled MP solutions solve all the relevant equations in a single matrix, producing a single solution; putting all equations in one matrix and coupling them can mean compromising in many areas. To obtain high performance and quality results from MP simulation, each discipline involved needs to deliver high performance and quality on its own. Moreover, useful MP analysis only needs to exchange the data that is relevant to the actual engineering problem that must be solved.

Our efforts at Altair have focused on obtaining quality results with scalable solutions on single physics aspects, while simultaneously ensuring the relevant data to solve the MP problem is seamlessly exchanged during the simulation run. To achieve this, we have the choice of applying strong or weakly coupled interaction or mapping data from one discipline to another (such as using manufacturing simulation results as inputs for structural analysis).

Additionally, relying on a coupling strategy instead of integrating in one matrix allows the engineer to implement third-party tools during the process, so an open architecture has always been a key part of Altair's strategy.

Mathematically, a principal benefit of a single, monolithic code is its stability in solving highly coupled problems. This code, however, presents an inherent disadvantage in terms of size, as well as in managing an optimum solution for each of the physics. As a result, the method becomes impractical for large industry problems. Weakly coupled interaction may seem less stable in theory, but in practice we have developed technologies that furnish the stability of strongly coupled code without its drawbacks. In addition, this method's ability to foster close collaboration among the computational fluid dynamics (CFD), structural and multi-body dynamics (MBD) developers—allowing them to have access to one another's source code—has brought a measurable advantage to our solutions.

Adding Efficiency

Software that is developed with MP in mind can make MP analysis a much more efficient process. For instance, AcuSolve, Altair's CFD solution, is based on a finite element analysis (FEA) approach that fully preserves all the physical quantities, resulting in highly accurate results.

How can the engineer determine when various levels of deeper MP are required? The right approach depends highly on the physics, which needs to be understood by the engineer. Once the appropriate technology is determined, typically the approach is captured in a workflow that can be exercised for other parts or by other people later on.

The popularity of simulation technology continues to expand to new industries, and the availability of a single MP platform has become a key to unlocking solutions faster and more effectively—Smart Multiphysics, as we call it. **DE**

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