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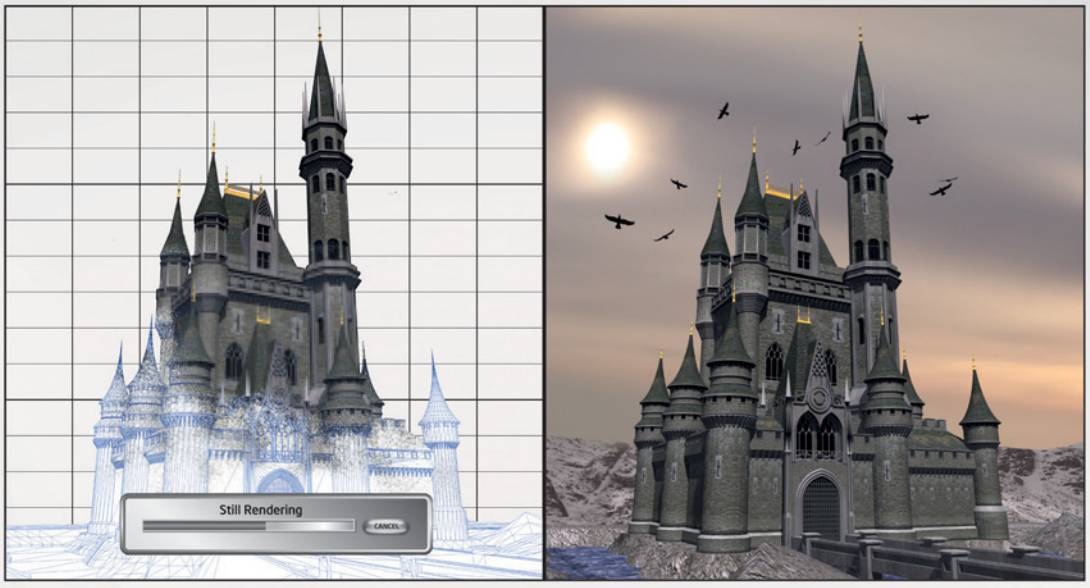

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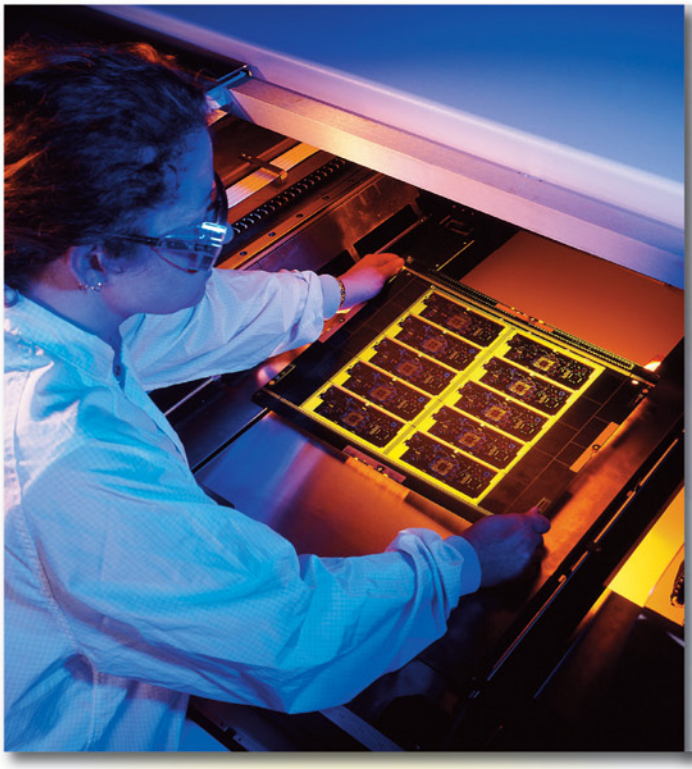

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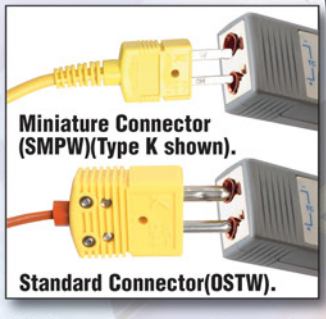

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Total Cost Becoming Important in Design

STEVE ROBBINS
steverobbins@deskeng.com

As most of us know, the all-in cost of computer purchases has been an important factor in the IT industry for many years now. The cost of a server decreases in importance when the cost of electric and cooling are figured into the equation. Large supercomputing and storage facilities are being moved to locations with inexpensive power and minimal cooling needs.

According to an article in The Times of London, a Harvard University physicist calculates a typical Google search session on a desktop computer, requiring a number of queries, as being responsible for 7 grams of carbon output. While I'm not sure more carbon would be emitted in such a search without the convenience of the Internet, it did make me stop and ponder the impact of our computing needs.

After all, a lot of us sit in front of a computer every workday. IT engineers are now designing ways for scaling servers to their workload automatically, turning off and on as needed. The impact on this will be a big benefit to companies like Google and Amazon.

> TCO will soon infiltrate everything that consumes energy or has a lifespan.

Designing for Total Cost

Design engineers have become aware that their designs are continually coming under the pressure of total cost of ownership (TCO). One of product lifecycle management's (PLM's) biggest benefits is to predict the cost of ownership. An engineer designing a complicated piece of industrial machinery is now being asked to design reliability and low cost while making a design of a product that is less expensive to run.

There's a quickly approaching deadline that will drive the cost of total ownership even further forward in the design cycle. The Energy Independence and Security act of 2007 (EISA), as it relates specifically to motors, will take effect Dec. 16, 2010.

This federal law has broad reaching implications to engineers who use

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three-phase electric motors from 1 hp to 500 hp. The act includes motors that are in OEM designs, and there is no distinction made between stock and custom-designed motors. These motors will cost around 20% to 30% more than the motors in previous use. Interestingly, these high-efficiency motors have been available for a while now and are already in high demand because they produce a lower cost of ownership. While these motors will cost more initially, they will save significant energy over their lifecycle and the impact on the environment will be gigantic. Everyone wins.

Consumer Demand

While the early adopters of PLM have been manufacturing companies where total cost of ownership has been a mantra for years, expect to see this filtering down to everyone else including the consumer. Consumers are already savvy to the concept when it comes to their automotive and appliance purchases, it will soon infiltrate everything else that consumes energy or has a lifespan.

Cell phones will probably be immune because they are a fashion statement and everyone wants a new one at least every 18 months, but other consumer electronics, power tools, white goods and transportation will continue to experience sales success based on the total cost of ownership. Product life, maintenance, and energy costs being the primary drivers.

As economic and environmental concerns merge, design engineers are in the perfect position to lead the way toward lower TCO and higher environmental sustainability. Their tools are merging too, as PLM, design software and upfront design processes become more integrated. ■

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

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ON THE COVER >

Ford Motor Co. designers and analysts work together using CATIA to shave time off the creation of a new powertrain. *Photo illustration created with images courtesy of NVIDIA and Dassault Systèmes.*

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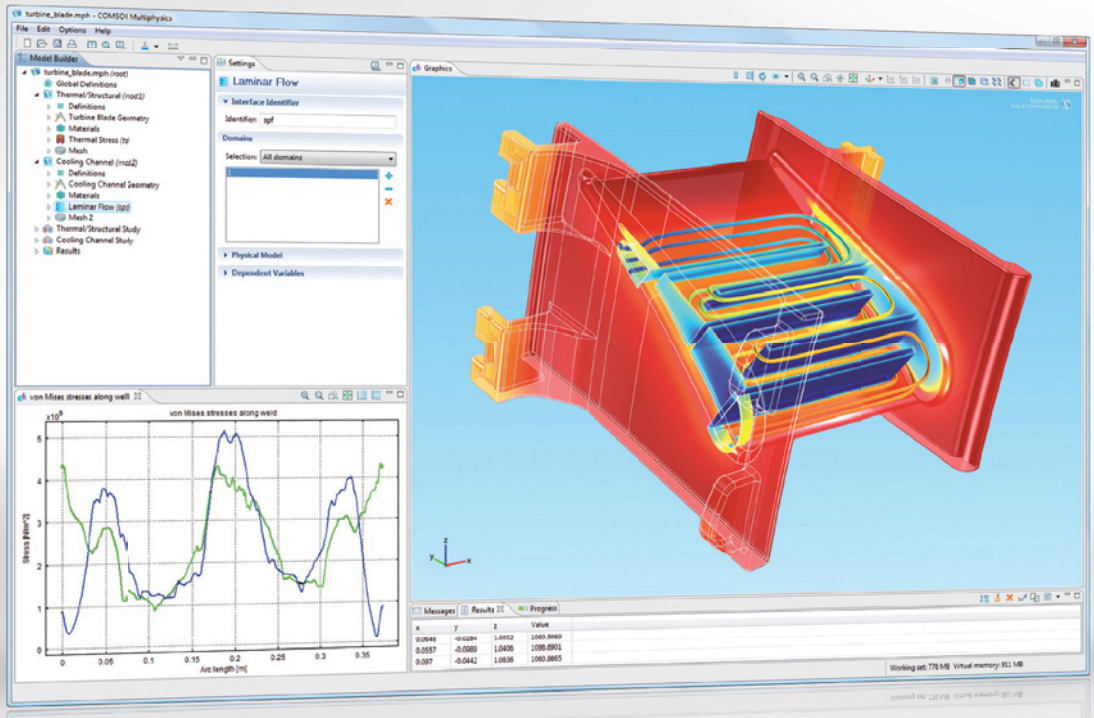

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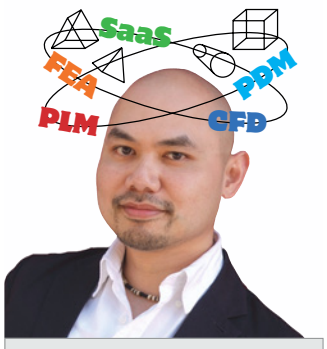
Digital Simulation vs. Physical Testing

> Digital simulation doesn't replace physical tests, but can reduce them.

During the live Q&A session in my previous webinar with Autodesk's Amy Bunszel and PTC's Sandy Joung ("Materialistic Engineering: Building Stronger, Better Parts Using Interactive Tables and Equations," sponsored by Knovel), one caller raised the following question: *Is digital simulation good enough to replace physical tests?*



KENNETH WONG
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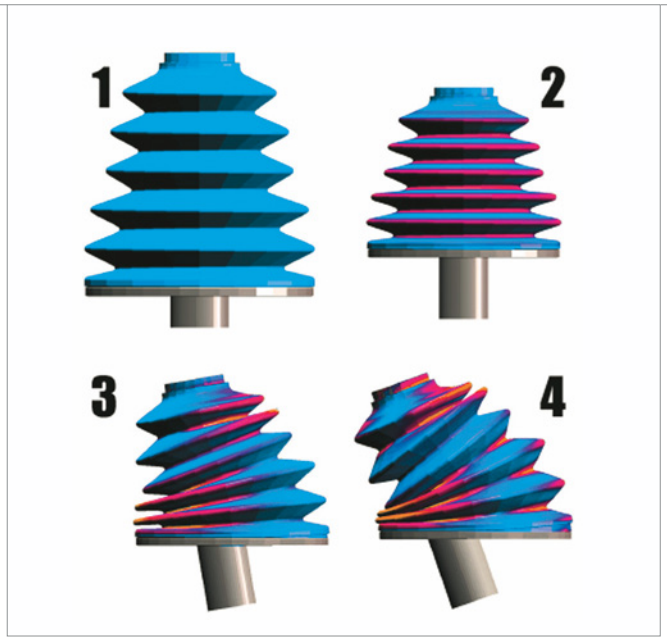
PTC's Joung responded, "As a blanket rule, eliminating all physical testing is not a good thing … Digital simulation today is not a complete replacement [of physical tests], but it does reduce the number of [test] cycles a company might have to go through."

Autodesk's Bunszel concurred, "The goal is to reduce the number of physical prototypes, but there's always going to be cases where you want to have a physical prototype. Some of those cases are in consumer product design, where you want to be able to hold and feel the product—something you're not going to be able to get no matter how beautiful your [computer-driven] visual is."

Lower Prototyping Costs

To explore the topic further, I enlisted the help of Dr. Kim Parnell, founder and principal of PEC-Parnell Engineering & Consulting. According to Parnell, "[Digital] simulation has definitely come a long way from its initial applications in linear, structural analysis. Today, complex nonlinear structural analysis is commonplace … the other area where it has grown is in fluid dynamics."

Nonlinear finite element analysis (FEA) of a coupler with MSC MD-Nastran including effects such as large deformation, buckling, and self-contact.



Nonlinear FEA of a rubber (elastomer) CV Boot performed in MSC.Marc including nonlinearly elastic Ogden material model, pre-stress associated with installation, large deformation, large strain, contact with other components, and self-contact.

On software-driven simulation's reliability, he noted, "If the question is, 'Can I totally replace physical testing [with digital simulation], and therefore do no physical testing and only do simulation?' I would say, in most cases, 'No.' But you can definitely reduce the amount of [physical] prototypes you build by the use of simulation … Tests can be expensive. Prototypes may be very expensive. By reducing the number of prototypes you build and the number of tests you perform, you get a tremendous amount of benefit."

Go Beyond the Basics

He also cautioned, "Simulation by itself is not enough. You need to do a certain amount of testing for understanding the variability—in geometry, materials, load, etc.—and the environment in which the product is going to exist. The more high-value the product is, the more critical it is to life and safety, then the more you need to do beyond basic simulation."

>To weigh in on this topic or to listen to the entire Q&A, visit the Virtual Desktop blog at deskeng.com/virtual_desktop/?p=2248. ■

Is Inventor Better Than SolidWorks?

> Controversial study investigated.

On the web, there's a firestorm raging over a study TechniCom published in August. In "Comparing the Capabilities of Autodesk Inventor Professional 2011 and SolidWorks Premium 2010," TechniCom analysts found that "Inventor rated higher than SolidWorks in every one of the 15 categories."

Introducing the paper, TechniCom president Ray Kurland wrote, "Both products were rated … by a team of four experts for each software product who rated how well each product performed for that functional question. TechniCom's analysts independently selected the questions. In my estimation, the functional questions do not favor any specific vendor or product."

In other words, the evaluation was performed by four Inventor experts and four SolidWorks experts, not by eight experts well-versed in both programs. Kurland said he resorted to this method because finding experts with equal exposure to both programs proved challenging.

He acknowledges that one evaluation category, the integration of building information modeling (BIM), tips the scale in Autodesk's favor, a sponsor of the published paper. He clarified, "The study was not asking whether each system could perform BIM — rather, the seven questions we asked the experts were focused on the interaction between a mechanical system and BIM. In essence, could mechanical parts be designed for use within a BIM system?"

Neither of the packages compared in the study is meant for architectural modeling or BIM. However, Autodesk Inventor offers BIM exchange tools that allow users to export mechanical models into Autodesk Revit, an architectural modeling program from Autodesk. Both programs facilitate import/export of common file formats such as IGES, STEP, or DWG, allowing their users to work with architectural modelers.

Functionality Areas Chosen

Sustainability, a category omitted from the evaluation, could have conceivably favored SolidWorks, as SolidWorks ships with Sustainability Xpress, a tool for measuring the environmental impact of designs. Technicom experts scored the packages in 24 functionality areas, but responses from only 15 were used to compile the paper in the end — an approach that leaves many wondering about the paper's fairness.

"Readers might ask how unbiased this analysis is, since it was sponsored by [Autodesk] the author of one of the products being compared," Kurland noted. "While we admit to some bias in select-

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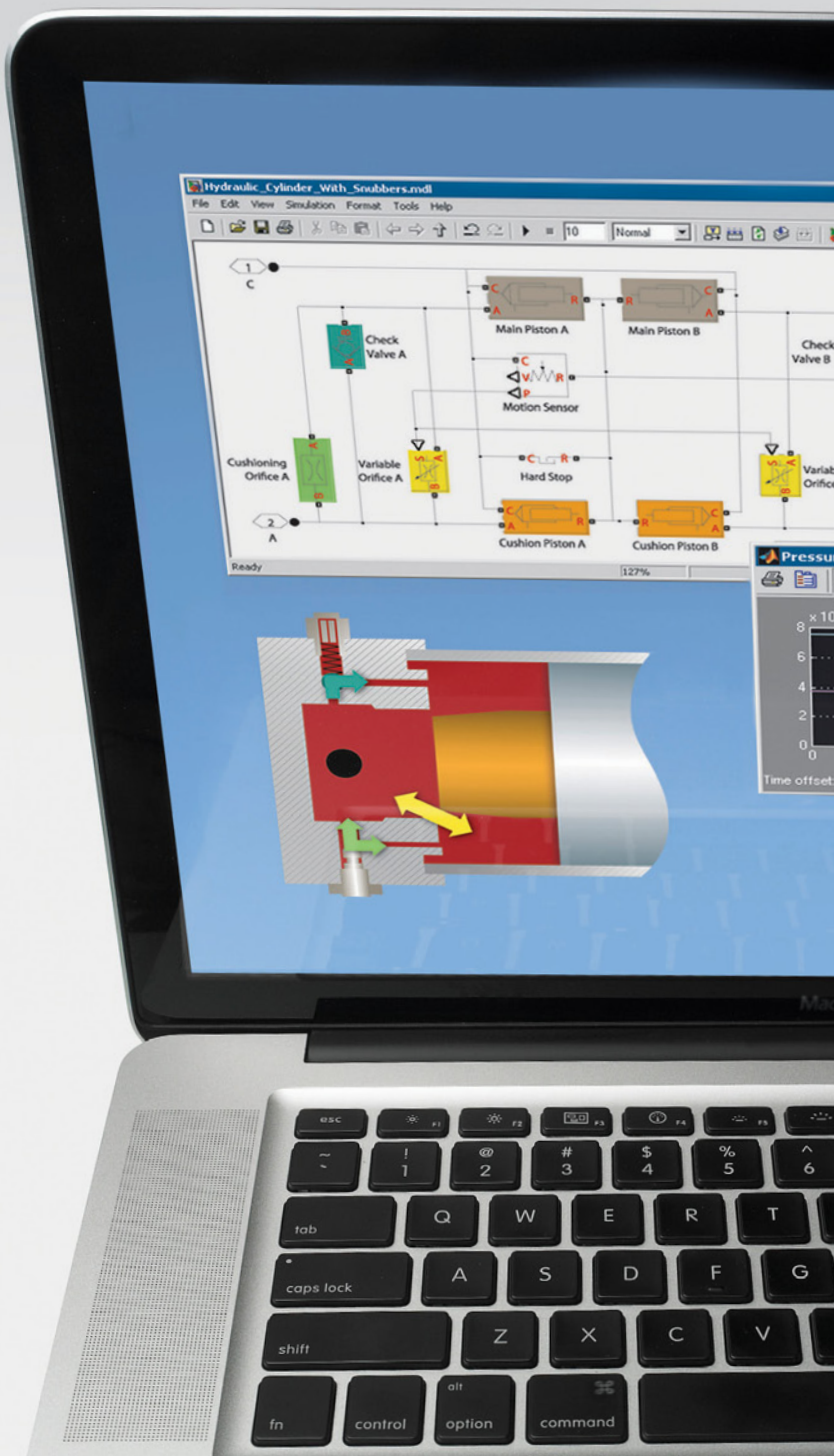

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ing the functions to be compared, particularly as it relates to the mechanical interest in BIM, all the functional areas selected for comparison are important."

Its controversial nature notwithstanding, Kurland stands by the study. He concluded, "Readers need to understand that this report provides a glimpse of certain expert opinions. While this was a small group considering that both products have hundreds of thousands of installations, we believe that the results are valid in assessing overall capabilities."

"Readers need to understand that this report provides a glimpse of certain expert opinions."
– RAY KURLAND

In my view, the Technicom paper doesn't make a convincing case for Inventor's superiority over SolidWorks. The results reveal that, among a small sample pool of eight, Inventor scores higher in 15 functionality areas, but there's no saying which of the two packages would score higher if they were judged by all 24 functionality areas by a larger number of CAD users or if SolidWorks was given the chance to pick the categories where it feels it's stronger.

>To share your thoughts on the study or to listen to my interview with Ray Kurland, visit deskeng.com/virtual_desktop/?p=2281. ■

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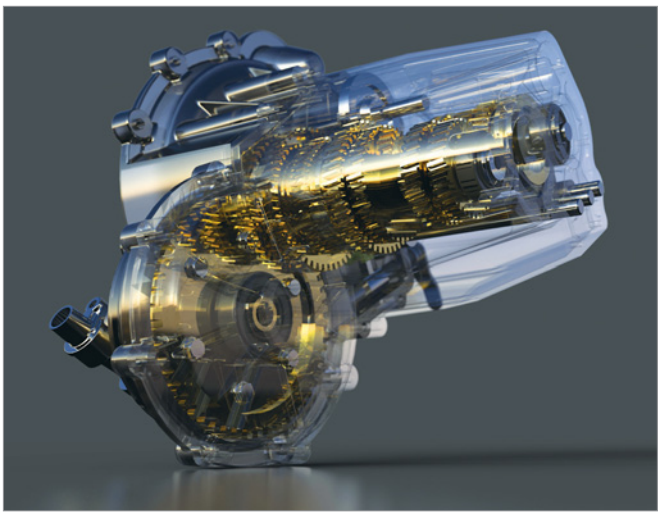
NVIDIA Rolls Out Fermi-Class Quadro Cards

> Raises the memory to 12GB and cores to 896.

Timed to coincide with Siggraph 2010, NVIDIA released four new Fermi-class Quadro cards: Quadro 4000, 5000, 6000, and Quadro Plex 7000 (not shown in picture).

Your finite element analyses, fluid dynamic studies, and ray-traced renderings can run anywhere from five to eight times faster — if you can get a hold of one of the new NVIDIA Fermi-class Quadro cards, according to NVIDIA.

Timed to coincide with Siggraph 2010, the arrival of the new NVIDIA Quadro 4000, 5000, 6000, and Quadro Plex 7000 cards promises to turbocharge many computation-intense visualization tasks. Depending on the card you pick, you get 256 to 896 CUDA processing cores, with 2 GB to 12 GB of memory. As powerful as it is, the previous generation Quadro FX 5800 with 240 cores can't compete with its newer, faster cousins.



A gearbox rendered in Bunkspeed SHOT, powered by a GPU.

Just as parallel processing on multicore central processing units (CPUs) have become the norm, the same trend drives graphics processing units (GPUs). CUDA is NVIDIA's parallel computing environment for graphics processors. This gives software developers a way to tap into NVIDIA GPUs' virtual instructions so they can write code that runs as concurrent threads on multiple cores.

In addition to NVIDIA's own CUDA, the new Quadro cards also support Khronos Group's OpenGL 4.1 and OpenCL, and Microsoft's DirectX 11 and DirectCompute programming languages, all promoting multi-thread computing in their own ways.

"Quadro can deliver an unheard of 1.3 billion triangles per second, shattering previous 3D graphics limitations," hailed NVIDIA in its announcement. "Quadro is the only professional graphics solution

Nonlinear FEA of a rubber (elastomer) CV Boot performed in MSC.Marc including nonlinearly elastic Ogden material model, pre-stress associated with installation, large deformation, large strain, contact with other components, and self-contact.

with ECC [error code correction] memory and fast double precision capabilities to ensure the accuracy and fidelity of your results."

The new Quadro cards have been put to the test in Bunkspeed SHOT, a ray-traced rendering program powered by mental images' iray engine; RTT RealFluid, a real-time airflow simulation package for automotive engineers; Mari, a texture-painting program from The Foundry; and many others.

Dell and HP have both begun offering Quadro 4000 and 5000 cards with their systems (for the list, go to deskeng.com/virtual_desktop/?p=2219). Greg Weir, senior manager of Dell Precision workstations and independent software vendor (ISV) marketing, noted, "As the first professional-class GPUs to integrate high performance computing with advanced visualization, NVIDIA Quadro combined with Dell Precision workstations are poised to transform workflows. With this technology, we are enabling our design, research, animation, and film customers to deliver higher quality results in less time."

If you're puzzled by the number people sporting dark glasses in Siggraph photos, there's a good explanation: stereoscope. Stereoscopic map projection, stereoscopic games, and stereoscopic monitors dominated the exhibit floor and Emerging Technologies pavilion. NVIDIA plans to capture this market with its 3D Vision Pro, a bundle that calls for an NVIDIA GPU, a 3D Vision-ready display unit, a projector, and stereoscopic glasses. The new Fermi-class Quadro cards fit nicely into this mix.

DE will publish reviews of the new NVIDIA cards in the November issue. ■

Fermi Pricing

Manufacturer suggested retail prices (in U.S. dollars) of Fermi-Class NVIDIA GPUs:

- Quadro 4000, $1,199
- Quadro 5000, $2,249
- Quadro 6000, $4,999
- Quadro Plex 7000, $14,500

SIGGRAPH 2010: Pushing Pixels and Processors to the Limit

> Getting a glimpse into the future at SIGGRAPH's Emerging Technologies

Nonlinear finite element analysis (FEA) of a coupler with MSC MD-Nastran including effects such as large deformation, buckling, and self-contact.

In August, I flew to Los Angeles to join the people who skinned the 10-ft.-tall Na'vis in *Avatar*, polished the metallic armor worn by *Iron Man*, and helped a Viking kid soar in *How to Train Your Dragon*. I found them trading secrets and demo reels at SIGGRAPH 2010 (siggraph.org/s2010).

The Emerging Technologies Pavilion, always popular with the hands-on crowd, has become the place to get a glimpse of the future. This year's installations include a soup can-style 360° stereoscopic projection device, a touch-enabled stereoscopic terrain navigation table, and fibrous textures that light up in response to human touch. Promising or puzzling (sometimes both), these working prototypes are tangible proof that innovation is alive and well.

The kind of innovations these pixel pushers undertake — high-resolution renderings, full-length animated features, stereoscopic imaging, to name but a few— require tremendous computing power. One alternative to meet these demands is to acquire more CPUs and GPUs; another is to take better advantage of the existing multicore processors through parallel computing.

Two of the largest booths in the exhibit hall belonged to Intel and NVIDIA, the CPU and GPU giants. In one aisle, Intel touted the horsepower of its Intel Core i7 and Intel Xeon chips. In the next aisle, NVIDIA boasted its new Fermi-based Quadro cards. (Intel's presentation: "How leading content creation and gaming applications take advantage of Intel Core i7 and Intel Xeon platforms;" NVIDIA's talk: "iray-CUDA accelerated photorealistic rendering.")

In the last five years, multicore computing has become the norm. The latest generation Intel Xeon processors are available with up to 8 general-purpose computing cores. Quadro Plex 7000, one of NVIDIA's latest GPUs, houses 896 CUDA processing cores. Even the entry-level consumer notebook Dell Inspiron 1545 now comes with a dual-core Intel chip. Dell Precision M4500, a workhorse beginning at $1,239, comes with Quad Core Intel i7 chips.

But hardware makers like Intel and NVIDIA must now encourage software developers to catch up, to write (or rewrite) code that takes advantage of parallel computing. Tony Neal-Graves, general manager of Intel's workstation group, said, "We're making it easier for people to [create computing clusters] through Intel Virtualization Technology (Intel VT)." The technology consolidates multiple computing environments into a single server or PC, allowing you to create a virtual computing cluster from unoccupied cores.

One of the factors expected to drive computing demand, noted Neal-Graves, is "the migration from overnight rendering to real-time rendering." In the past, digital artists might have been willing to wait overnight to get a rendered view of their scene; today, they expect instantaneous rendering results with little or no delay.

The proliferation of stereoscopic devices—a stereoscopic terrain-navigation table, glass-powered stereoscopic displays, and glassless stereoscopic monitors, to name but a few—suggests many animators, movie makers, and digital artists must now render their footage and images twice—for the left-eye and right-eye views to create the perception of depth. The popularity of smaller, portable devices—netbooks, iPhones, and iPads, for example—may also catapult high-quality ray-traced rendering and 3D visualization into the cloud.

Many technologies found at SIGGRAPH may be too playful, too abstract, and too eccentric to be commerce-ready. That's consistent with the SIGGRAPH tradition: Creativity takes precedence over business plans. But these pixel pushers—many of them students with small budgets—are also pushing the limits of what can be done with personal and portable computing devices, forcing CPU, GPU, and high performance computing providers to pump more firepower into their products. ■

Kenneth Wong *writes about technology, its innovative use, and its implications. One of DE's MCAD/PLM experts, he has written for numerous technology magazines and writes DE's Virtual Desktop blog at deskeng.com/virtual_desktop/. You can follow him on Twitter at KennethwongSF, or send e-mail to DE-Editors@deskeng.com.*

Meggitt Sensing Systems Debuts Seismic Accelerometer

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Offered with noise performance of 0.5 µg rms and a sensitivity of 10 V/g, the Wilcoxon Research Model 731A incorporates use of ultra low-noise electronics for clear signals at sub micro-g levels. The sensor is designed to operate over a temperature range of +14°F to +149°F and includes an integral low-pass filter to help eliminate high frequencies and ensure greater measurement quality. Units include electrostatic discharge (ESD) and reverse wiring protection.

Saelig Announces SGD 24-M TFT Color Display

>**Saelig Company, Inc.** (saelig.com) has introduced SGD 24-M, a new, customizable high contrast, 2.4-in. TFT color display with built-in touch screen, dual analog inputs, alarm outputs and SPI and I^2C bus capabilities.

The SGD 24-M can be used to create a range of display instruments.

SGD 24-M is configured using Panel Pilot, a Windows-based software platform that allows users to design and customize color displays. Six analog, digital and bar graph styles are available to be downloaded via USB to the display. Colors, text labels or scaling options can all be chosen as needed. Once all selections have been made, the custom configuration can be saved and downloaded to the display.

SGD 24-M is available at $95 per display with Panel Pilot software available as a free download.

Acromag Releases I/O Modules

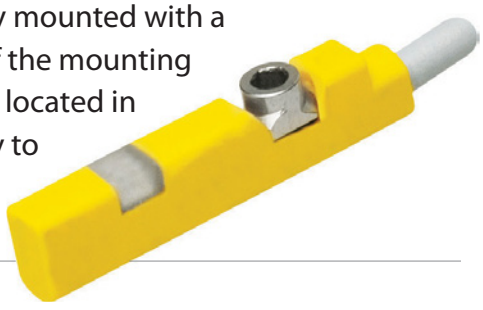
>**Acromag** (acromag.com) has released new isolated CAN bus modules to interface network sensors and actuators to high-performance control systems.

Two versions of the CAN bus interface module are available. The IP560 is an Industry Pack ANSI/VITA-4 card that plugs into VME, CompactPCI, and PCI bus mezzanine carrier cards or single-board computers in embedded systems. IOS-560 models are designed for use within Acromag's I/O Server industrial PC, a small fanless box computer, which services mobile computing, machine control, and test applications. Single quantity pricing starts at $500.

TURCK Expands BIM-UNT Sensors Line

>**TURCK's** (turck.us) line of BIM-UNR magnetic cylinder position sensors—designed to mount within C-groove cylinders with no accessories required—has been expanded to include sensors with NPN outputs.

BIM-UNR sensors are also now enhanced with a combination mounting screw that allows users to choose a 3/16 in. (1.3 mm) allen wrench or a flat-bladed screwdriver for sensor installation. Sensors can be securely mounted with a quarter-turn of the mounting screw, which is located in close proximity to the cable exit.



Kontron Supports COM Express COM.0 R 2.0

>**Kontron** (Kontron.com) supports the recently launched PCI Industrial Computer Manufacturers Group (PICMG) COM Express COM.0 R 2.0 specification.

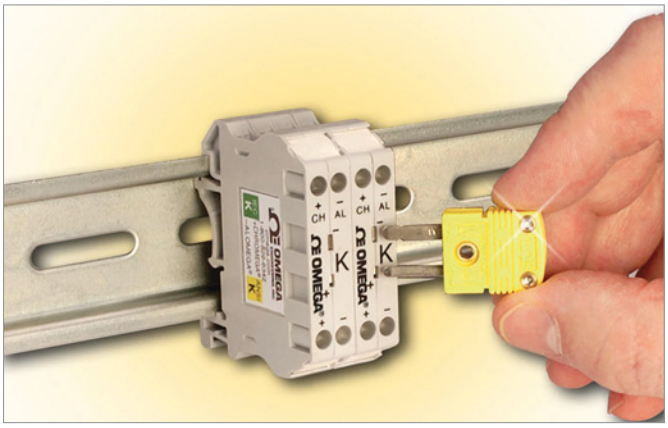
Two new pin-out types (type 6 and type 10) are detailed in the new revision. While maintaining backward compatibility, the new pin-outs offer dedicated interfaces for digital displays and other future-oriented features.

An additional feature of the COM Express COM.0 Revision 2 specification is the creation and adoption of a sister specification: EeeP (Embedded EEPROM Specification). EeeP facilitates describing the carrier functionality and embedding the system descriptor information (manufacturer, serial number, PCIe configuration, etc) on the carrier.

Tektronix Expands Logic Analyzer Family

>**Tektronix, Inc.** (tek.com) has announced the TLA6000 Series, a logic analyzer that it says brings debug and analysis to mainstream embedded systems designers. The TLA6000 Series delivers capabilities of the TLA7000 Series of instruments at a lower price point, while offering more capabilities than the portable TLA5000 Series models.

The TLA6000 Series has a base system configuration price of $19,800.



Omega Releases Thermocouple Terminal Blocks

>**Omega's** (Omega.com) new DRTB series of thermocouple terminal blocks come in type K, J, T, E, N, R/S and U calibrations. They are equipped with a built-in miniature female thermocouple connector for auditing and troubleshooting.

The DRTB is DIN Rail mountable and audit capable. This product is manufactured with thermocouple-grade alloys for accurate readings, according to the company.

Prices start at $8.

EDITOR'S PICK OF THE WEEK

FROM THE DESK OF **ANTHONY J. LOCKWOOD**, EDITOR AT LARGE, *DESKTOP ENGINEERING*

WOULD YOU TRUST THIS GUY? Well that question has already been answered by thousands of readers who have indicated they already do, implicitly. So here are Lockwood's most recent musings about the products that have really grabbed his attention, and deserve yours.

NVIDIA Introduces Quadro-Class Graphics Processing Units

> Company says new GPUs deliver up to eight times faster simulation performance.

This is a great time for engineering workstations. The new generation is really flooding in on us: multi-core, parallel processing, and so on. And now your ability to visualize what's going on is just about to take another leap forward.

NVIDIA just announced a new series of its Quadro graphics processing units (GPUs) based on its Fermi architecture. NVIDIA says that these new Quadro GPUs deliver performance that is up to five times faster for 3D applications and up to eight times faster for computational simulation, and they have benchmarks supporting that claim.

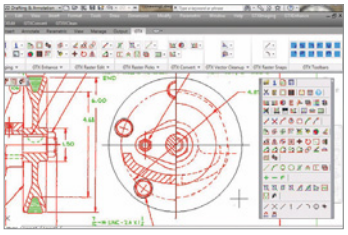
The Fermi architecture is intended to use dramatically less power than current technology to deliver supercomputing features and performance less expensively.

READ MY COMPLETE REVIEW:

>NVIDIA

Software Bridges Paper to AutoCAD Gap

> GTX Corporation updates its raster-to-vector conversion and editing tools.

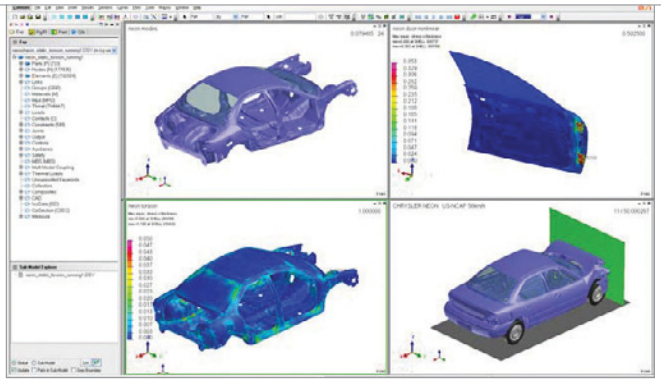


Converting your paper documents into images for AutoCAD can be a drag with all that editing and cleaning up of files. It's kind of like cleaning out the garage: One of those jobs that has to be done but no one really gets excited about doing it, so you procrastinate. Only there's a bonus element of trepidation about the whole process. You know too well that you can easily mess up what you're trying to do because clean-up is also such an exacting a job. With the latest release of GTX Corporation's GTXRaster CAD 2011 Series for AutoCAD 2011, your excuses are gone—as is much of the fretting over making a hash of things.

Your No. 1 takeaway about the GTXRaster CAD 2011 Series is that it's software engineered to provide reliable and easy-to-use image enhancement and clean up tools as well as all the functionality for raster and hybrid editing, raster-to-vector conversion, and character recognition that you want.

READ MY COMPLETE REVIEW:

>GTX Corporation



ESI Releases Virtual Performance Solution 2010

> Multi-domain analysis with a single-core model.

ESI Group's 2010 version of its Virtual Performance Solution is a good one for those of you designing for the transportation-related industries as well as consumer products like washing machines and stuff. How come? Because it brings together your work in a rational way so that you can focus on your work and not your tools.

The Virtual Performance Solution embraces a lot of things, such as gold-standard tools like PAM-CRASH. But what it really provides you is an integrated simulation environment. That is what makes it so cool. And so does this: You work across multiple analysis domains with a single core model—not different models for every load case. This streamlines your workflow, saving time and money by reducing the number of individual solvers you have to deploy and all that model re-creation business.

Virtual Performance Solution enables you to use both explicit and implicit solvers for such mechanical analyses as static linear and dynamics analysis.

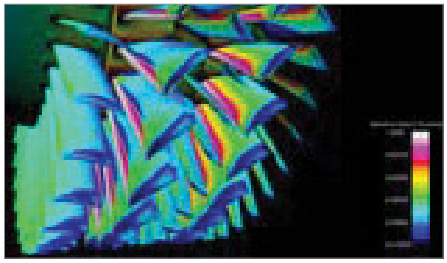
READ MY COMPLETE REVIEW:

>ESI

Integrated CFD Simulation Environment Updated

> STAR-CCM+ V5.04 offers over 180 productivity enhancements, greater speed.

So, I was on this field trip to investigate "the best Buffalo Wings" in town when this earnest young man wearing an awful tie on the barstool next to me asked for my opinion of integrated devices like my new iPhone. I told him that anything that brings together top-shelf, multi-function technology into one convenient unit was the future. Why lug around like a nomad, say, three devices when one can do it all? The same concept applies to your software environment. Why have multiple clean-up, meshing, and post-processing environments when you can have one environment that does it all as well as three discrete environments? Such is the beauty of STAR-CCM+ from CD-adapco.



Recently out in version 5.04, STAR-CCM+ unites the CFD analysis process from CAD to post-processing in a single integrated environment. Now what this means to you is that CAD prep work, meshing, model set up, and design study iterations are all handled from one location rather than the so-called normal "start, stop, load new app, start again" sequencing of the past.

READ MY COMPLETE REVIEW:

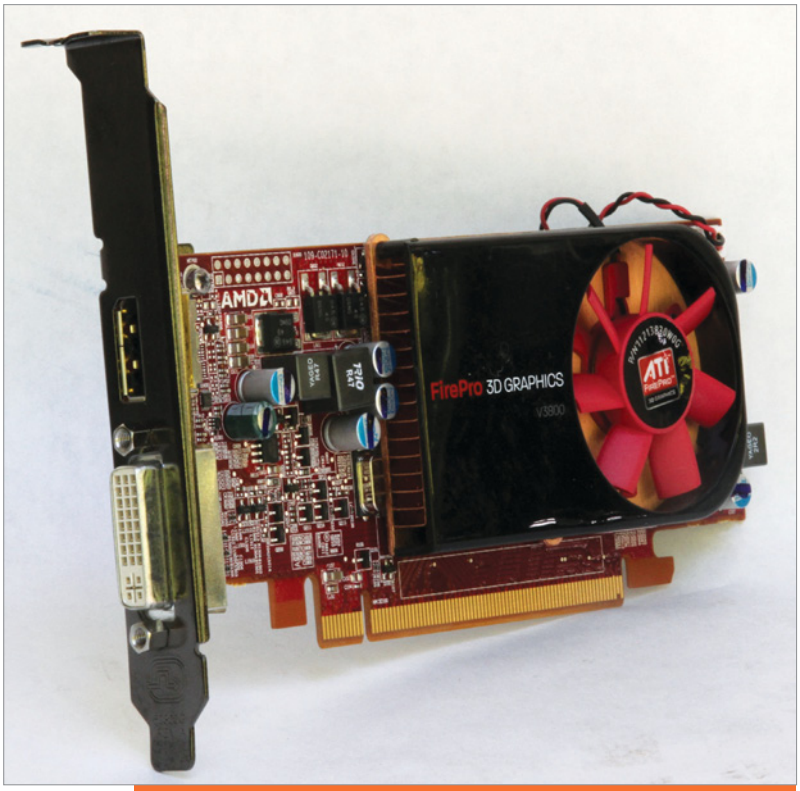
>STAR-CCM+

Graphics Power Bonanza

> AMD updates its ATI FirePro V-series lineup, doubling memory and GPU power.

BY DAVID COHN

Each year, graphics board manufacturers introduce a new generation of workstation-class graphics accelerators, leapfrogging their previous offerings with greater power and performance. This year is no different, with AMD releasing a complete refresh of its ATI FirePro family, offering CAD and digital content creators advances in performance and features at every price point. And as is true every year, our tests show that the new boards provide better performance than last year's boards at equal or lower prices.



The entry-level ATI FirePro V3800.
Photo by David Cohn

All five of the new ATI FirePro V-series graphics accelerators—the V3800, V4800, V5800, V7800, and V8800—use a PCI Express 2.0 x16 bus interface and feature a full 30-bit display pipeline, enabling more color values than 24-bit boards for more accurate color reproduction and improved visual fidelity. All also support DirectX 11 and OpenGL 3.2 as well as Full Shader Model 5.0. All five boards also support multiple monitors, with all but the entry-level V3800 also supporting ATI's Eyefinity technology, which enables users to run up to four independent and simultaneous displays with a single graphics card. With Eyefinity, you can have different applications open on each screen or span an image across multiple displays as one desktop workspace.

But the biggest differences from the previous generation of FirePro boards are the amount and speed of memory and computational power in each card's graphics processing unit (GPU). Until a few years ago, GPUs relied on dedicated geometry engines and pixel shaders. That all changed with the introduction of unified graphic architectures in which the power of the GPU can be dynamically allocated to vertex or pixel shading. AMD calls its

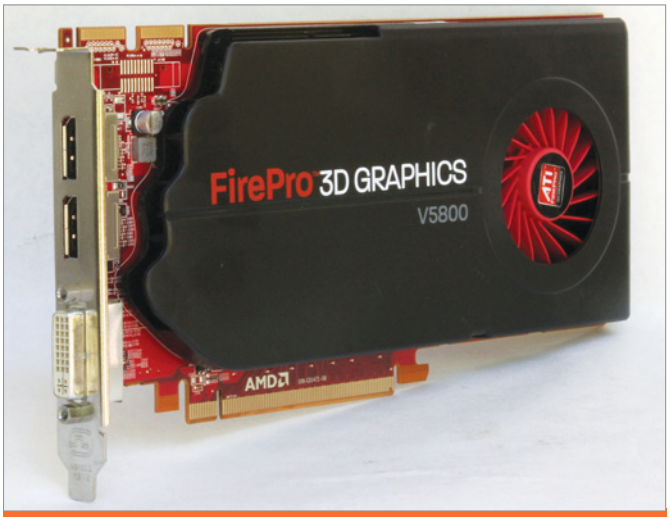
unified shader architecture Stream processors, and the new generation of FirePro boards feature 400 Stream processors in the entry-level V3800 (up from a mere 40 in the previous generation V3700) up to a whopping 1,600 Stream processors in the top-of-the-line FirePro V8800 (twice that of the previous generation V8700).

Like their predecessors, the new ATI FirePro V-series graphics accelerators include AMD's AutoDetect feature, which optimizes the graphics driver based on the user's specific software applications even while running multiple programs simultaneously. With AutoDetect, users no longer need to manually adjust application-specific driver settings to achieve top performance.

With the exception of the V3800 and V8800, all of the new FirePro boards include a single DVII dual-link output and a pair of DisplayPort (DP) connectors. The entry-level V3800 includes only one of each while the high-end V8800 sports four DP ports but no DVII connection.

The New ATI FirePro V Family

At the entry-level, the new FirePro V3800 ($109 manufacturer's suggested retail price) provides 512MB of GDDR3 memory, double that of last year's V3700, and 400 unified shaders, 10 time that of its predecessor. Its 64-bit memory interface and 14.4 GB/second memory bandwidth are essentially the same as last year's board, but the extra memory and more powerful GPU result in a significant increase in performance—ATI claims up to 10X performance gain—while entering the market at just $10 more than the card it replaces.



The ATI FirePro V5800 balances price and performance. *Photo by David Cohn*

The FirePro V3800 requires a single PCIe x16 slot and consumes 43 watts of power. Although AMD can no longer claim to offer an entry-level 3D graphics board for under $100, the V3800 packs a lot of power in a very small package.

While the V3800's price makes it incredibly attractive, those looking for an entry-level workstation-class graphics accelerator can get a lot more bang for their buck by going with the FirePro V4800 ($189 MSRP/$168 street). Also billed as an entry-level board, the V4800 replaces last year's V3750 at a slightly lower price. Although its GPU provides the same number of Stream processors as the V3800, the V4800 comes with 1GB of fast GDDR5 memory, compared to just 256MB of GDDR3 memory in last year's V3750. The new board has the same 128-bit memory interface and 24.4 GB/second memory bandwidth as last year's board, but again the improved GPU and larger memory yield a significant performance improvement. The FirePro V4800 also includes both a dual-link DVII connector and a pair of DP ports and supports

ATI's Eyefinity multi-display technology.

At the mid-range, AMD replaced last year's V5700 with the new FirePro V5800. The mid-range always seems to be the sweet spot in the lineup, and that proves true again this year. With a suggested retail price of $469 ($403 average street price), the V5800 is priced more than $100 lower than the board it replaces. Although it requires just a single PCIe x16 slot, the V5800 comes with 1GB of GDDR5 memory (double that of last year's card) and its GPU now contains 800 Stream processors (compared to 320 in the V5700). Its 64 GB/second memory bandwidth is also significantly faster than its predecessor. Like all of the new boards, the increase in power does come at the expense of greater power requirement, with the V5800 consuming 74 watts, but that's still below the threshold at which supplemental power is required, so the V5800 should be at home in any workstation. Like the V4800, the V5800 provides one dual-link DVII output and a pair of DP connections. The V5800 also supports ATI Crossfire Pro, which enables users to harness the power of two GPUs by linking two identical FirePro cards together with the supplied connection cable.

The V4800 has 1GB of GDDR5 memory.
Photo by David Cohn

At the high-end, AMD introduced two new boards. The FirePro V7800 ($799 MSRP, $651 street) replaces the V7750, which we did not review last year. The new board comes with 2GB of GDDR5 memory, double that of its predecessor, and its GPU provides a whopping 1,440 unified shader processors, compared to just 320 in last year's board. The V7800 also supports Framelock/Genlock with the addition of a FirePro S400 Synchronization Module. AMD claims up to a 4.5X performance improvement over the prior generation. But while the V7800 requires just one slot, the extra power comes at a cost: the V7800 consumes 138 watts and therefore requires an auxiliary connection to the system power supply.

At the top of the new AMD lineup is the Fire-

ATI FirePro 2010 Round-up

	V8800 NEW!	V8700	V7800 NEW!	V5800 NEW!	V5700	V4800 NEW!	V3750	V3800 NEW!	V3700
Manufacturer's Price	$1,499	$1,499	$799	$469	$599	$189	$199	$109	$99
Average Street Price	$1,186	$1,229	$651	$403	$499	$168	$169	$116	$85
SPECviewperf 11.0 (HP xw 6600)									
catia-03	7.78	7.29	7.56	7.14	6.47	7.08	6.69	5.58	4.97
ensight-04	26.70	20.22	23.28	19.26	10.66	18.40	7.09	9.18	4.40
lightwave-01	12.30	5.13	11.81	8.63	5.00	7.83	5.06	5.97	4.42
maya-03	24.09	19.26	24.03	23.60	21.58	23.11	2.25	9.29	2.02
proe-05	1.61	1.45	1.60	1.59	1.66	1.59	1.24	1.35	1.48
sw-02	21.00	20.99	20.95	20.79	20.67	20.67	20.19	19.87	15.13
tcvis-02	11.37	8.50	11.35	10.03	9.71	9.93	5.21	6.08	4.07
snx-01	28.08	24.54	24.89	23.66	19.47	23.59	11.06	16.12	6.44
SPECviewperf 10.0 (HP xw 6600)									
3dsmax-04	63.37	63.30	63.21	63.21	61.08	63.01	56.82	59.53	38.29
catia-02	63.28	62.81	62.68	62.60	61.86	62.48	58.35	57.86	44.89
ensight-03	74.06	57.91	64.13	59.03	47.95	55.76	38.41	33.19	26.14
maya-02	207.19	171.69	170.56	173.80	154.00	168.76	147.21	141.95	80.67
proe-04	49.93	49.70	49.71	49.69	49.65	49.59	48.66	47.71	33.67
sw-01	89.83	89.30	88.35	88.17	87.66	87.81	87.79	85.54	60.14
tcvis-01	50.55	43.37	46.29	38.53	38.30	38.29	31.00	27.55	17.07
ugnx-01	81.81	59.17	68.26	64.55	48.99	63.95	37.57	43.79	15.93
Specifications									
Bus Architecture	PCI Express X16	PCI Express X16	PCI Express X16	PCI Express X16	PCI Express X16	PCI Express X16	PCI Express X16	PCI Express X16	PCI Express X16
Extra Power Required	Yes (2)	Yes (2)	Yes (1)	No	No	No	No	No	No
Form Factor	4.38"x10.50"	4.38"x9.50"	4.38"x11.00"	4.38"x6.62"	4.38"x6.62"	4.38"x6.62"	4.38"x6.62"	4.38"x6.62"	4.38"x6.62"
Slots Used	2	2	1	1	1	1	1	1	1
Max Power (Watts)	208W	151W	138W	74W	56W	69W	48W	43W	32W
PCIe Version	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Length	Full-length	Full-length	Full-length	Half-length	Half-length	Half-length	Half-length	Half-length	Half-length
Processors	1600	800	1440	800	320	400	320	400	40
Memory Configuration	2GB (DDR5)	1GB (DDR5)	2GB (DDR5)	1GB (GDDR5)	512MB (GDDR3)	1GB (GDDR5)	256MB (GDDR3)	512MB (GDDR3)	256MB (GDDR3)
Memory Interface	256-bit	256-bit	128-bit	128-bit	128-bit	128-bit	128-bit	64-bit	64-bit
Memory Bandwidth	147.2 GB/sec	108.8 GB/sec	128.0 GB/sec	64.0 GB/sec	57.6 GB/sec	24.4 GB/sec	24.4 GB/sec	14.4 GB/sec	15.0 GB/sec
Number of Dual-link DVI Outputs	0	1	1	1	1	1	1	1	2
Number of Display Port Outputs	4	2	2	2	2	2	2	1	0
Stereo 3D Connector (3-pin DIN)	Yes	Yes	No	No	No	No	No	No	No
Framelock/Genlock	Yes	Yes	Yes (1)	No	No	No	No	No	No
ATI CrossFire Pro	Yes	Yes	Yes	Yes	Yes	No	No	No	No
OpenGL Version	3.2	2.1	3.2	3.2	2.1	3.2	2.1	3.2	2.1
DirctX/Shader Model Version	11/5.0	10.1/4.1	11/5.0	11/5.0	10.1/4.1	11/5.0	10.1/4.1	11/5.0	10.1/4.1
Maximum Resolution Support (@ 60 Hz)	2560x1600	2560x1600	2560x1600	2560x1600	2560x1600	2560x1600	2560x1600	2560x1600	2560x1600

Pro V8800. Although priced at $1,499 (the same as the V8700 that it replaces), its average street price of $1,186 is a bit lower than last year's card. The V8800 comes with 2GB of DDR5 memory, double that of the previous board. Its GPU also ups the ante, with an incredible 1,600 Stream processors, again double that of the board it replaces. Of course, its power requirements are also significant: 208 watts. Its two required auxiliary connections to the system power supply means that it can only be installed in a workstation that can supply the necessary juice. The V8800 is also so thick that it will cover an adjacent expansion slot. Like the V7800, the V8800 also accommodates the S400 Synchronization Module for Framelock/Genlock support, but unlike the other new boards in the 2010 FirePro lineup, the V8800 does not include any DVII connections, but instead provides four DP outputs. The V8800 comes with two DP to DVI single-link adapters as well as a CrossFire Pro connection cable. A workstation equipped with a pair of V8800 cards could power up to eight displays.

The high-end V8800 takes up two slots and requires 208 watts. *Photo by David Cohn*

Benchmarking the Boards

We tested the five new ATI FirePro boards using the same HP xw6600 workstation equipped with a pair of 3GHz Quad-Core Xeon E5450 processors, so all of our results are directly comparable. Since the newer boards require updated versions of the ATI Catalyst driver software, we also retested last year's boards using the updated driver to get an accurate comparison of the performance improvements.

All tests were performed using both version 10 of the SPEC Viewperf benchmark (www.spec.org) and version 11, which was recently released, both at a resolution of 1,280x1,024.

Our test results clearly indicate improved performance over the previous generation of FirePro graphics boards, although not the 2X to 10X gains claimed by AMD. That said, this new generation of ATI FirePro boards do indeed equal or surpass the performance of the older boards at prices often significantly lower than their predecessors. All of the new ATI FirePro boards are fully certified with most CAD sand DCC applications and use the same unified video driver. Drivers are available for most

32- and 64-bit operating systems, including Windows 7, Vista, XP, and Linux.

With these new ATI FirePro boards, the competition between AMD and NVIDIA continues, with users like you and me reaping the performance benefits. ■

David Cohn is a computer consultant and technical writer based 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 www.dscohn.com

AMD

ati.amd.com/firegl

>Priceing:

- **ATI Fire Pro V3800:** $109 (suggested retail), $116 (average street)
- **ATI Fire Pro V4800:** $189 (suggested retail), $168 (average street)
- **ATI Fire Pro V5800:** $469 (suggested retail), $403 (average street)
- **ATI Fire Pro V7800:** $799 (suggested retail), $651 (average street)
- **ATI Fire Pro V8800:** $1,499 (suggested retail), $1,186 (average street)

FOR MORE INFO:

> Deskeng.com

Luxology modo 401 Impresses

> Modeler now supports 2D planar inverse kinematics (IK) setups, replicators and volumetric lights

BY MARK CLARKSON

Luxology modo 401 is a polygon and subdivision surface modeler. It's not at all CAD-like. That's either good or bad, depending on who you are. Personally, I like it a lot. I reviewed modo 302 a couple years ago (deskeng.com/articles/aaamzk.htm). I recently took a look at version 401 to see what's changed.

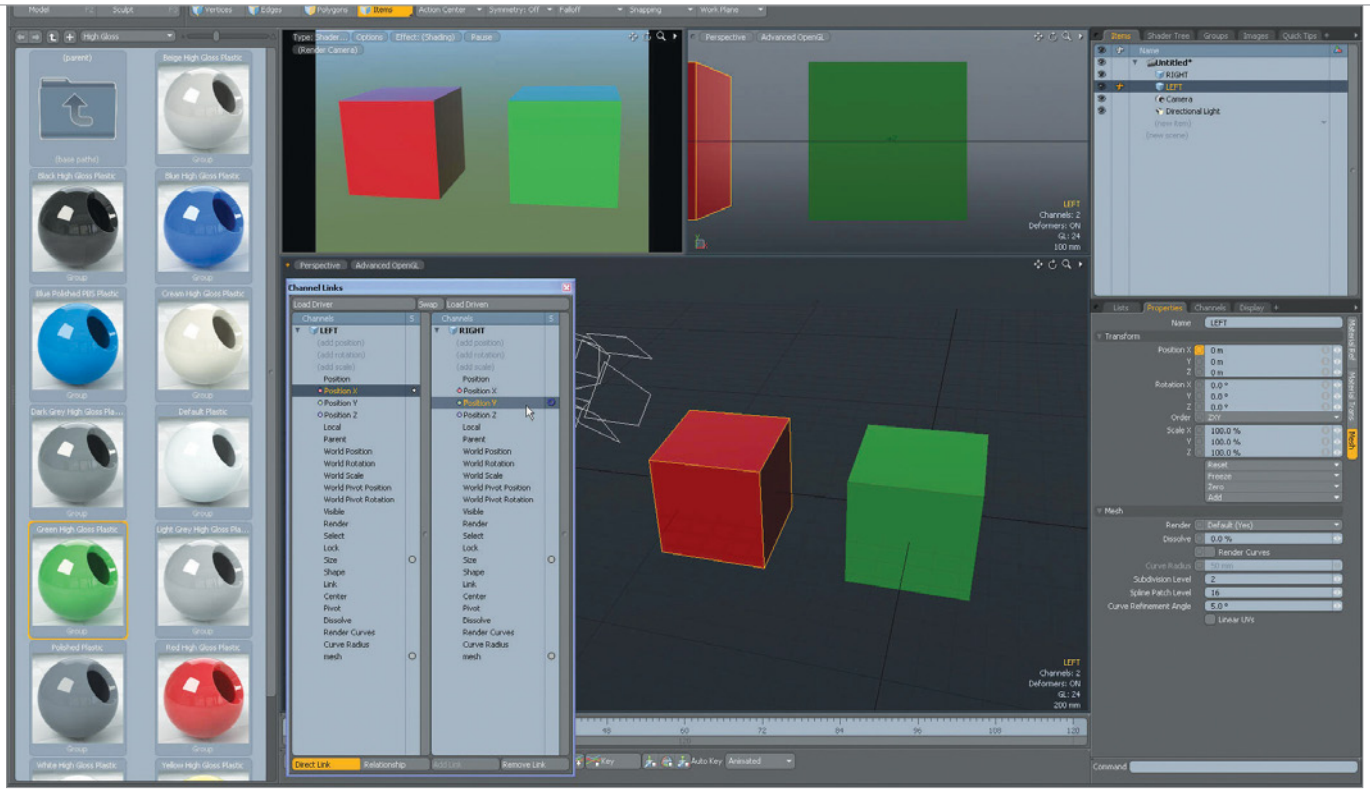
modo 401's preset browser is much improved. The real-time preview window lets you navigate textures in your scene.

So, What's New?

As expected, 401 comes with quite a few handy new tools and options. There are big, splashy additions such as replicators, which allow you to populate your scenes with vast numbers of objects, and volumetric lights for creating cool 3D light and shadow effects, not to mention fur and hair.

And there are the small additions, things that just make doing what you already do a little bit easier. Background constraints have been expanded, making it easier to create new geometry that conforms to existing geometry. The pen tool has news settings to speed the creation of walls. As someone who occasionally does architectural modeling, that's something that I appreciate, as are all the new bevel and end cap presets. Drag-weld—which lets you drag vertices together and automatically weld them—is one of my favorite new time savers, as is Grow Quads, which quickly creates new geometry around the edges.

These little improvements may only save you a



Setting up a simple relationship in modo. The first object's X position will drive the second object's Y position. As the red box moves right, the green box will go up.

click or two, but they save those clicks dozens—or hundreds—of times per modeling session. It really adds up.

Kinematics, Relationships and Constraints

modo's biggest strides have been in its animation. In my previous review, I pronounced modo's animation adequate for turntable spins and opening and closing a cell phone. It's come a long way since then.

modo now supports 2D planar inverse kinematics (IK) setups. With IK, long chains of linked objects can be driven by a single goal. Think of a robot arm reaching for a tool. Rather than manually setting the angle of each joint to place the hand in the right location, you attach a goal to the tool. modo's IK automatically and continuously computes the correct angles for all the joints, so

that the hand ends up where it's supposed to be.

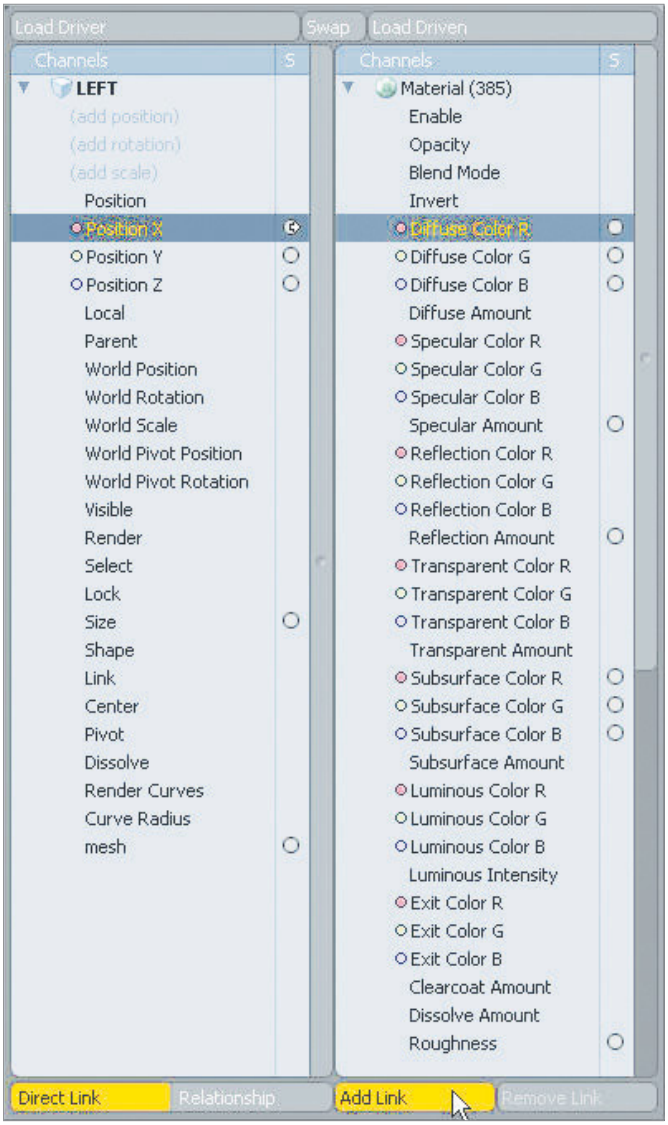
IK in modo is currently limited to 2D planes. You can't create an IK chain with a rotating ball joint, for example. Nor does modo support bones, needed by character animators to control organic objects. But what it does do, it does in a very robust way.

In addition to IK, 401 adds an array of linkages, constraints and relationships. You can constrain an object to travel along a path, or stick to the surface of another object. You can link objects together in ways both expected (A goes up when B goes up) and unexpected (A turns red when B goes up.)

You can drive nearly anything from nearly anything else. An object's position and orientation, for example, can drive another object's texture, or vice versa.

You can drive nearly anything from nearly anything else. An object's position and orientation, for example, can drive another object's texture, or vice versa. You can make a phone's LCD screen light up when the phone is flipped open by building a relationship between the rotation of the phone and the luminosity of the screen material. You can turn a car's headlights on and off depending on the position of the physical sun, and extinguish the dome light when the doors are closed. Relationships are easy to set up, and can include math and graphs that can be tweaked to further refine interactions.

In its simplest form, you might use a direction constraint to keep your camera looking at an object (its target), but you can create setups of arbitrary complexity. Luxology has shown a demo of a fully-rigged WWII era tank with 10,000+ linkages (watch it at vimeo.com/5219591), and offers a video tutorial on setting up a radial engine complete with working pistons and cam-driven valves—all controlled by a single object that can be animated.



You can drive any channel from any other channel. Here, the X position of one object will drive the red component of another object's texture.

Presets in Plain Sight

In previous versions, presets and textures were all but hidden. Thankfully, 401 makes them much easier to get at and use. It is now easy to browse through materials, meshes, environments and assemblies and add them to your scene by double clicking or dragging and dropping.

The results of drag-and-drop materials are much more predictable than with previous versions. You can take a "blank" model and fill it in with real world textures and materials in record time.

modo's new, faster real-time preview renderer works hand-in-glove with the texturing process. It updates continuously to let you know what your rendered textures will look like. Right clicking on any object in the preview gives you a complete breakdown of its texture. If the shader tree is open, modo it will also select the material there.

401 comes with more presets than ever, and modo's active user community creates more assets every day. Luxology sells special preset libraries as well (see "Presets Kits" sidebar).

Replicators and Fur

401 has a nifty new tool called the Replicator. Replicas are similar to the instances that modo has always had. An instance of an object has no editable geometry of its own. It's just a copy, a doppelganger. So it is with a replica. But while instances can be moved and spun around, rep-

licas stay where they are created.

The Replicator creates a number of replicas of a base object. The number of copies can be quite high, so you can populate a park with blades of grass or a tree with leaves. You can make replicas in rectangular and radial arrays, cloned along curves, or scattered at random. You can also manually create a point cloud to guide the replicator, placing replicas of a single rivet across an entire airplane wing, for example.

A closely related new feature is modo's new Fur system, with all the basic tools to create hair, fur, bristles and grass. You can comb, stretch and curl the fur, and texture it using all of modo's texturing tools. While most of us don't model hairy objects very often, fur is still handy for creating toothbrush bristles or carpet nap.

SolidWorks Buddies

Luxology has been catering to the SolidWorks crowd lately. Its PhotoView 360 visualization and rendering software comes bundled with some versions of SolidWorks. And now, Modo 401 opens SolidWorks parts directly. This capability is a real boon to SolidWorks users, but it comes with a serious gotcha.

For some reason, SolidWorks import is only supported by the 32-bit version of the software, not in the 64-bit version. I spent quite a bit of time trying to open SolidWorks files in modo before finally figuring this out. That's really too bad. I imagine SolidWorks users being the most likely to be using the 64-bit version of the software. The workaround is apparently to install both versions of modo and use the 32-bit version to open and re-save your SolidWorks files. This treats the 32-bit modo software as a stand-alone file translator and rather defeats the purpose of the feature. I hope it's addressed in upcoming versions.

Assemblies do not come in with their SolidWorks links and constraints. If you want to animate them in modo, you'll have to set them up again.

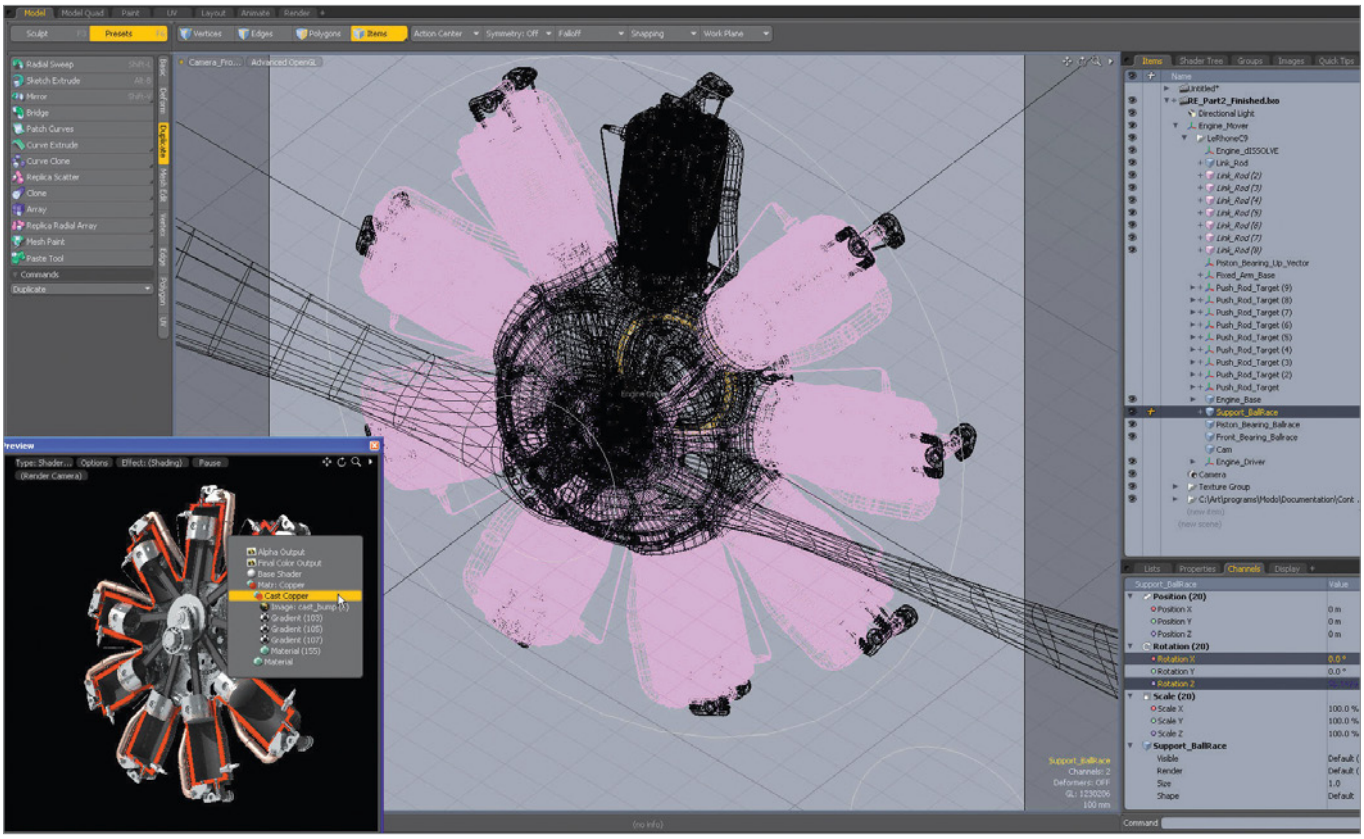
Presets Kits

I took at look at Luxology's HDRE Urban and Landscape kits. These are both designed to give you a selection of completely set up outdoor environments.

Double-click an environment and you get an HDRI background, as well as high-resolution background plates. The camera is set up at the correct distance, angle, and lens settings. The physical sun is at the right place in the sky. You've got a shadow catcher ready to go. Drop in your mesh and hit render.

Luxology also offers a studio lighting kit that emulates real-world lights and materials to easily create renderings with that "studio look." The lights even look like their real-world analogs, complete with tripods and other rigging.

I also took a look at Luxology's Product and Automotive Design Presets Pack, an impressive collection of 350 material presets ranging for the simple (black matte) to the complex (textured fur carpet and metalflake paint). I had a lot of fun customizing cars with this.



A radial engine complete with working pistons and cam-driven valves—all controlled by a single "animatable" object. (Video tutorial available from Luxology.)

All that said, it's still easier than ever to bring your SolidWorks projects into modo for a bit of photorealistic rendering and animation.

The Verdict

All-in-all, I like modo a lot. In fact, it's my modeler of choice, at the moment. Yes, sometimes it makes me quite cross with its disorganized help system, periodic crashes, and elements that don't update as and when they should.

And, as someone whose computer has two cores but whose video card has hundreds, I'm anxiously waiting for modo to jump on the bandwagon and better leverage all the computing power of my GPUs.

But it's a fun piece of software capable of some truly impressive output. I give it a thumbs up, but you can grab a free trial version and see for yourself. ■

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

FOR MORE INFO:

> Luxology

A Window into the Soul of Time

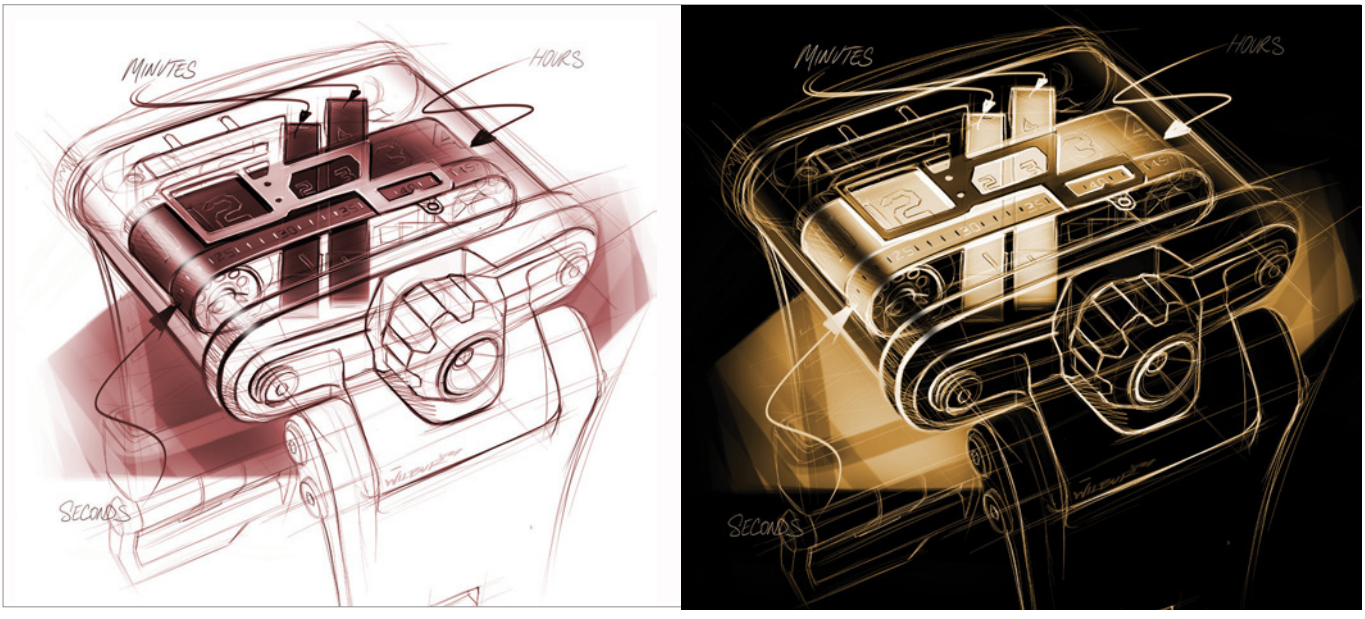
> A car designer turns watchmaking inside out with SolidWorks and Bunkspeed SHOT.

BY KENNETH WONG

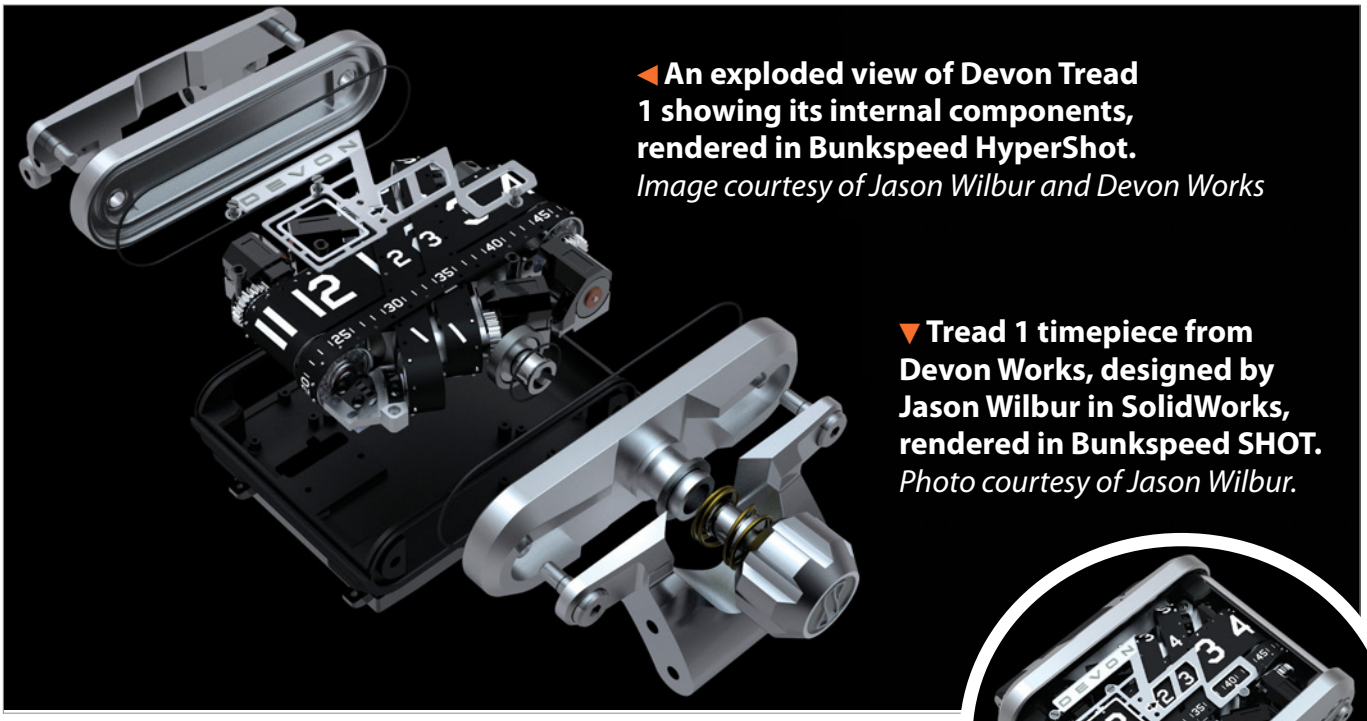
As spring arrived last April, international watchmakers and jewelry designers descended on Basel, a border town in Switzerland where Swiss, French and German borders meet. The place is the site for Baselworld, the annual conference where Seiko, Tissot, Raymond Weil and other high-end timepiece merchants come to impress one another and the world.

In the crowd of roughly 2,000 exhibitors and 100,000 attendees was Jason Wilbur, a former graphics designer and automotive designer. He was there to show his new creation, dubbed Devon Tread 1.

This newcomer had good reason to be nervous, as he was turning the art of watchmaking inside out—literally. Devon Tread 1 is a radical departure from the typical dial-and-needle timepieces. Its movement hinges on a series of overlapping,



Early concept sketches of Devon Tread 1. *Images courtesy of Jason Wilbur and Devon Works.*



◀ An exploded view of Devon Tread 1 showing its internal components, rendered in Bunkspeed HyperShot.
Image courtesy of Jason Wilbur and Devon Works

▼ Tread 1 timepiece from Devon Works, designed by Jason Wilbur in SolidWorks, rendered in Bunkspeed SHOT.
Photo courtesy of Jason Wilbur.

interwoven belts, encased in glass. The internal mechanism—the soul of the watch—is in full display, completely visible.

"There's a formula for creating high-end watches," says Wilbur. "And I wanted to break that formula."

To break the rules of timekeeping, Wilbur resorted to what he used to design cars and create brochures: SolidWorks CAD and Bunkspeed HyperShot (recently rebranded as Bunkspeed SHOT).

From Logos and Cars to Timepieces

Wilbur began his studies in upstate New York, with a fine arts course he never finished. It was interrupted when his internship turned into a real job. He drifted into graphics design, and when he grew weary of creating logos and brand collaterals, he enrolled in a transportation design course at the Art Center College of Design in Pasadena, CA. This time, he would complete the program, graduating in 2005.

"I like cars, but my real love is design," he says. "I'm also an artist, so I never want to do what everyone else is doing. I want to do something new."

For the next four years, he was employed by Honda to design mass-market vehicles and concept cars. "I've always been fascinated by motors and engines," he says. "There's a certain beauty in the way they function with mathematical precision."

Eventually, he decided to flex his creative muscles beyond automotive design. This time, his challenge was to be time itself. When people listen to their watches, they hear ticking. Wilbur hears something else: the heartbeat of a mechanical life form.

"Watches seem to have the same kind of soul [as cars]," he muses. "Both are mechanical, with central nervous systems and characters."

Wilbur recognizes that cell phones are far more accurate at keeping time than a watch is. For a watch to be relevant and appealing, he decided, it had to do more than tell time.

"It needs to be emotional sculpture, [something] driven more by passion than its mechanical function," he says.

Wilbur's timepiece has hundreds of components, with very few that are standard off-the-shelf parts. He knew that if he'd provided manufacturers with 2D sketches, he'd be taking a risk that they might not be interpreted as intended—or worse, the finished pieces might not assemble correctly.

"I used SolidWorks because I found it to be the best tool to make mechanical items beautiful, to bring out the subtleties in them."
– JASON WILBUR

"I used SolidWorks because I found it to be the best tool to make mechanical items beautiful, to bring out the subtleties in them," he says. Though Wilbur sculpted the timepiece aesthetically to his liking, he also knew that he'd have to turn his idea over to engineers to adjust the mechanical components to the appropriate ratio, scale and dimensions. When the time came, exchanging 3D SolidWorks files with engineers helped him create an iterative workflow.

The belts, the most delicate elements in the piece, gave Wilbur pause.

"They needed to be thin," he recalls. "But they mustn't bend or flex with exposure to the sun and weather elements."

He remembered a type of glass-reinforced nylon material used in avionics. "You could have [that material] at 150ºF heat or 20ºF below zero without worrying about it."

A Time to Render

Before his watch project was picked up by Devon Works, a Los Angeles-based design lab, Wilbur was looking for funding. He needed to raise roughly half a million dollars, he estimated. He judged—correctly, as it turned out—that photorealistic renderings created from a 3D model would inspire more confidence than 2D sketches could ever do. For this purpose, he turned to Bunkspeed HyperShot, a rendering program meant for those unfamiliar with typical rendering jargons and technicalities.

Devon Tread 1's time window is made of scratch-resistant, anti-reflective polycarbonate crystal with bulletproof toughness. The watch is manufactured by a California aerospace engineering company.

At Baselworld, Wilbur wore an early model of Tread 1 as he made his way through the exhibit halls. He fully anticipated snickers and skepticism from traditional watchmakers. But instead, "Everybody welcomed me into the world of fine watchmaking," he recalls.

FOR MORE INFO:

> Bunkspeed SHOT
> Devon Works
> Jason Wilbur
> SolidWorks
> Watch Journal

Ready for its Close-up

Devon Tread 1 appeared on the cover of a recent issue of Watch Journal, a magazine devoted to luxury watches. Normally, the magazine would use photographs of the star watch. Devon Tread 1's debut in the publication marks the first time the magazine used a rendered image on the cover.

Announcing the availability of limited editions of Devon Tread 1, Devon Works described it as "a big, bold, sexy declaration of independence from the status quo." In most cases, that would be hyperbole. With Tread 1, however, it's a fitting description.

Wilbur's masterpiece goes for an estimated $15,000 (roughly the price of a Honda Civic sedan).

A review of Bunkspeed SHOT is scheduled to appear in the November issue of DE. For a comparison of Bunkspeed SHOT and its closest competitor, Luxion KeyShot 2, read "One Scene, Two Shots," at deskeng.com/virtual_desktop/?p=2135. ■

Kenneth Wong *writes about technology, its innovative use, and its implications. One of DE's MCAD/PLM experts, he has written for numerous technology magazines and writes DE's Virtual Desktop blog at deskeng.com/virtual_desktop/. You can follow him on Twitter at KennethwongSF, or send e-mail to DE-Editors@deskeng.com.*

Rapid Economics

> Service bureaus offer variety and low overhead to a number of industries.

BY SUSAN SMITH

The complexity of this product's twisting manifold could have been challenging and expensive to machine or mold. It was produced with direct digital manufacturing by RedEyeOnDemand.

Rapid manufacturing service bureaus offer a variety of services, both additive and subtractive. Some offer as many of the up-to-date technologies and processes as possible; others focus on fused deposition modeling (FDM) processes, yet others focus on computed numerically controlled (CNC) or injection-molding processes, on 3D scanning, and 3D computer-aided design (CAD) modeling upon which all these processes depend.

The most common advantage that all service bureaus cite is that they offer a low-cost way to get parts manufactured, without carrying the overhead of machinery and materials. The other commonly cited advantage is that service bureaus generally have a number of different machines, processes and materials in-house, as well as the expertise to know which combination will work best for the parts a customer wants manufactured.

'Eye' on the Prize

To go out and buy an FDM system is something only the largest manufacturing companies can afford to do. To have FDM-made parts, which are comparable to injection-molded parts but can be produced in vast quantities and faster, without the overhead of equipment ownership, is a huge plus.

According to Jeff Hanson, director of RedEyeOnDemand, Stratasys' service bureau arm, business was flat in 2009.

"We managed to avoid a decline in 2009, though, because late in '08 we made a strategic shift to go from targeting just prototyping business to targeting low-volume production," he says. "This

new revenue stream is now more than 20% of RedEye's business."

RedEye's business was built on providing durable thermoplastic prototypes for functional testing.

"Now that we're pursuing the manufacturing market, it's even more imperative to have machines that can produce thermoplastic parts," says Hanson. "This requires FDM technology. We also offer [Objet] PolyJet for those customers who need prototypes with the glass-like edges, tiny feature detail and surface finish."

Hanson says the recession has been a catalyst for change.

"It creates out-of-the box thinkers," he explains. "When a business is making lots of money, it's sometimes harder to get that company to try something different and risk upsetting their money-making machine for something even more profitable. In the last year, we've seen lots of companies adopt additive fabrication as a viable alternative for production."

The Superstore Concept

Some service bureaus can offer "one-stop shopping," where customers can get a lot of different parts built from varying materials using varying processes, plus expert advice.

Quickparts' CEO Patrick Hunter says his company came out of the recession stronger than it was going in, because it was forced to concentrate on its core business.

"One of the best things we have is our people. Tough situations force you as a team to become closer," he says.

Hunter reports that Quickparts is seeing more positive activity in the market. Lead times are becoming more critical for customers as the manufacturing industry ramps back up, and there is a need to get new products on the market quickly.

Part of the job, he says, is to educate customers on what is going to best meet their needs and requirements: "I think we're seeing more of them relying on us more to help guide them in the process regarding lead time, price and functionality."

Hunter points out that the PolyJet process is continuing to pick up speed in certain applications, because some of its build characteristics are unique. Another area seeing a shift in is in the cast urethane process.

"In the past, it was a bridge from rapid prototyping to tooling, and now with the rapid tooling, we're able to offer cast urethane," Hunter says, noting that it is used for large, low-volume components like large medical housings. "The investment of an injection mold doesn't make sense when you can get a cast urethane tool and parts for the quantity that's required."

The fact that individuals and small companies can acquire a low-cost 3D printer has actually helped the overall rapid prototyping industry, Hunter says, because "it validates that 3D printing is here to stay.

"I think the biggest thing that drives rapid manufacturing in the industry is the creation of new and better materials," he continues. "The technologies have been out there, but the materials are what's helping advance it. The industry is rebounding; things are taking shape. We're moving as manufacturing product development is picking up, and new players are coming into the industry."

Expanding in a Down Economy

3D Systems is a provider of a family of systems that consists of the 3-D Modeling, SLA and SLS product lines. The investment of adding a service bureau arm to its business was a notable undertaking.

Abe Reichental, 3D Systems' president and CEO, says his company went public Oct. 1, 2009 with its service bureau, 3Dproparts, because "the service bureau industry was struggling with its ability to invest in the latest technology, and to fulfill its defined role as channel between equipment and materials suppliers and the ultimate end users."

3Dproparts set about investing in the latest additive manufacturing technology and materials. It purchased four service bureaus in different geographic areas: AcuCast Technologies in Lawrenceburg, TN; Advatech in Goodland, IN; Moeller Design in Seattle and DPT Design Prototyping Technologies in Syracuse, NY.

The business is divided into four segments: 3Dproparts Online Services, 3Dproparts Premier Services, Aerospace and Defense, and Dental/Medical. The service bureau offers SLA, SLS, selective laser melting (SLM), jet printing (MJM), AcuCast simulated die-casting metal parts, MQast proprietary metal casting solution, Objet PolyJet and CNC machining.

Reichental says he expects the new 3Dproparts business to earn between 15% and 20% of 3D Systems' total revenues by the end of this year.

3D Scanning, from Art to Industry

Michael Raphael, CEO of Direct Dimensions, says the economy has barely affected Direct Dimensions. In fact, his firm has been busier than ever for the past two years.

Painted selective laser sintered part by 3Dproparts.

"We think when the economy sours, large companies tend to lay off a few people and they still need to get the work done, so they outsource it," Raphael says.

Direct Dimensions provides reverse engineering, 3D measuring, 3D modeling, inspection/analysis and 3D laser scanning.

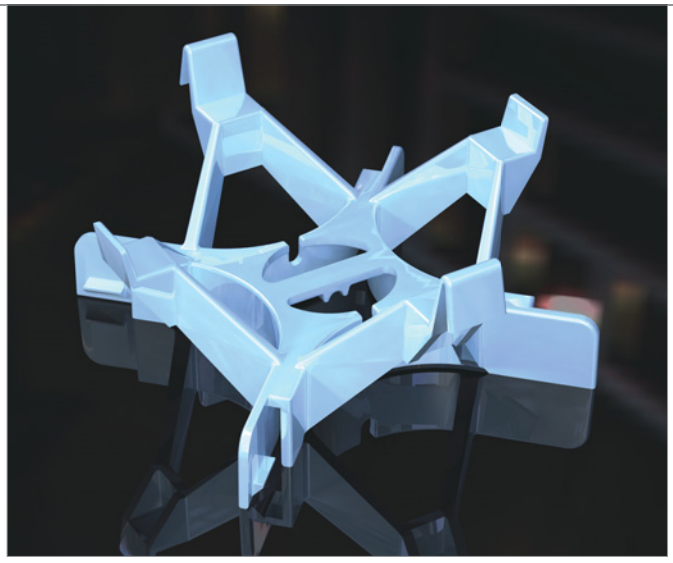
"People send us objects of any nature from any industry, or if it's too large, we go to it onsite—if it's a ship, boat or building," explains Michael Raphael, CEO of Direct Dimensions. "As a service, we convert their physical object into CAD format, using a lot of different equipment and software."

Laser scanning equipment is extremely expensive—$100,000 and up—so most customers would prefer to outsource that work to a service bureau.

Companies that do laser scanning every day, such as Boeing, need the equipment because they have old parts and tools that they want in CAD for the future. But they also outsource themselves to their customers.

Direct Dimensions is also a reseller and distributor—primarily PolyWorks, Geomagic and Rapidform for CAD conversion. Companies that want to bring scanning in-house often think they need to investigate all the equipment, but Direct Dimensions helps bring them up to speed quickly.

"We often can help them short-circuit that process, which could take weeks to a year. They send us a typical project; we do it as a service, and then they call us up and say 'We wanted to use that project as a test, and want to know what you used,'" explains Raphael.



Proto Labs manufactures custom CNC machined and injection-molded parts directly from customer's 3D CAD models that have been uploaded to its website.

Other equipment includes a CT scanner that they outsource for medical or industrial use. Direct Dimensions has a new system, ShapeShot, which takes a 3D picture of a person's face. It's useful for orthodontic applications and plastic

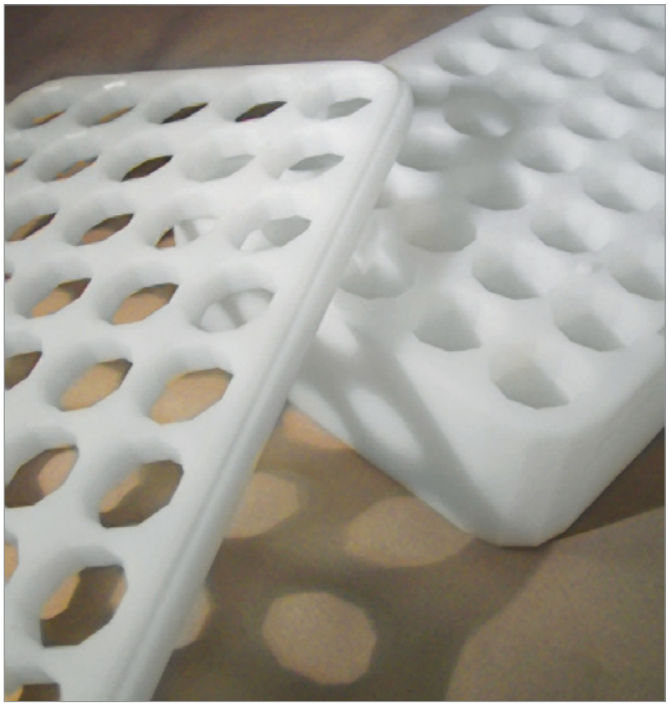
FOCUS ON THE SHAPE OF THINGS

Taking the increasingly popular concept of mass customization a step further, Shapeways offers a new business model. It has a "marketplace and community" focus, with the aim of making 3D printing technology accessible to consumers.

Shapeways enables consumers to use their own 3D software to design a product themselves, or open a shop and sell their items at Shapeways.com to others who don't have those skills. Consumers can also make their items customizable, so that people without 3D skills can adapt templates, make a mockup and Shapeways will then produce the item.

Shapeways currently offers FDM, SLS, ZCorp, and will re-introduce Alumide, a mix of nylon and aluminum dust; Objet white, black and transparent materials, stainless steel and the newly introduced first commercial offering of 3D printing of glass from ExOne.

Shapeways does not own its own machines, and outsources production. It has close to 40,000 members, and the website has approximately 650 shops run by community members, home to more than 9,000 products.



Quickparts offers a variety of options, including stereolithography (SLA), selective laser sintering (SLS), FDM, Objet PolyJet, CNC machine parts and sheet metal prototypes, as well as low-volume, injection-molded parts.

surgery, as well as to put faces in digital format for video games.

Subtractive Processes

Proto Labs is a custom manufacturer offering quick-turn injection molding and CNC machining services for prototype and low-volume parts. The company had a relatively flat year for 2009, but things have picked up for 2010. CEO Brad Cleveland attributes this change partially to the rebound in the economy and partially to some actions his team took to increase the envelope of parts they could make.

"Last year, we significantly increased the size and complexity of the parts we can injection mold and turn around in just a few days, and last year, we also introduced the ability to ship CNC aluminum parts in just a few days," he explains. "That's a fast-growing part of our business now."

In support of its four-year-old CNC machining service, called First Cut, the company has offered thermoplastics from the start. Last year, it added aluminum—and Cleveland hopes to announce additional metals over the course of this year.

"Aluminum has gone from nothing to a significant fraction of our CNC machining business in less than a year," he says. "We expect the demand for the new metals to also grow very quickly."

Proto Labs ships CNC machined parts, in plastic and aluminum, within one to three business days of receipt of an order, Cleveland says. It developed the software to automatically generate the toolpaths and CNC commands for 3-axis CNC mills. In addition, the company developed the fixturing technology to be able to hold the parts as they are machined and can machine from up to six sides.

Its Protomold injection molding service supports hundreds of thermoplastics. ■

*Contributing Editor **Susan Smith** is DE's expert in rapid technologies, and has been immersed in the tech industry for more than 17 years. Send an e-mail about this article to DE-Editors@deskeng.com.*

FOR MORE INFO:

> 3D Systems/3Dproparts
> Direct Dimensions
> Proto Labs, Inc.
> Quickparts
> RedEyeonDemand
> Stratasys

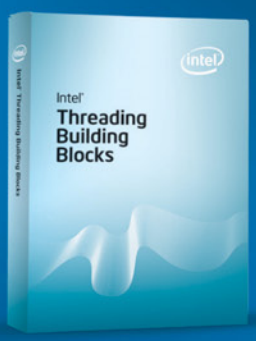
DEVELOPER ROCK STARS

Crank up app performance.

ENGINEER:
Robert Reed

APP EXPERTISE:
Threading Algorithm Libraries

DEVELOPER TIP:
Boost productivity.
Lambda constructs available in Intel® Parallel Composer make short work of parallelizing loops and other structures using the parallel_for or parallel_reduce functions in Intel® Threading Building Blocks.



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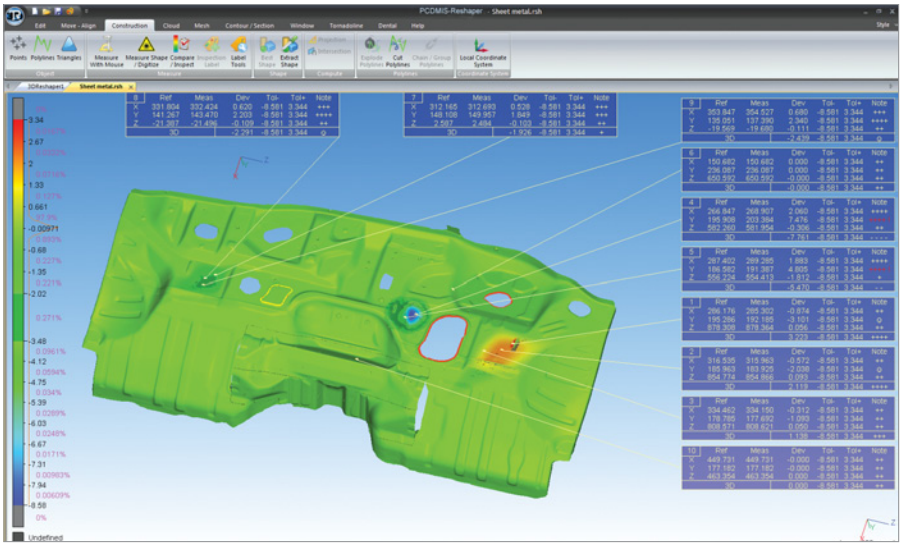
How to Choose 3D Point-Cloud Processing Software

> PART 2: High-power model creation and handling comes in well-priced packages.

BY PAMELA J. WATERMAN



Example of sheet-metal part inspection done with Hexagon Metrology's PC-DMIS Reshaper Inspection3D tool.
Image courtesy Hexagon Metrology

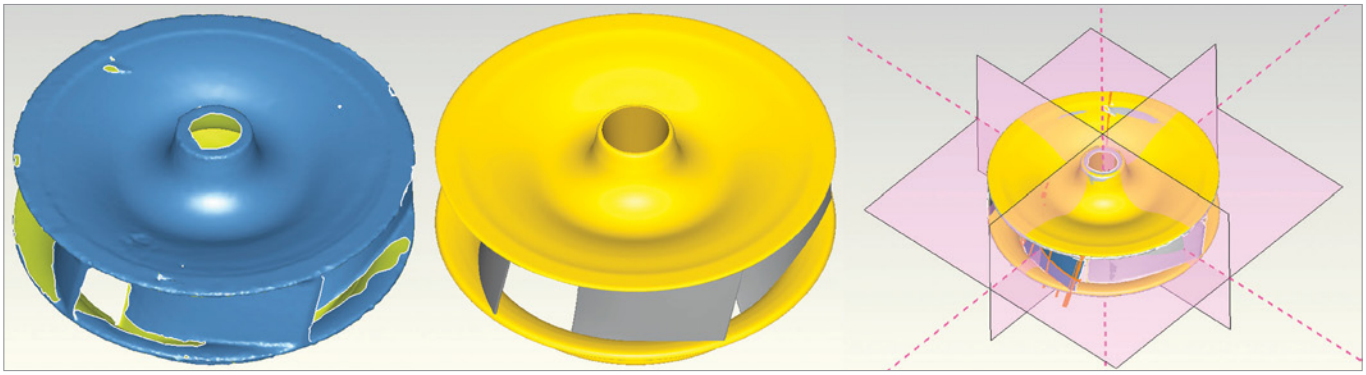
Scanning systems based on lasers, structured-light and other non-touch-probe technologies capture millions of data-points referred to as point clouds. Sorting, organizing and combining subsets of these points to represent the true details of physical parts is an intense challenge worth doing and doing well, to save the time of generating CAD files from scratch or to readily compare manufactured parts with their as-intended dimensions.

More than a dozen well-respected software packages tackle these jobs in various ways and with different levels of capability. In the September issue of Desktop Engineering, we dug into the nuances of three such packages—Geomagic, PolyWorks and Rapidform—known for their power and the variety of processing options they offer. Now DE turns its attention to an array of task-intensive packages that also offer strong value for the money.

Defining the User and Problem

Are you scanning legacy parts to recreate identical or improved versions? Or instead do you need to make your part fit into someone else's existing assembly? Lou Gallo, vice president of Digital Dimensions, a design and consulting company that resells SolidWorks products, sees these two questions as the first steps toward choosing point-processing software for reverse engineering.

"Does it matter if it's parametric or that you can edit it?" asks Gallo. "If the goal is to truly do



Scanned data of a fan converted into a solid model with Leios processing software.
Image courtesy 3D3 Solutions

Pricing for 3D Point-Cloud Processing Software

DE asked vendors to provide general pricing figures for their packages. The specifics will vary depending on which options are chosen.

VENDOR	PACKAGE	PRICE RANGE
3D3 Solutions	Leios	$1,500 to $3,000 (package)
Hexagon Metrology	PC-DMIS Reshaper	Inquire with Company
InnovMetric Software	PolyWorks V12	$20,000
Materialise	3-matic	$18,000
McNeel Software	Rhino-3D	$995
Raindrop	Geomagic Studio 12	$20,000 (Surface/Parametric together)
Rapidform	Rapidform XOR3	<$20,000 including 1 year of maintenance
Verisurf Software	Verisurf/BASIC, REVERS	$8,500 (BASIC and REVERSE)
VirtualGrid	VRMesh	$995 Reverse, $495 Design, $695 Forward; $1,695 all three (Studio)

reverse engineering so you can modify the design and release a different product, then parametric recognition makes it a lot easier to manipulate down the road. If the goal is to try and make a product that's going to interface to (the scanned piece), then it becomes less important that it's parametric and more important that it's accurate." Reverse engineering software does the former to different degrees, while inspection-oriented software addresses the latter. And if you just want to go directly to additive manufacturing, there are targeted tools for that job, too.

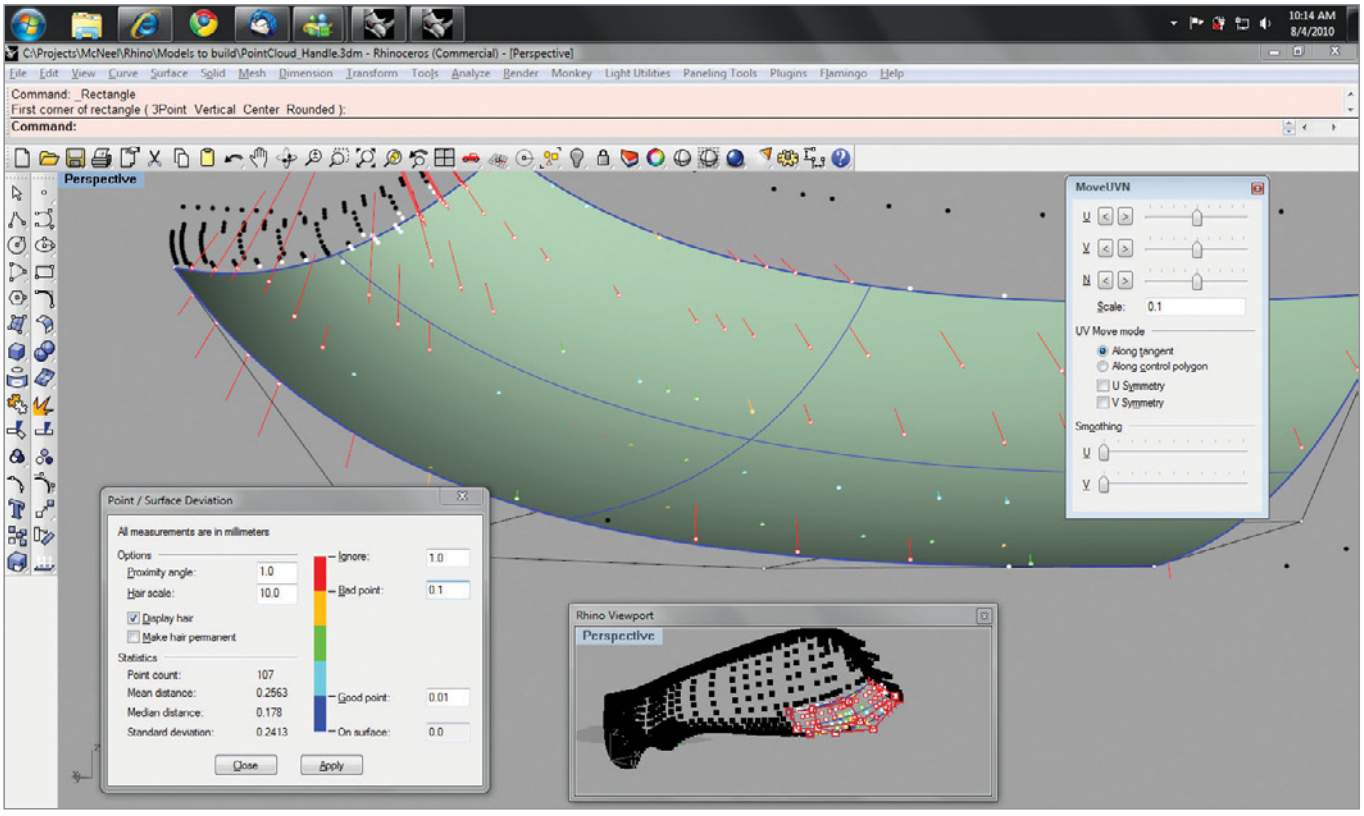
Some people also use the term "high end" as a way to distinguish certain point-processing software. However, although the opposite phrase then comes to mind for everything else—"low end"—think instead of these other packages as having tremendous capabilities, too, just in different combinations for a different price point. Large corporations tend to use the high-end packages, while small to medium businesses find the cost-savings of more streamlined packages best suit their needs. (See "Pricing for 3D Point-Cloud Processing Software" sidebar.)

Value-Loaded Point-Cloud Packages

As the classic TV advertisements say, "But wait, there's more!" For many users in both the reverse engineering and inspection worlds (in fact, about half the market), their tasks can be well served with point-cloud processing software from Verisurf Software, Virtual Grid, McNeel Software, 3D3 Solutions, Materialise and Hexagon Metrology. DE asked each company to point out several features that set its product line apart.

VirtualGrid markets affordable packages targeted to four different end users. VRMesh Reverse includes automatic meshing for reverse engineering; VRMesh Forward offers wire-frame curve detection for creating NURBS surfaces; VRMesh Design offers mesh repair and editing techniques for STL file creation and conceptual design; and VRMesh Studio includes all three versions. The software generates Class A meshed surfaces and Class B NURBS surfaces, with special attention to high-accuracy noise reduction, intelligent point-cloud decimation and remesh smoothing. The company recently released Cloud Decimator for AutoCAD 2011.

Packing extreme power for a great price is Rhino-3D from McNeel Software. Known for its rendering capabilities, Rhino-3D can also import point-cloud data and create, edit and repair meshes from NURBS



A point cloud of a 3D part and a surface being fitted to it using the Rhino-3D PointSetDeviation tool. This tool keeps track of the distance of the points to the NURBS surface as the surface is edited. The MoveUVN dialog box is also open; this tool lets users nudge the surface closer to the points. *Image courtesy McNeel Software*

surfaces. Its approach to free-form NURBS modeling makes it extremely robust, in fact. For example, the company says its ability to match curvature changes across a seam rivals that found in such high-end surface-modeling packages as CATIA and Alias.

3D3 Solutions markets Leios 2010 from EGSolutions. The software is used mostly for scan data alignment and data merging, though Thomas Tong, 3D3 Solutions president, adds that about 25% of their customers also use it for deviation analysis and surfacing. "Through extensive testing, we've found Leios is one of the most powerful and easy to use stand-alone packages for scan-data cleanup in its price range," he says. "It has strong automatic (Class B) surfacing features, and most of the surfacing is exported to CAD/CAM packages for refinement."

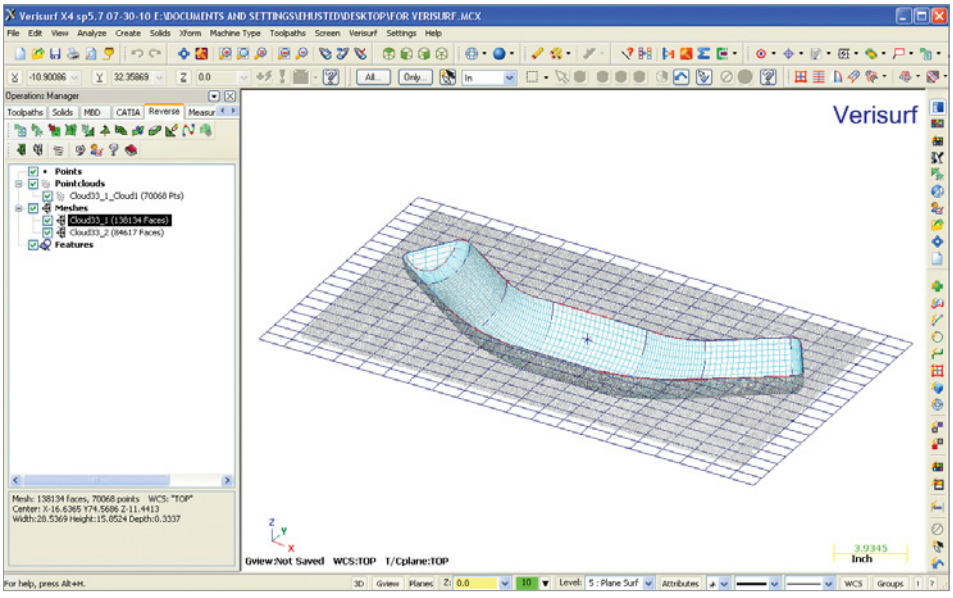
At Verisurf Software, director of sales and marketing David Olson explains that his company's standard solution offers multiple functions. It includes the Verisurf BASIC Class A NURBS modeler, Verisurf Device Interface for connecting to all 3D scanners and Verisurf REVERSE for point-cloud editing. Based on the Parasolid kernel, it creates editable solid models within Verisurf itself, generating surfaces, features, meshes and cross-sections. It opens major CAD files and compares and displays deviations between models and manufactured parts in real time.

A new effort under way at Verisurf Software involves working with aerospace companies and metrology hardware partners to address Outer Mold Line Control technology. The goal is to speed up assembly of fixed composite skins, access panels and hinged hatches while minimizing edge-to-edge steps and gaps.

You may not be familiar with PC-DMIS Reshaper from Hexagon Metrology, but the company's version 6.0 aims to offer an attractive price point for a product that serves needs in both reverse engineering and inspection. Users

cover the gamut of medical/dental fields, architecture/civil engineering/cultural objects, inspection tasks and reverse engineering. Innovative triangulation algorithms provide fast meshing even with noisy data.

Geometry preparation with additive manufacturing in mind is a specialty at Materialise. Among its many products, the company's family of 3-matic packages (Fixing, CAE and Design) takes scanned data directly to manufacturing using simple to sophisticated approaches. Materialise application engineer Jon Moss says one aspect that sets 3-matic software apart is its ability to manipulate polygonal data using CAD operations. Other features include interfacing directly with many CAE formats, as well as combining data from many different sources into an STL format with options to work on the data with various mathematical controls. Future plans include more macro programming capabilities and possibly brick meshing.



Scanned part mesh created with Verisurf 3D REVERSE Module. *Image courtesy Verisurf*

More for your Money

Looking ahead, the Holy Grail for many users of scanning software is automatic feature extraction. However, this requires knowledge beyond surface shape, including each feature's design intent and an understanding of the end-use, and may still be five years down the road. In the meantime, engineers are looking for more customizable programming options, better triangle mesh editing, faster task automation and better ease-of-use for occasional users. Given the progress that developers have made in just the past three years, these topics may show up sooner than you think. ■

Contributing Editor ***Pamela Waterman****, DE's simulation expert, is an electrical engineer and freelance technical writer based in Arizona. You can send her e-mail to DE-Editors@deskeng.com.*

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Server Clusters: Flexible Performance

> Clusters can provide much of the performance of a supercomputer costing much more, if you choose your systems and software right.

BY PETER VARHOL

Engineers have long faced a tradeoff in their efforts. The better and more comprehensive analysis and simulation they do on designs, the better the resulting product. Yet to get the most comprehensive and detailed results, it has been necessary to turn to mainframes and supercomputers, which are the only individual systems powerful enough to turn around high-fidelity analyses in a reasonable period of time.

The cost of the most powerful computers is enormous, in the tens of millions of dollars. Even renting time on a shared supercomputer can run a hundred thousand dollars or more. In the vast majority of design initiatives, engineers make do with less detailed analysis work.

Intel Ready Clusters such as the SGI Altix enable engineering teams to configure cluster servers, interconnects, and software based on a common specification.

Today, the server cluster is rapidly emerging to fill the gap between the detail that can be achieved on an individual workstation and the supercomputer. Clusters usually consist of industry-standard server systems with lots of memory and processor cores, linked together with a high-performance interconnect like InfiniBand.

Clusters are a classic case of the whole being more than the sum of its parts. High-end analy-

sis and simulation software, such as the ANSYS product line, enables problems to be broken apart and run not only on multiple processor cores, but also on multiple processors, even across different physical servers.

The result is that properly designed and configured clusters can cost a fraction of the price of a supercomputer, and perform engineering computations almost as fast. Further, because they use standard hardware and operating systems, corporate IT can use them for general-purpose computing tasks when not running engineering jobs.

Cores Make the Cluster

A good starting place to talk about server clusters is the list of the 500 fastest supercomputers, found at top500.org. The vast majority of the systems listed there are in fact clusters, not traditional supercomputers. In many cases, they are custom-built and more expensive than off-the-shelf systems, but they demonstrate the power of inexpensive industry standard processors.

A key differentiator that reduces the cost of servers today is multiple processors and processor cores. Individual servers have had multiple processors for a number of years, but most general-purpose applications can't effectively take advantage of more than a single processor at a time.

Cores are more or less full processors, though in a single processor package. Each core has only one execution pipeline, a sequence of steps through which an instruction or set of instructions is executed. That means each core can take a piece of an engineering computation, and execute the computation. Common analyses and simulation problems often involve running the same computation many times on different data, making these problems readily adaptable to executing on multiprocessor and multi-core systems.

Hyperthreading adds still more to the equation. A hyperthreaded core has multiple parts of the execution pipeline, though not all of it. This allows the processor to appear as two processors to the operating system, enabling the operating system to schedule two threads or processes simultaneously.

The result is that each core can hold multiple thread states at one time. It can't be actively executing multiple threads, because there's still only one pipeline, but it can be holding threads that are waiting partway through the execution process. Processors could always do this, as a part of a context switch, but the additional registers means it can hold the entire thread state on-chip while another thread is using the pipeline.

Cluster configurations with high-end server processors are available from the vast majority of system vendors, including those who use industry standard Intel and AMD processors. In addition, competitive clusters with other common processor families can be found from IBM and Oracle.

Interconnect Speed Matters

They key to running engineering computations across servers is the ability to have extremely fast connectivity between those servers. That speed makes it possible for processors on different computers to be able to synchronize the execution of an analysis problem without significantly slowing down its completion. The net effect is that clusters

Fast connectivity between servers, essential for cluster performance, is often provided by InfiniBand components, such as this switch from Mellanox.

can achieve close to the full benefit of all of the processors and cores without the additional expense of putting them in a single custom computer.

The bad news is that most common networks don't have anywhere near the speed to make this happen, even over short distances. Ultimately, the faster its connectivity, and especially the lower its latency, the better the cluster will perform.

The primary technologies used for cluster interconnects are InfiniBand and Fiber Channel, with a smattering of other choices such as gigabit Ethernet. Of these, InfiniBand is the most common, primarily because it offers among the lowest latency, or response time, of any interconnect. Many of the fastest clusters, such as those on the Top 500 Supercomputer list, use InfiniBand components from the likes of Mellanox or QLogic. Having fast interconnectivity can make a big difference in the performance of analysis software, and the overall value of the cluster.

Software Provides the Edge

None of this hardware would matter without engineering software that can seamlessly break up an engineering problem into multiple parts that different processors and processor cores can execute. While writing applications that can run on multiple processors and cores is notoriously difficult, the performance advantages of doing so can more than justify the investment in more powerful systems and clusters with multiple processor cores.

While much of the high-end analysis software, such as that from ANSYS and The MathWorks has been written to run in parallel on these systems, there are still many applications that don't have that ability. In addition, the completeness of that effort varies from vendor to vendor, anywhere from a few key algorithms parallelized to the entire application.

This is why benchmarking is important. In general, the better the parallelization, the faster the software on clustered systems, so engineers should check the performance on their own cluster, or a similar cluster. While competing software packages may note that they enable parallel execution, one may be significantly better for your work than another. Get published data, run your own tests, or ask other engineers.

Many engineering groups have also developed their own analysis software in-house, customized

for their type of projects. If the expertise exists in-house to parallelize that code, it should also benefit from running on a cluster. Even changing a few key algorithms may dramatically decrease execution time, depending on the problem, so even those with custom software can take advantage of clusters.

Pre-Configured Clusters Ease the Transition

Cluster computing was given a boost with Intel Cluster Ready, a specification from the chip vendor that enables system buyers to be assured that cluster components, including servers and software, can reliably work together. Platform providers and system integrators use the Intel Cluster Ready architecture and specification to develop interoperable clusters that are straightforward for engineering groups and their IT shops to deploy and manage.

Because many high-end servers use Intel Xeon processors, the chip maker has an interest in ensuring that vendor hardware scales up well, and works with both components and software. Developed with hardware and software vendors, Intel Cluster Ready lets engineering groups match HPC applications to today's leading platforms and components. This includes servers from Appro, Dell, SGI, or Super Micro, as well as InfiniBand interfaces and engineering analysis software.

If your engineering team needs to take advantage of the power of a cluster to deliver relatively low-cost HPC, there are a wide variety of cluster systems to choose from, many running Intel processors, but also IBM servers using POWER processors, and Oracle servers using Sun SPARC processors. IBM and Oracle clusters often have better performance characteristics, but sometimes have less software support.

Lastly, choosing the right application software is critical. You may already have a preferred vendor for engineering analysis and simulation, or you may be looking for solutions that can take advantage of a cluster. In either case, make comparisons of benchmark results. Use published benchmarks if they are available, and if possible run some of your own analyses.

If you need more than just a workstation for the best analysis and simulation, a server cluster can make a lot of sense. Because they are typically standard servers, an IT department can help configure and manage them if needed. Ultimately, server clusters for fast and high-fidelity engineering analyses can pay for themselves with better product designs more quickly, without the added expense of supercomputing services. ■

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

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Amcor Loses Weight with Simulation

> Abaqus FEA helps plastic container division slash design cycle times, reduce unit weight and enhance product performance. BY LYNN MANNING

The competitive landscape of the consumer packaged goods (CPG) industry demands nimble adaptation strategies. Polyethylene terephthalate (PET) plastic container manufacturers are juggling business consolidation and government regulations with the need to demonstrate corporate and social responsibility. At the same time, changing consumer preferences, as well as energy and raw material costs, are driving an exponential expansion of product portfolios. The PET customer wants manufacturers to develop a wider variety of quality, innovative containers in ever-shorter time periods and at lower unit prices.

READ THE COMPLETE STORY:

> FastApps

CoCreate Used to Develop Livengood Platform

> Rolling medical deviceplatform's frequent design changes handled with explicit modeling. BY GEOFF HEDGES

The Livengood Platform is a rolling medical device platform used in hospitals to organize a patient's multiple IV bags, pumps, oxygen, and electronic monitors. It is also a stable platform enabling ambulatory patients to move about while tethered to the devices they rely upon for medical care.

When Livengood Engineering set about to develop the platform, its aim was to create a single cart that would consolidate all the devices attached to a patient, eliminating the need to attach devices to the bed, wall, or separate IV pole. Additionally, it would function as an ambulatory-assist device to improve patient independence and mobility.

The Fort Collins, CO-based entrepreneurial company realized it needed a design program that offered engineers flexibility for its often unpredictable and frequent design modifications. For that reason, among others, it chose PTC's CoCreate explicit modeling software.

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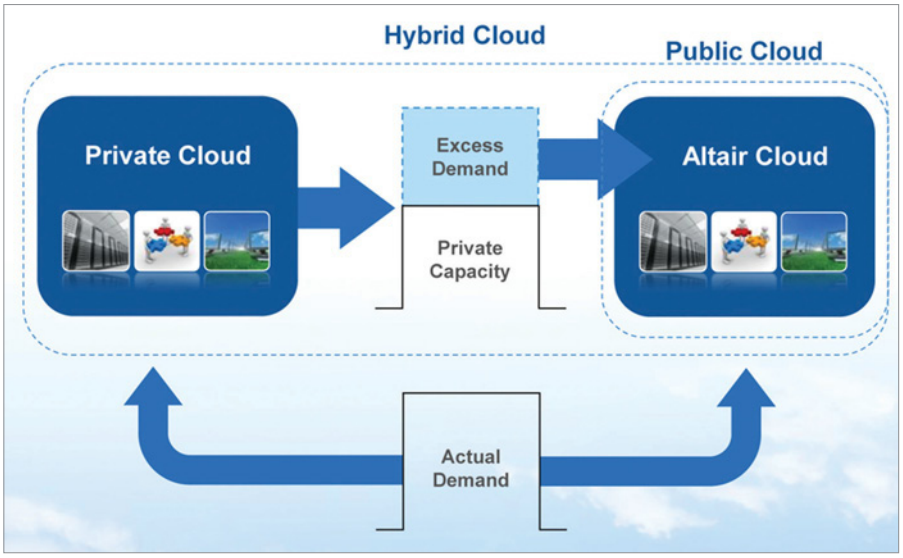
On-Demand Computing with Altair's PBS Works

> Tapping into private and public high performance computing systems.

BY KENNETH WONG



As explained in this diagram, when a user feels his/her local resources are no longer enough, he/she has the option to tap into Altair's cloud-hosted HPC environment to run the job.

Network computing was much simpler in the '90s, when most computers—desktops, laptops, and servers—came with single-core processors. In general, each node—usually identified as a single physical box in the network—came with a single computing core. Now, with multi-core processors becoming the norm in the consumer market as well as professional market, a single node could comprise as many as 12 computing cores.

If multi-core CPUs add complexity, they also open up new opportunities. One is to strategically manage and prioritize your computing demands using job schedulers. Another is to bundle your existing multi-core machines into a virtual cluster, ready to perform rendering, animation, analysis, and other heavy-duty tasks during off hours and weekends. These introduce what global engineering firm Altair and many others call desktop cycle harvesting, a way to reap more from your hardware investment.

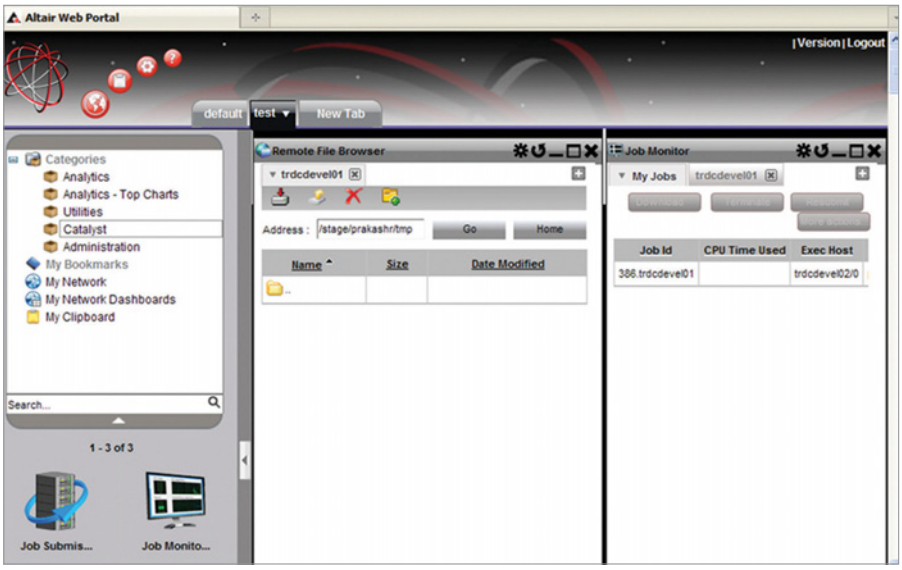
HPC Management for All Sizes

PBS Works, Altair's portable batch system software suite for distributed computing, can be used for setting up and managing high-performance computing (HPC) systems with as many as 120,000 cores, and as few as four to eight cores.

PBS Works used to be one behemoth applica-

tion encompassing workload management, cluster setup, and cloud-computing access. It has been refashioned into three complementary components:

- PBS Professional (commercial grade HPC workload management)
- PBS Analytics (usage monitor, reports, and planning)
- PBS Catalyst (job submission application)



Web interface for PBS Catalyst, the module for submitting jobs to HPC clusters.

The drag-and-drop job management interface, PBS Catalyst, is available as a desktop client or as a browser-based web client. This client functions as a portal to tap into the processing power available in your local machine or your company's internal network. If the internal computing capacity is not sufficient to process your jobs, you may choose to reach into Altair's on-demand computing environment through the client. Altair offers PBS Catalyst as a free download for managing up to four local cores.

"We're taking the technology that was once exclusive to large organizations and bringing it to the smaller ones that don't have all the necessary expertise," says Robert Walsh, Altair's director of business development for PBS GridWorks products.

PBS Works consists of a server, a scheduler, and machine-oriented mini-servers (MOMs). The server creates, monitors, and tracks job batches. The scheduler houses policies (administrative rights, credentials, access granted, and others).

The MOMs (mothers of all execution jobs) monitor the execution nodes' native resources (CPUs, disk, etc.) and custom resources (for instance, tagging a node with Altair's Radioss FEA program will tell the scheduler to route Radioss jobs to that node). They also monitor jobs in progress and help clean up the nodes where jobs are running. This allows the next jobs to run on those nodes without competing with leftover job remnants.

Drag and Drop Job Scheduler

The tabulated interface of PBS Catalyst shows you a summary of jobs generated, along with a list of local and remote computing resources (HPC nodes) at your disposal. You may configure the client to query the backend systems at regular intervals for updated lists of resources and jobs. Through the client interface, you may point to the specific HPC system to use and the priority level it gets in the queue.

While the PBS Catalyst client lets you customize and manage your own local resources, you won't be able to do the same with the backend

FAQs for HPC

Fielding daily inquiries from business prospects, Robert Walsh, Altair's director of business development for the PBS GridWorks product line, has noticed certain issues tend to be on most HPC buyers' mind. Here are a few, with the responses he usually gives.

QUESTION: ***If I want to set up my own private HPC system, do I need to acquire machines with the same type of CPUs? Or can I put together a system with a mix of CPUs? (For example, CPUs with varying number of cores and speed.)***

ANSWER: It depends on the application you want to execute on the system. With some analysis and simulation software, the floating point calculation method changes depending on the CPU architecture it's running on. So if you're repeatedly running the same analysis scenario to compare results, you may need to make sure you're running it on the same platform. If you want to run a job on eight cores, comprising four newer CPUs and four old ones, the newer CPUs will finish the job much quicker than the older (and slower) ones. So the newer CPUs will be forced to wait for the older CPUs to catch up. So if you'd like to retain older machines you've purchased as distributed computing resources to use in conjunction with newer ones, you can, but the older machines may not be the best resources. You'll need a job scheduling program like PBS Catalyst to designate the appropriate cores to different jobs.

Q: ***Can PBS Works give me an estimated amount of time a certain job will take to complete based on the number of cores designated and the volume of data involved?***

A: If you run a job, say an analysis scenario, on machine X, then run it again on machine Y with additional degrees of freedom or with different constraints, the time it takes to complete will be different. It's almost impossible to make an accurate prediction [of how long each variation will take]. In PBS Works, we display wall clock time—not CPU cycle time, but clock time—so if the user specifies that he/she wants to run a job for two or four hours, we can tell when the next job will start running. What we're working on now is to be able to take into account your past history—how long similar kinds of jobs took when you ran them previously—to predict how long your current job will take. But that's in the future. Today, time estimates are based on user input only.

Q: ***How do I get billed for using on-demand computing?***

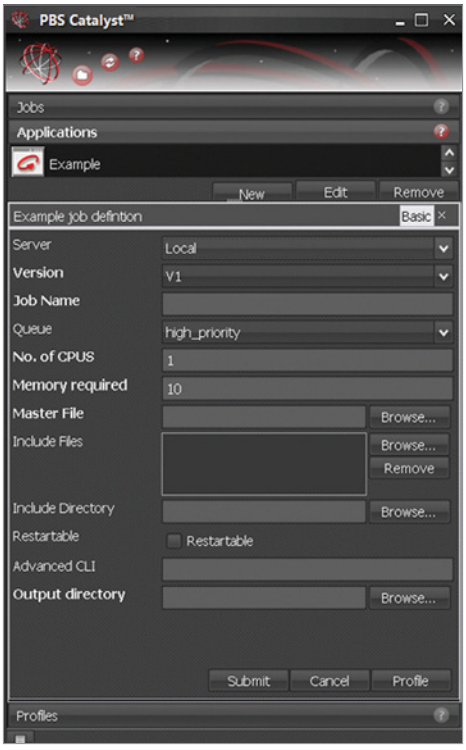
A: If you're using PBS Catalyst to submit jobs to your local machine or private HPC clusters, you only pay for the units (licenses) of PBS Works you're checking out. If you access our cloud [Altair's HPC system], then you pay additional $1.99 per node per hour.

Q: ***Can I use PBS Works to schedule works on GPU clusters?***

A: Absolutely. Today we don't even charge you for GPU management. So, for example, you have a machine with a quad-core CPU and a 128-core GPU, you're only paying for using the licenses of PBS Works you run on the CPU.

distributed networks (the company's internal network and the remote cloud network provided by Altair). They are, however, available for you to customize and submit your jobs to within the boundaries set by IT administrators.

"The reasoning behind this approach is, we're giving engineers the ability to manage their own local resources, but the backend resources are shared resources managed by IT staff, so users won't have the ability to do whatever they want to those systems," explains Walsh. These configurations are left to network administrators and IT managers with the right credentials to edit them via PBS Professional.



In PBS Catalyst, users can specify the number of processors and amount of memory required, along with priority setup options

If you run a certain job repeatedly, you may save the job setup with preferred parameters in your local profile. The next time you need to run the job, you can simply drag and drop it—with all your saved settings—into the appropriate queue.

Insight from History

The purpose of PBS Analytics is to let users monitor and study job queues, resources accessed, time requested, and other historic patterns to help develop enterprise-wide HPC strategies. Walsh says PBS Analytics might help you better answer the following: Are you short on licenses or computing cores? How many jobs are you running? Who's running most of the failed jobs? Do they need additional training?

In the future, it may also play a role in PBS Works R&D team's efforts to tackle one of the most challenging problems with distributed computing: estimating time required to complete jobs based on user history.

Open Architecture

Altair develops and markets its own computer-aided engineering (CAE) solution, HyperWorks, but PBS Works is designed with an open architecture to allow users to manage job scheduling with third-party software. "Even though I'm at a CAE company, I work with all the solvers from others, from Abaqus (from Dassault Systèmes) and MSC (Nastran, Patran, etc.) to ANSYS. They're all our partners," says Walsh. ■

Kenneth Wong *writes about technology, its innovative use, and its implications. One of DE's MCAD/PLM experts, he has written for technology magazines and writes DE's Virtual Desktop blog at deskeng.com/virtual_desktop/. You can follow him on Twitter at KennethwongSF, or send e-mail to DE-Editors@deskeng.com.*

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5 Ways to Fail When Prototyping a New Design

> Here's what not to do when starting a new design from scratch.

BY P.J. TANZILLO

Figure 1: This first prototype of a pipeline inspection gauge (PIG) focused only on the high risk aspects of the geolocation algorithm. The bicycle was a creative way to move the electronic system at a rate comparable to the PIG.

Product developments tend to come in one of two forms: the evolutionary and the revolutionary. In evolutionary projects, incremental improvements or small additional feature sets are added to an already existing and released product. The effort and risk tend to be much better understood in the product definition phase, and therefore, the timelines and results are easier to predict.

The revolutionary designs begin with a pipe dream or a moment of inspiration They tend to be higher risk and often venture into uncharted technical and business territory. These are the projects that require experimental prototypes before the solution can even be specified, and these are the projects that have the most volatile schedules.

Revolutionary designs are the inventions that can change the way we live. They are the cotton gin and the steam engine, the cell phone, the robotic surgeon and the electric car. National Instruments provides prototyping platforms that are used in innovative research and design projects, from the CERN Large Hadron Collider to the space elevator. This article will describe some common pitfalls to digital prototyping the company has discovered, so you can avoid them on your next revolutionary project.

1: Treat Failed Experiments as Project Failures

What better inspiration for invention than Thomas Edison, a classic example and a role model for innovators everywhere. In Harper's Magazine in 1890, Edison spoke of the many failures leading up to his invention of the electric light bulb.

"I would construct a theory and work on its lines until I found it was untenable. Then it would be discarded at once and another theory evolved. This was the only possible way for me to work out the problem. I speak without exaggeration when I say that I have constructed 3,000 different theories in connection with the electric light, each one of them reasonable and apparently likely to be true. Yet only in two cases did my experiments prove the truth of my theory."

For truly revolutionary designs, one sometimes needs to rule out many of the invalid solutions before arriving at a valid one. Each failed experiment is an opportunity for learning, and though frustrating, this is the only way to achieve truly revolutionary results. Mangers should celebrate failures alongside successes as progress toward an eventual solution.

2: Optimize for Cost too Early

Project managers and business owners love to shave cost from a project. Time and time again, we see engineers making decisions based on the cost of a first prototype at the expense of weeks of development. For experimental prototypes, most of the initial work will likely be thrown out, so reducing the schedule has a far larger impact on overall project cost than the cost of goods.

If we speak in practical terms, a good rule of thumb for the cost of an "engineering year" is $200,000. This includes salary, benefits, opportunity cost, support staff, etc. and although it varies greatly between regions and companies, it's a good conservative estimate. If there are 250 workdays in a year, each engineer costs about $800 per day. If you can make a decision that gets your first prototype to your customer a week earlier, for a five-engineer team, that is worth $20,000. Haggling over pennies on a revolutionary project is simply impractical before you reach volume production.

3: Optimize for Performance too Early

Similar to the project manager's desire to optimize cost early, software engineers love to optimize for performance so they can use their hardware resources in the most efficient way. Though this is an important step in the deployment phase of product development, we need to recognize that most code in an experimental prototype is "throw away" code, so time spent optimizing is time wasted. Instead, it's often better practice to prototype on a system with far greater resources than you think you need so optimizations of large subsets of code can be delayed to later iterations.

4: Try to Solve the Entire Problem in the First Prototype

In most designs, it's unnecessary to implement every aspect of the design in the first prototype. Instead, it's best to start with the highest risk element and work from there.

A good example of this can be found in the design of a pipeline inspection gauge (PIG) by the Brazilian company EngeMOVI. A PIG is a tool for oil and gas pipeline inspection that is inserted into the pipeline and propelled by the pressure of the circulating product. The PIG examines deformations and corrosion anomalies, helping prevent failures that can cause ecological accidents. To reduce costs and quickly replace the pipeline after the detection of an anomaly, it is necessary to know its georeferenced position.

Figure 2: This second prototype of the EngeMOVI PIG reduced the degrees of freedom only to those that would be present in a pipeline by mounting the system on rails.

A continuous GPS is unavailable inside the pipe where the PIG is located, so a more sophisticated georeferencing algorithm combining the acceleration and angular rate measurements of the PIG with external sensors needed to be developed. This was the highest risk software component, and therefore, where they began development.

The mechanical design of the PIG required a complex suspension system to guarantee the survival of the unit in extreme conditions, so to avoid schedule delays, they devised a platform to test the algorithms under development. In figure 1 you see an NI CompactRIO controller and sensors on a bicycle, which they used as a first prototype to map the path the same way they would with the PIG inside a pipeline.

After a few rounds of collecting data and modifying the algorithm, it became clear that the bicycle has more degrees of freedom than a pipeline; therefore, they needed a prototyping platform with movement more like the final conditions. For this, they transferred their electronics to a railway cart (see Figure 2) to further develop a georeferencing scheme accurate within 1m.

Finally, after assembling the PIG mechanics, they conducted a field test of the system prototype on an actual pipeline. After nearly a year of commercial operation in Brazil and Colombia, the PIG is still operational. The success of the initial prototype is constantly being improved and has inspired an entire family of tools such as submarine robots for deep-water pipeline inspection, welding robots with redundant kinematics and, more recently, a motorized PIG.

5: Forget the Reason you Prototype

Engineers build experimental prototypes for a variety of reasons, but most often, it involves either proving technical feasibility or gathering user feedback. The most successful designs often iterate on these prototypes multiple times, each time gathering more information that helps them

improve the next version of the system. Once a solution is well understood and the engineer has a deep understanding of both the problem and the solution, a detailed specification can be made.

Therefore, the prototype is really a sophisticated means of requirements gathering. Code reuse from the prototype to the deployed system is desirable, but generally should not be the focus of development.

Not all engineers are working on the next light bulb or phonograph; however, we can take the lessons of the innovators like Edison and apply them to our day-to-day projects. Any time we're creating a design from scratch, it's best to fully understand the problem before deciding on the implementation strategy. In our experience at National Instruments, the fastest way to such an understanding is through iterative and experimental prototypes where schedule is the primary concern and cost and optimizations are secondary. ■

FOR MORE INFO:

> National Instruments

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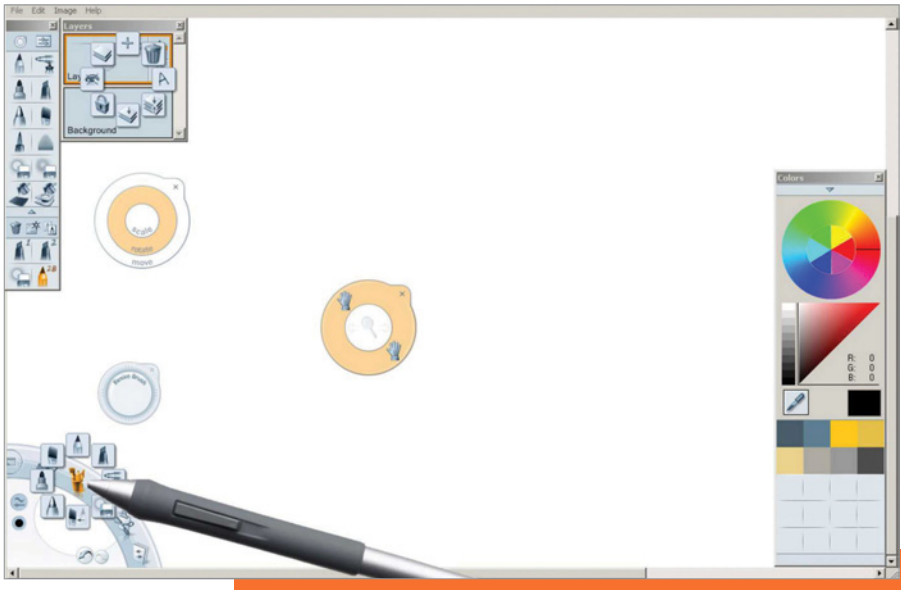
Concept Sketching Tools

> Say goodbye to the napkin scrawl and hello to intuitive sketching hardware and software options.

BY MIKE HUDSPETH, IDSA

You've heard the old shtick about designing bleeding-edge products on a napkin over lunch. Once you've solved the world's problems, you wad the napkin up and stick it in your pocket. You return to the office and you have to model what you discussed.

Don't you wish there was a better way? Well, there is.



Autodesk Sketchbook Pro is about as intuitive and simple as a program can get. It's also fairly inexpensive and has versions available for the iPhone and iPad.

The Hardware

You're going to need a budget for this, but don't worry, it doesn't have to be a huge one. There are a few ways you can go. A digitizer pad costs anywhere from $50 to several hundred dollars, depending on how fancy and large you want to get. These take input from a stylus and translate it onto your screen. Many digital artists, and even some 3D modeling programs, use these to sketch out designs.

The down side to a standard digitizer is that you draw on your desk while looking at your screen. Yes, you can get used to it, but why have to when there's a better tool? You have probably heard of the tablet PC. The tablet PC allows you to use a stylus to write directly on your screen. Another handy thing about using a tablet PC when you're out and about is that it packs enough computing power to do many of your modeling jobs right where you are. However, their screens tend to be on the small side.

Another great tool for fast sketch creation is the Wacom Cintiq. These are like a hybrid of a traditional digitizer and your computer monitor. The Cintiq is an LCD with a built-in digitizer. You can

pick it up and let it rest in your lap, or you can use the included stand. You draw directly on the screen like the tablet PC.

The Cintiq is not a computer, but it's more than a monitor. It is wonderful for sketching. It is available in two sizes, and if you do a lot of sketching I believe that it is well worth the investment ($2,000 for the 21-in. model; $1,000 for the 12-in. model). If that sounds steep, just remember that they can also be used as your monitor.

If your budget is a little bigger, there are whiteboards that can digitize and save hand-drawn images to your computer. They aren't cheap, but they can save the scribblings of your meetings for posterity.

The Wacom Cintiq is a great way to create sketches. It has a natural surface and is intuitive to use.

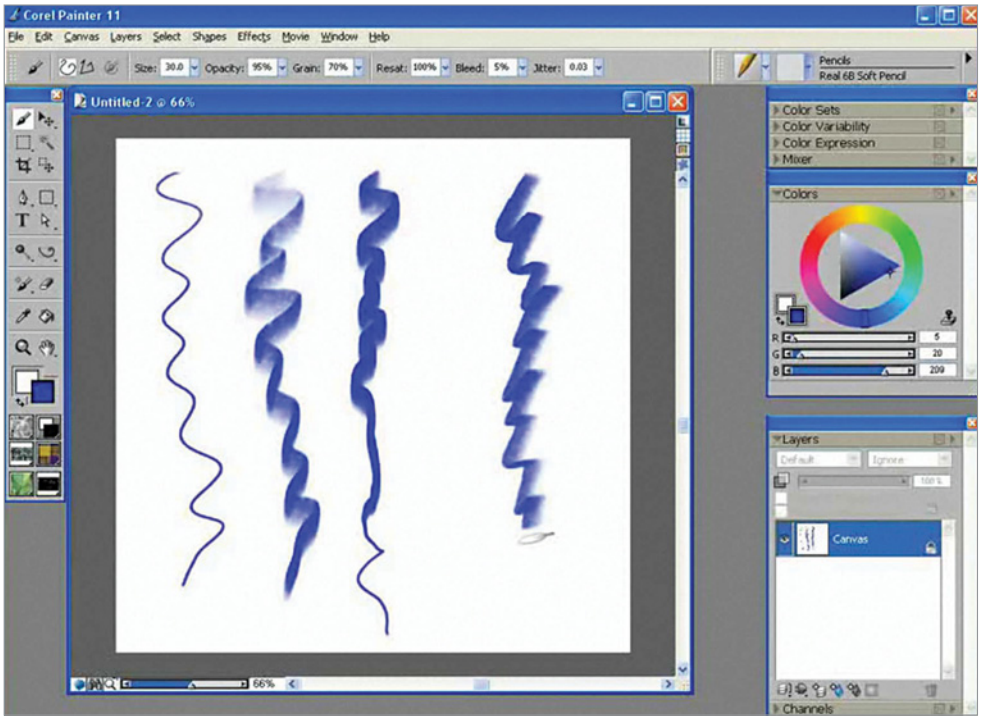
The Software

Of course, hardware isn't of much use without software. There are various programs you can use to make your concept sketches. Adobe Illustrator and Photoshop are probably the first that come to mind, but they could be over-kill for what you want to do.

Corel Painter 11 ($279) is an art program that tries to give you the tools you need in as intuitive an interface as possible. You can use simulated pencils, brushes, markers and even airbrushes. You can sketch with a pencil, fill in the colors with a watercolor wash, then outline the important points in black marker for emphasis—all the while working on different layers to keep everything straight. You can change the width of your tool or its shape. You can even change the type of virtual surface on which you're sketching.

Corel also has a less-expensive program (around $120) called Corel Painter Sketchpad. You can have multiple sheets of sketches as well as layers. It doesn't have all the bells and whistles of Painter, but it certainly has the sketching chops to help you realize your designs. The page toolbar lets you change things about the sheet you're working on, add/select/delete sheets, and work with layers; the color picker lets you pick and mix colors. There's also a drawing toolbar, and a "view" toolbar, where you can pan, zoom and crop your sketch.

Another popular program is Autodesk Sketchbook Pro ($100). It was designed with the tablet form factor and digitizer in mind, although you can use the standard mouse if you prefer. What sets Sketchbook Pro apart from most programs is the interface. It has all the required brushes and pens, but it accesses them in a novel, more natural manner: You have a banner-like device in the lower



Corel Painter has all the tools for fine art, but can also be used for technical sketching. As you can see here, you can change line weights and styles to get the look you want.

left corner (which you can move elsewhere) that you just hover over, and all the controls appear. It's a great program for ideation. Many are the times while sketching when an undo would come in handy. Now you have one.

With Sketchbook Pro's layers, you can import an image onto a layer, sketch over it on another, then add shadows on another and highlights on another. You can even add a different layer for each product color choice. With Sketchbook Pro, you can also create your own brushes to get just the effect you want or require. You can import a photo or add a layer for text. You can even use it to mark up redlines to send out to manufacturing.

Of course, unless you have a tablet PC, you can't take it with you, right? Wrong! In an interesting stroke—no doubt brought on by the release of the iPad—Autodesk brought out a Sketchbook app. I downloaded Sketchbook Mobile for my iPhone for $2.99. Of course, there is also version for the iPad, but it's a little more expensive: $3.99!

Fast concept sketching tools are a great way to jot down the essence of the innovative ideas you have and communicate it to others. They will help you maintain the look and feel of the napkin sketch you and your customer liked—right into production.

The only thing these tools don't give you is the coffee stain. But you can always add that later. ■

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FOR MORE INFO:

> Autodesk
> Corel
> Wacom

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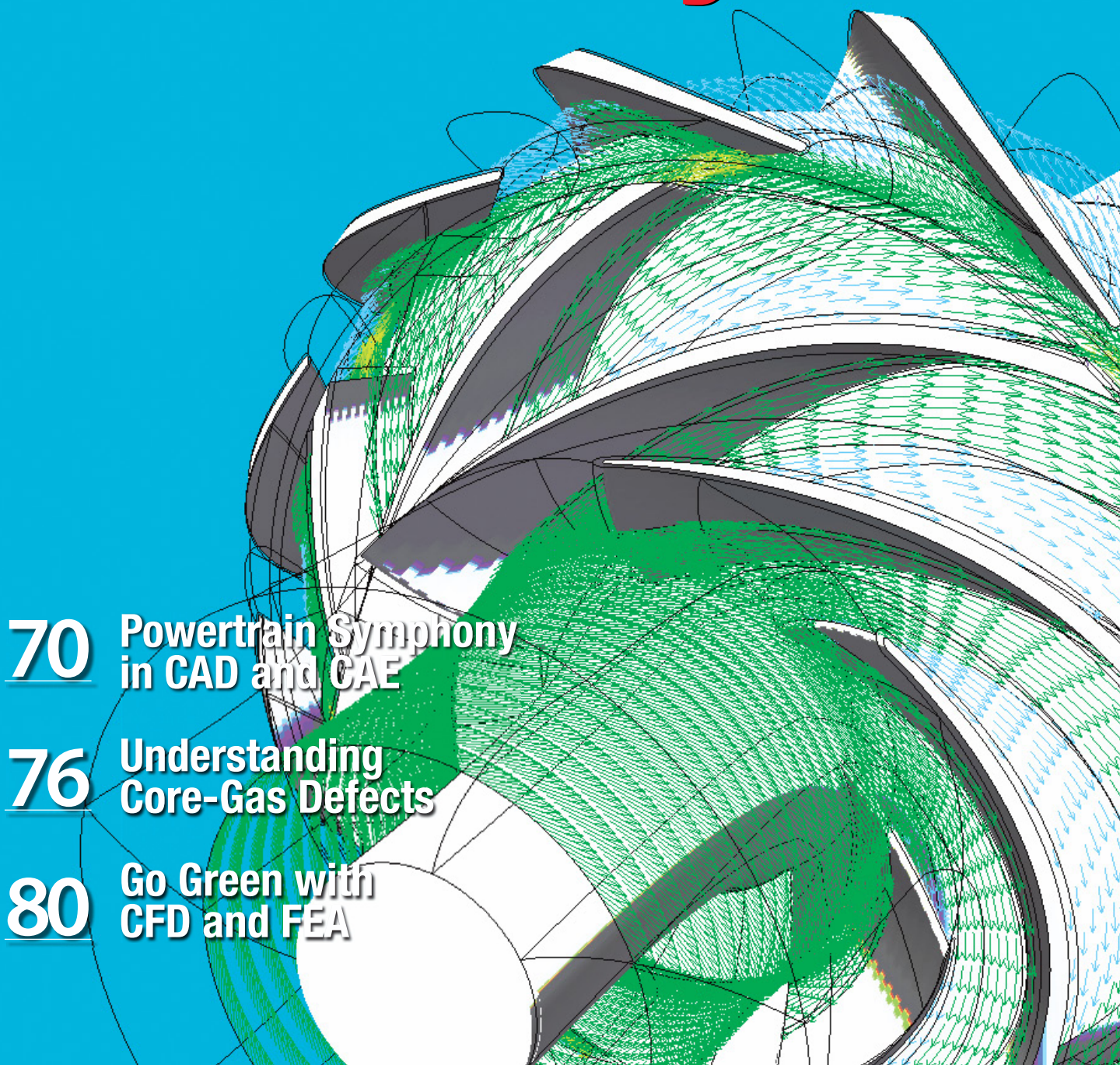


By Christopher Hardee

Powertrain Symphony in CAD and CAE

> An initiative at Ford to use Abaqus for CATIA and model templates ups the tempo of powertrain design.

Designing and building a car is like composing and performing a symphony. CAD designers and CAE analysts act like a team of composers, drawing upon their creativity, the laws of physics, and a host of engineering software tools to create a design "score." Then the instrumental sections—the powertrain, electrical, exhaust, steering, and other systems—bring the composition to life. Revisions and rehearsals follow. Finally the premier arrives, and when everything is in sync, the orchestra of components produces an on-the-road performance in perfect pitch. With the right talent and tools, the results can be music to the market.

In more straightforward terms, designing an automobile is an extremely complex endeavor. Ford Motor Company's North America Engine Engineering Organization, for example, has more than 100 CAD designers and CAE analysts in the Powertrain Analytical Design and Six Sigma (ADSS)

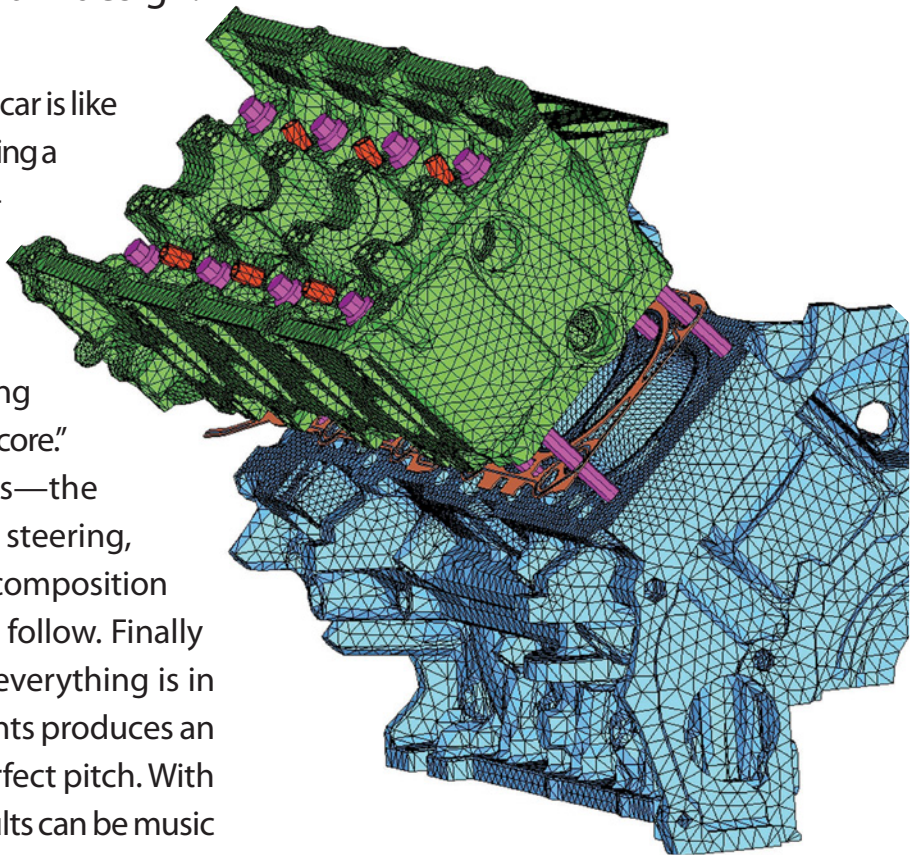


Figure 1: Model of engine block and cylinder head for a cylinder head deck lift analysis.

department alone. This team has responsibility for the design of all of the powertrain components, including the cylinder block and head, connecting rods and crankshafts, pistons, turbo chargers, and valvetrains. To manage this task with a Six Sigma mindset and develop the most robust designs in the shortest amount of time is a challenge that requires precise inter- and intra-departmental coordination, robust engineering tools, and well-tuned processes.

With those coordination goals in mind, Ford created a global program to improve product development efficiency, increase throughput, and deliver 100% geometric compatibility. As part of this PLM effort, they implemented a series of digital innovation initiatives, one of which—Digital Vehicle Engineering (DVE)—includes development of multiple intelligent CAD templates with tight integration of CAE and optimization modules. The goal is to promote enhanced collaboration among engineers, designers, and analysts in a virtual product design and verification environment.

First Movement: CAD and CAE Integration

About five years ago Ford made the decision to migrate all CAD model building to CATIA, the Dassault Systèmes' brand for virtual design and product innovation.

"What made the difference for the management team was the capability of CATIA to integrate CAE tools," says Jeffrey Bautz, Ford's ADSS manager. "They recognized that the resulting efficiency improvements would be significant."

The ADSS team saw potential benefits for the powertrain system and was one of the first groups to use the integrated CATIA CAD/CAE solution for production inside Ford. To implement this solution, the team chose Abaqus for CATIA (AFC), a solution from the Dassault Systèmes' SIMULIA brand that brings the FEA capabilities of Abaqus into the CATIA environment through two CATIA workbenches—nonlinear structural analysis and thermal analysis.

When the ADSS team began using AFC to integrate CAD and CAE within CATIA, they were able to greatly accelerate the analysis process. With the CAE model and the CAD geometry easily accessible in one interface, the workbenches enabled the team to do multiple iterations quickly. Using an integrated platform, there is "associativity" between the geometry and analysis models, no time delays between steps, and a much more streamlined workflow.

Second Movement: Template Development

In search of even greater efficiencies, the ADSS team next focused on automating the CAD and CAE processes and recognized the Abaqus for CATIA environment as being robust enough to handle this task. With this in mind, the team embarked on a path of developing software templates to facilitate process automation—starting with CAD templates about two years ago, followed by the CAE templates roughly one year later. The team realized, in developing templates to use inside CATIA, that there were tremendous opportunities to improve product development cycle times.

"With integrated CAD/CAE templates as part

of our DVE strategy, we are able to accelerate the initial geometry and analysis generation process," says Sassan Khoubyari, PLM strategy and implementation manager. "This allows CAE to drive design upfront, rather than validating later in the design process."

Since an analysis is only as good as the analyst's assumptions, the team spends a tremendous amount of time developing their methodology. The process consists of multiple iterations between physical test data and the model to ensure correlation. Once assumptions are validated, capturing their value is important. Templates do that, standardizing the conditions and variables for a model or simulation. They can then be used to guide each engineer on the team down a single analysis path that's proven and repeatable.

Once a method for building a complicated model—like for a cylinder head— has been developed, the analyst must still apply a huge number of different boundary conditions, contact elements, and loads. It is possible to have cases with 250 to 300 different types of boundary conditions in a single model. Before templates, most of that work was done manually. With hundreds of components in the powertrain and multiple iterations for many analyses, it's easy to imagine the extra time spent crosschecking designs. Simply put, templates minimize the potential for human error while saving time.

To get started, the ADSS team used a 6-Sigma-like approach and developed value stream maps for all of the major engine components—for the cylinder head, the block, the connecting rod, the exhaust and intake manifolds, to name just a few.

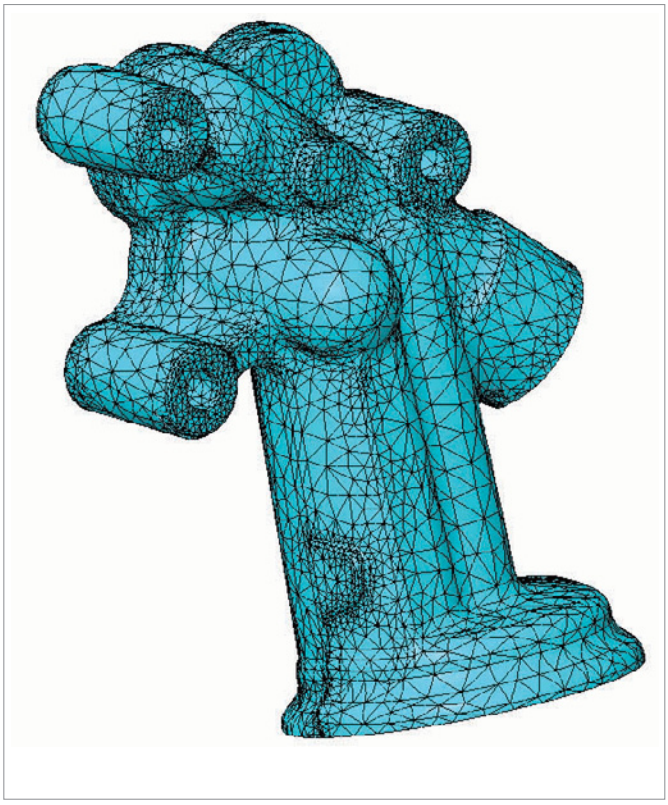


Figure 2: Model for an oil filter adaptor noise, vibration, and harshness (NVH) analysis.

The value stream maps were used to prioritize component template development, the goal being to identify those templates that could potentially improve the product development cycle most dramatically.

First, the team chose to test an oil filter adaptor analysis, because it was relatively simple, could be completed quickly, and could serve as a template proving ground. This analysis template included parameterized ribbing (see Figure 2). They also chose a cylinder head lift deck rigidity analysis, a much more complicated project, because it would test CATIA's ability to handle complex CAE templates. This analysis template included a variety of features:

• Automatic set-up of 51 contact pairs and 71 constraints.

• Creation of parameterized components including steel plates, head bolts, plugs for spark plug and injector holes.

• Elastic-plastic material property of head bolts.

• Geometry partition and grouping of a combustion chamber surface to define the mesh boundary for a cylinder pressure application.

• Five analysis steps, including press-fit of valve seats, bolt down of a cylinder head with steel plates and, finally, peak combustion pressure application in each cylinder head respectively (see Figure 1).

Both analysis templates were attractive candidates because they are current production programs in the early phases of development where there is a tendency to do many iterations.

The team uses Excel spreadsheets that are attached to the templates with all the key parameters. The CAD template defines the geometry. The CAE template includes the basic information for the simulation—the mesh, load, and boundary condition requirements. Because the templates are linked, a CAE analyst can easily change the key parameters, which then automatically updates the geometry along with the mesh in the analysis model. In addition, for further consistency across the department, the CAD and CAE groups now have standardized hardware and are working on high-end PCs in a Microsoft Vista environment.

Third Movement: Benchmarking Efficiencies and Savings

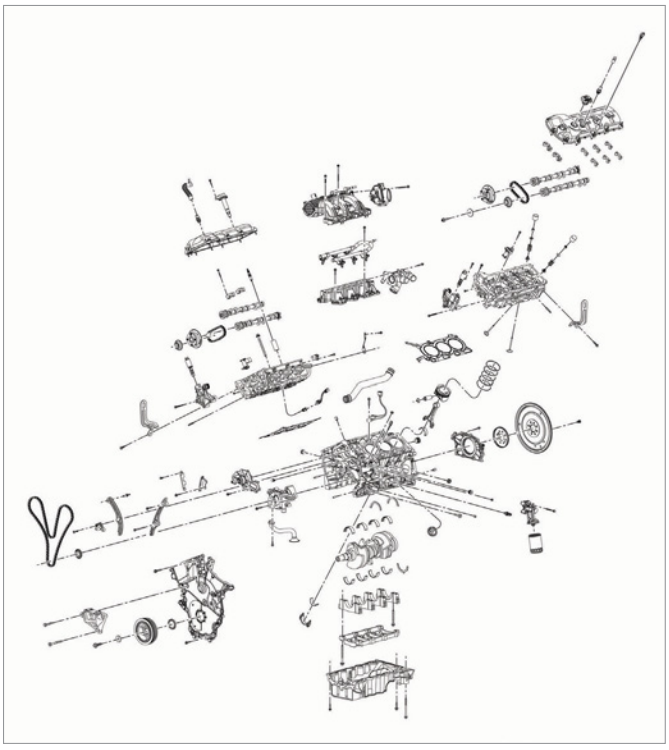
Two years into the CAD/CAE integration, the ADSS team has made improvements in the product development cycle for a number of powertrain components. The team now has CAD templates for all the major components and has begun to actualize the return on investment, with long-term impacts lining up to be significant.

For an accounting of the specific improvements, Bautz turns to his team leaders. According to John Norcut, CAD template development manager, the oil filter adaptor analysis has been greatly improved. "By eliminating the CAD-to-CAE-to-CAD hand-offs, there has been a savings of three to four weeks overall in product development cycle time," Norcut says.

"For the cylinder head deck lift analysis, it used to take an analyst one to two days to set up the model," says Alex Tang, CAE technical specialist in charge of the CAE template development effort. "But with the template and a CAE-ready model, set-up time has been reduced to less than 30 minutes."

Improvements are equally dramatic for other components. To mesh the connecting rod for a dynamic analysis, it used to take an experienced analyst as much as four to eight hours. With templates, it can now be done in as little as 10 minutes if the CAD model is clean. For an intake manifold burst analysis, mesh generation has been collapsed from three weeks to only about two hours. For a connecting rod durability analysis, a one-and-a-half week mesh-time has shrunk to minutes.

As a result of these gains, the ADSS team is looking at ways of bringing additional analysis tools inside CATIA as well. Their plan for the future includes the use of SIMULIA's Isight optimization software. This tool provides a visual and flexible process of



Exploded schematic view of a powertrain.

automating the exploration of design alternatives and identifying optimal performance parameters.

Fourth Movement: Quality on the Road

The CAE integration and template effort will have a number of long-term impacts, including a change in workflow. CAD designers and D&R engineers, rather than CAE analysts, will be able to handle many of the simple analyses. As a result, analysts will gain time to tackle more difficult problems—such as higher-end analyses and new methods development—that require their level of training and expertise. This workload balancing will further improve design validation efficiency because every new method will allow the team to eliminate a hardware test.

And fewer hardware tests mean substantial cost savings.

The template initiative is now being deployed throughout Ford's operations globally. What's more, the initiative is in synchrony with Ford President and CEO Alan Mulally's ONE Ford plan to accelerate development of new products that customers want and value.

From powertrain solo to full automotive system symphony, the results of design improvements at Ford are already on the road today, and the consumer is the ultimate beneficiary. For the past three years, Ford vehicles have been statistically proven to be equivalent in quality to those of its leading competitors. With CAE integration now added to the design composition, the harmonies of automotive performance are only going to get that much tighter and sweeter. ■

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FOR MORE INFO:

> CATIA

> Simulia.com

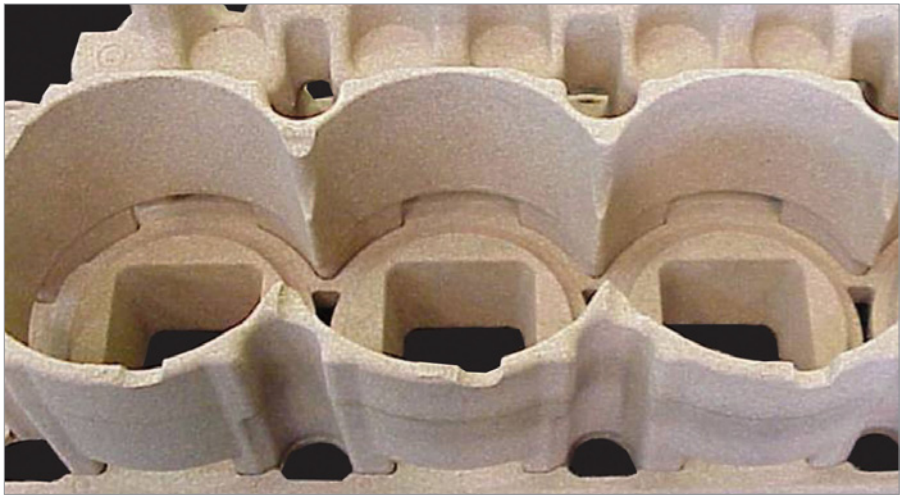
DE MARKETPLACE

By Pamela J. Waterman

Understanding Core-Gas Defects

> Flow-3D software helps trace, predict and avoid bubble streams in metal castings.

Successful metal casting requires a great deal of planning to avoid problems with flow paths, solidification rates and unexpected stresses. Flow simulation software that tackles these issues has come a long way, but some problems have proved tougher than others—particularly that of managing the out-gassing from sand-core binders.



Core prints for castings with internal geometries must be sufficiently vented to avoid core gas blow defects.

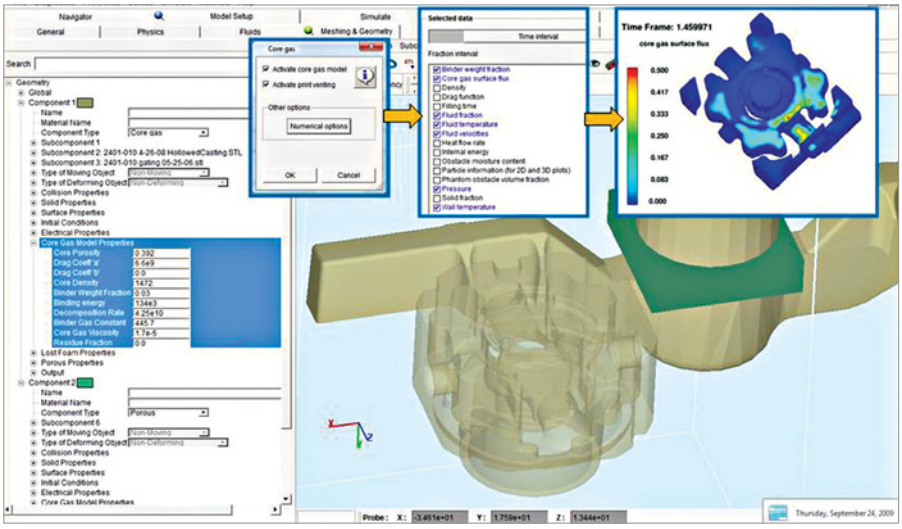
For any cast piece requiring internal details, chemically bonded sand cores must be "printed" to shape and placed inside the mold. Cores form the internal shape for the metal to flow around, and each step in the manufacturing process puts constraints on its design. The art of core design is a fine balance between making the core sturdy enough to maintain its shape during heating, and ensuring that the bonding breaks down enough for removing the sand when the part has cooled.

Designing the Best Breakdown

The mechanism of the planned core breakdown is the thermal conversion from solid to gas, but mold designs must then allow that gas to escape through the core print. If not, the metal may trap the bubbles and form pores. At best, the porosity is uncovered with surface machining; at worst, the part fails somewhere further down the line.

In the past, if materials and casting engineers

found a porosity defect issue because of core gas bubbles, they would step through a standard series of problem-solving tasks: reduce the binder content, increase the core venting, coat the core or possibly bake the cores ahead of time. Because it was impossible to see the path that the gas followed, this was a long, drawn-out process, often taking weeks to complete for one mold. In addition, it had to be repeated every time there was a problem with a different part.



Core gas surface flux and binder weight fraction for an unvented core, from flow analysis done with Flow-3D from Flow Science.

The market-driven need to compress this processing timeline has prompted the development of casting simulation software. Useful for both design and manufacturing, computer-based modeling allows engineers to test a variety of approaches without any real part cost or waste. To help foundries apply simulation specifically to venting design, Flow Science has recently added core-gas modeling to its Flow-3D casting analysis capabilities.

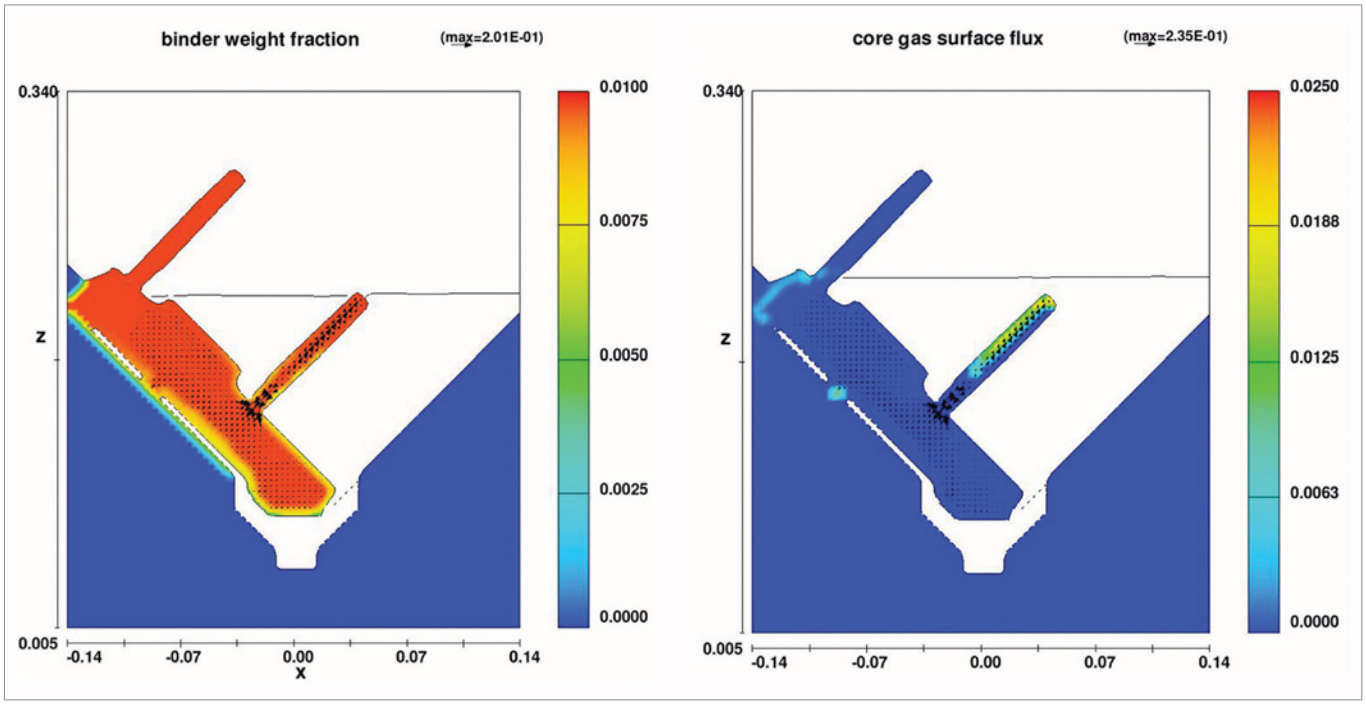
Going with the Flow

Flow-3D is a computational fluid dynamics (CFD) software package that gives insight into a wide range of transient fluid-flow processes, whether the fluid is air, water, molten metal or a gas. It models and tracks moving fluid surfaces.

Applying CFD methods to core-gas flow is a challenge. Due to the chemical complexity of resin-based binders, understanding just where and how the gas flows after sand-core thermal breakdown is a complicated process. However, Flow Science collaborated with several groups to obtain experimental data and compare results with those from the simulated models. The company gathered core-gas flow rate information from General Motors, Graham-White Foundry and AlchemCast, getting real-world data on sand-resin cores used with aluminum, iron and steel.

Dr. David Goettsch, a casting analysis engineer at GM Powertrain, has used Flow-3D for 15 years for analyzing filling and solidification of metal castings. He says the new core gas model has been useful for optimizing the jacket core venting at the design stage. It is difficult to implement vent tracks into an existing core box with all the other demands on the core prints.

"Upfront analysis work on core gas venting can save you from high scrap rates during your start-up," he explains. "Perhaps process chances can solve the problem. But it may take a lengthy test period to get to that point."



Details of Flow-3D core gas flow analysis for transient analysis, for an iron valve casting. Several results options, such as core gas flux, binder weight fraction and outgassing rate, can be analyzed.

Defining the Flow Parameters

Depending on the temperature, the gas pressure can peak before the metal head pressure reaches the same value, causing the gas to form a bubble. Slight changes in the gate design can help increase the pouring rate, allowing the metal pressure to build faster and push out the gases first, but a physical trial-and-error approach takes time. Identifying which way to make geometry changes using a virtual model was a prime goal in developing the core-gas simulation software.

Flow Science's developers combined the physics behind the flow with such process-specific parameters as the binder decomposition gas source, the fineness of the sand, the amount of binder by weight percentage, the operating temperature and the physical permeability of the core. All of these values have been verified using industry calibration samples of sand-shell binders and polyurethane cold-box binders (PUCB).

The Flow-3D analysis assumes an ideal gas of constant composition, and takes the worst-case scenario of total binder decomposition. As conditions evolve within the core during the pour, the software calculates the changes in gas pressure, the geometry of the gas flow fields, the binder degradation-zone evolution and the possible surface locations of gas blow into the metal. All data is available for post-processing; users can easily visualize the gas flow, zoom in and click on a point to get its specific values.

With the core-gas models now available in Flow-3D v9.4, Goettsch can try different insertion and venting locations and get a global diagnosis. He

can see how much gas develops, where it goes and how much got out before the metal front caught up to it.

"It's very nice when you can actually see the root cause of the problem," he adds. "These visualizations are great to try to get a little window on what the real phenomenon is doing."

Multi-core Challenges

Another experienced foundry engineer, Elizabeth Ryder of Graham-White Foundry, echoes the opinion that gas porosity has always been difficult to investigate. She adds that with multiple cores in particular, "it was hard to pinpoint which core was the source of the problem. You tried to address the whole system."

With ongoing production runs of 1,700 parts—some of them in quantities of 10,000 parts per year—Graham-White was receptive to improving its manufacturing processes through simulation. Thin-walled parts are a particular problem, with their high core-to-metal ratio and outgassing.

Working with a 3D model of a grey-iron part (approximately 3x4 in.) created by laser scanning, Graham-White provided the current venting design for evaluation. This gating design comprised four impressions per pattern plate in a horizontally parted mold, with each impression having vents for each core. A central sprue enabled filling each mold in less than two seconds.

Simulation with Flow-3D software confirmed the fill rate, but also showed that one core had insufficient venting. Graham-White then began drilling deeper holes in the core to help channel more gas through the existing vents. Since switching its approach, the company has seen an approximately 30% decrease in core blow scrap.

Also based on the Flow Science analysis, the engineering group is evaluating a further change to the problematic core that would break it into two parts, with additional venting for each part. Ryder says that Flow-3D results helped the Graham-White team narrow their design focus, letting them zero in on which core (of a multi-core design) was the culprit, and even which area of the core was the problem source.

"The more you can do on a computer ahead of time, the better," she says. "It all comes down to saving time."

Foundries can reduce scrap and improve the efficiency of their core-print designs with casting-simulation software. The core-gas model in Flow-3D CFD analysis package simulates critical porosity factors. This helps designers evaluate venting designs before first casting. Development continues on validating the core-gas model for additional materials and filling orientations. ■

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FOR MORE INFO:

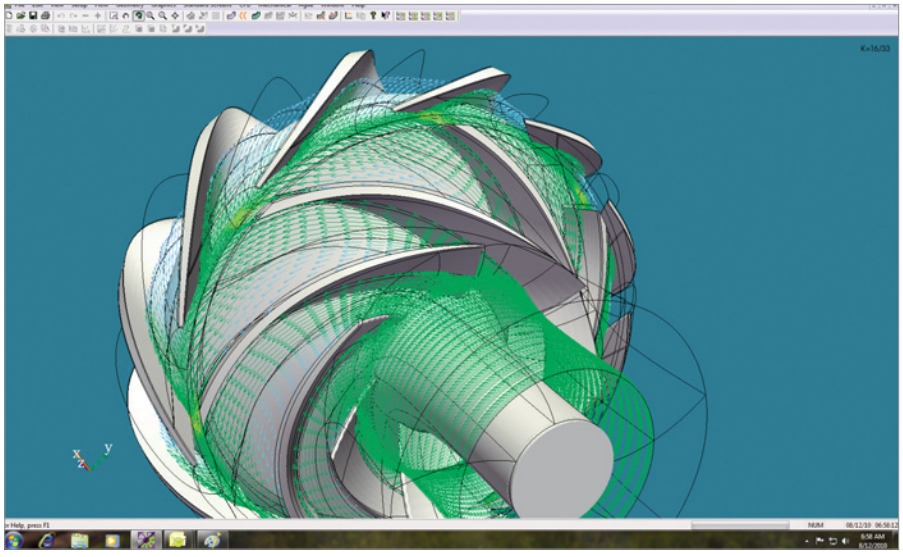
> **Flow Science**

By Greg Case

Go Green with CFD and FEA

> Optimizing the equipment that moves fluids can reduce costs and improve reliability.

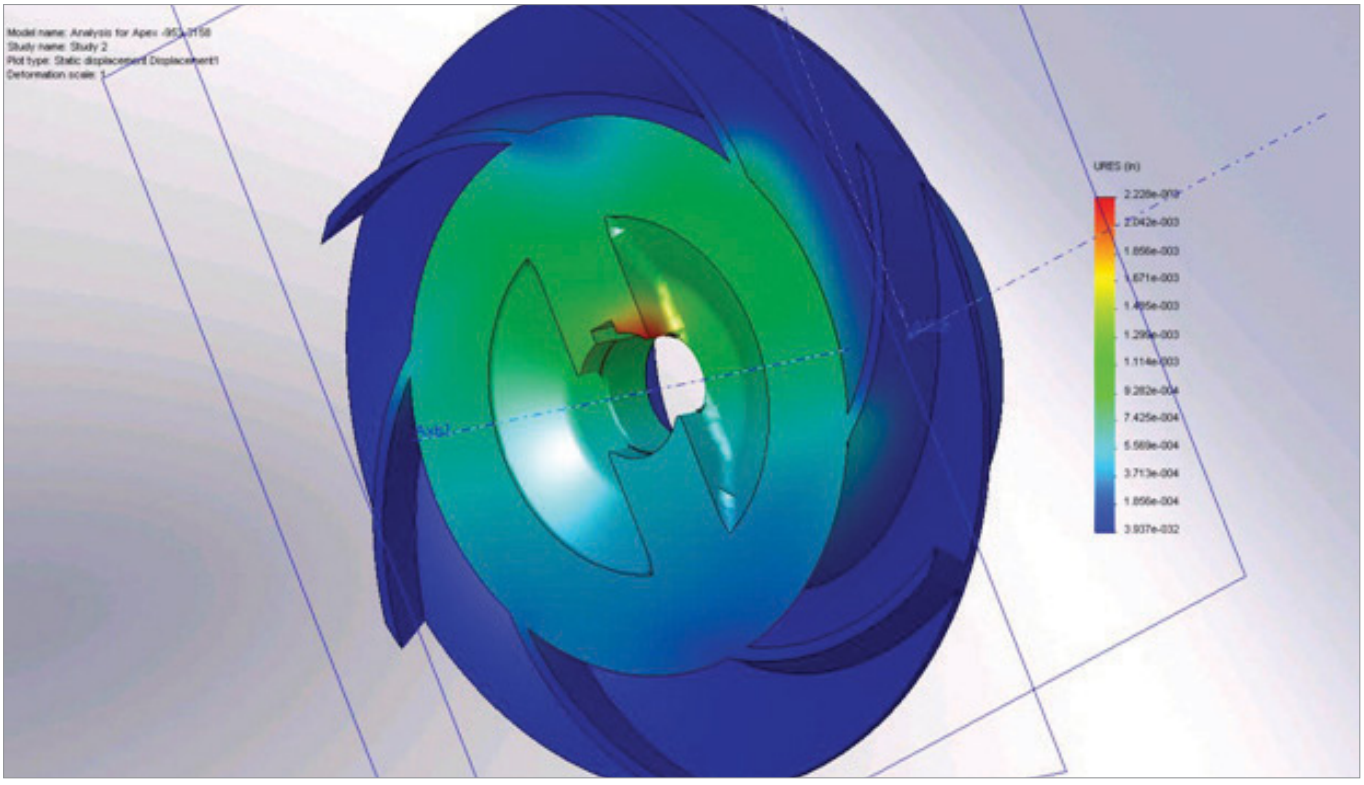
Several sources have estimated 20 to 25% of all electrical energy produced in the world is used to power fluid moving equipment. An opportunity to reduce global energy consumption lies in improving the efficiency of such equipment. Computational fluid dynamics (CFD) and finite element analysis (FEA) play essential roles in optimizing these complex machines to improve efficiency and reliability, and reduce product weight and cost.



Relative velocity vectors of flow moving through a vertical turbine pump stage.

Fluid moving equipment has been designed using hand calculations based on assumptions and simplifications, relying on the designer's "feel" to produce efficient designs. Any departure from previous designs was a leap of faith, or a trial and error research and development exercise. CFD and FEA allow us to predict the internal interaction of fluids and components, giving us insight into energy-robbing phenomena within any new machine design.

The three Rs in the green movement are reduce, reuse, and recycle. As designers, we can make our products from recyclable materials and make them robust enough to be reused. But generally the factor over which we have the most control is reduction. We can increase efficiency, thereby



Drive key stress in a double suction pump impeller.

reducing energy requirements, and increase effective use of material, thereby reducing weight and material costs. Additional benefits are in reduced shipping costs and decreased fuel in transport. We don't need to reuse or recycle as much if we reduce in the first place.

Finding Efficiencies with CFD

For pump design engineers, most of the "low-hanging fruit" or "easy fixes" have been worked out over the years through testing, trial, and error. Now, we are left to make hard fought incremental gains. Though gains may not be of an order of magnitude, most turbo machinery has potential for significant improvement. Pumps are said to be the second-most-common machine in the world, second only to the electric motor. Think of all of the pumps you use every day in your car, dishwasher, washing machine, waste water services, gas pumps, supplying your water, etc. Efficiency improvement of just a few percent in these and millions of pumps could mean annual power savings of billions of dollars to the nation's economy.

CFD offers an opportunity to look inside the blade passages of the spinning impeller in a pump or fan and see all the areas where efficiency is stolen by recirculation, stall, choking, or other factors. Traditionally, the internal shape of impeller blades has been treated as a black box. We control the inlet and outlet parameters, but design of the "in-between" was more art than science. Leading pump manufacturers had "fluid dynamic savants" with a feel for good design who

could generally, after years of experience and lots of trial and error, produce quality designs. But significant variation from previous designs often produced unfortunate surprises. With CFD, "non-savants" can consistently produce credible high-quality designs meeting the performance requirements with minimal prototyping. This not only reduces development costs but also compresses the development cycle. This is a competitive advantage, and leads to the only kind of green the accounting department will acknowledge.

There are many more opportunities for CFD to improve our designs. I did a redesign of a complicated side inlet on an existing pump for a client, and by properly orienting the flow into the impeller we increased the design point efficiency by 12%. We were able to reduce the operating noise level and cavitation problems that had been reported. Without the flow visualization that CFD provided, I would not have been able to find the areas of high loss and make such an improvement. For another client I redesigned the volute of the pump, changing the angle of the cutwater, which boosted the pump head and efficiency.

Mapping CFD to FEA

In addition to fluid dynamic uses, CFD also provides the designer with a method to predict and/or troubleshoot the interaction between the fluid and the pump's structural components. This can predict bearing loads, blade tip stresses, and dynamic loading for shafts, keyways, etc. Often these outputs can be fed directly into FEA programs, so the fluid imposed loads can be mapped to the structural surfaces providing convenient setup of the FEA simulation.

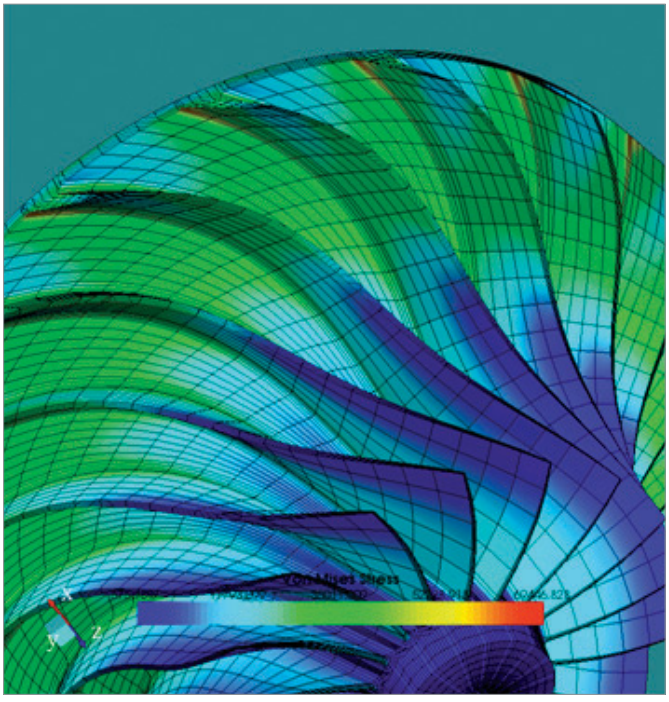
FEA is the structural equivalent of CFD. The designer can take a complex shape that is beyond the limits of hand computation and dissect it into a mesh of thousands or millions of small elements from which the computer can iteratively solve for stresses to within a pre-specified error. Many CFD programs provide pressure, temperature, force, etc. in formats that can be read by FEA programs so the designer can quickly transfer that data and develop an accurate model of the stresses imposed by the fluid.

Many CFD programs provide pressure, temperature, force, etc. in formats that can be read by FEA programs so the designer can quickly transfer that data and develop an accurate model of the stresses imposed by the fluid.

Create Competitive Advantages

This brings us back to the three Rs. With accurate input data for the FEA program, we can predict the actual stresses and strains experienced by the mechanical components during operation.

In the pump industry, like most industries, the old adage "when in doubt use more metal" was/is the motto. But metal costs money. For commodity products, to control costs, manufacturers have to find ways to reduce the amount of metal used



Mechanical and fluid dynamically imposed stress in a compressor impeller.
Courtesy of Concepts NREC

while maintaining the structural strength and durability of the product. This has led to extensive use of FEA to optimize component strength-to-weight ratios, strategically placing ribs and bosses to provide strength and rigidity while reducing the weight, often by as much as 30%. In the past, without proper FEA of components, shaving off metal often resulted in massive product warranty costs as areas of unexpected high stress failed in the field, costing some brands their reputation and market share. Done carefully, CFD analysis and FEA simulations can give manufacturers a competitive advantage, while simultaneously allowing them to lower material consumption and reduce their ecological footprint.

The ability of CFD software to produce equations describing pressure, forces, velocity, and temperature of the fluid with respect to time allows those who work in the field of vibration and rotor dynamics to predict structural response of the machine before installation. This avoids retrofitting expenses after the equipment is installed.

Such upfront analysis has been invaluable to many large pump stations. Foundations and structural supports are being reduced, but this diminishes their ability to damp out vibrations. At the same time, variable speed technology is being used to reduce pump power requirements during off-peak demand. Variable speeds of the motors increases the likelihood of structural resonance problems. Approximations and simplifications that have been standard for years no longer accurately encompass all of the variables in the complex operating scenarios found in modern pumping systems.

In the green engineer's toolbox, CFD and FEA can and should play a role in developing products that are more efficient, use fewer resources, and increase performance, permitting companies that use them to go green for our planet and their balance sheets. ■

Greg Case *is president of PD3, Pump, Design Development & Diagnostics, LLC, Contact him via de-editors@deskeng.com or pdcubed.net.*

Blue Ridge Numerics Releases CFdesign 2011

>**Blue Ridge Numerics, Inc.** (cfdesign.com/2011) has released its CFdesign 2011. New functionality and enhancements in CFdesign 2011 include automated fluid flow and thermal management decision making processes that provides an alternative to physical testing methods.

The new CFdesign 2011 collaboration tools connect local and global teams. The knowledge sharing features allow team members to have flow and thermal management tools available on-demand, according to the company.

New tools added to CFdesign 2011 are designed to simplify and expand the use of simulation using CAD-entity groups and Design Study Rules to have a simulation setup in one-click, according to the company.

CFdesign 2011 is built to support the multi-scenario design study process by helping to harness all the computational horsepower available on an existing network. A new remote solving manager can help users setup and allocate the workload across multiple workstations, and alert users via a text message and email .

Verisurf X Software Released

>**Verisurf** (verisurf.com) has released the fifth

SOLIDWORKS 2011 ANNOUNCED

> **Dassault Systèmes SolidWorks Corp.** (solidworks.com) has unveiled the SolidWorks 2011 product line.

New drawing detailing functions in SolidWorks CAD software allow users to automatically align, stagger, or center dimensions in a single click without any overlap, according to the company. 2D simplification helps speed up parts analysis. Users select an intersecting plane and apply the loads and restraints to perform static, nonlinear, pressure vessel, and thermal studies. SolidWorks Simulation calculates the results and displays them on the full 3D model.

A new Electronics Cooling Module lets users set up and execute thermal simulations, helping ensure that heat doesn't melt a product's electronics. A new HVAC module works the same way for heating, ventilation, and air conditioning.

SolidWorks' collaboration and visualization capabilities have also been improved. New in SolidWorks 2011, for example, is the ability to create photorealistic renderings in PhotoView 360. It is now fully integrated into SolidWorks CAD software.

SolidWorks 2011 also includes new features that automate weld placement and documentation. Additionally, creation of pipe, tube, and conduit runs (especially when supports and hangers are involved) promises to be simpler with new routing capabilities.

For more information, visit deskeng.com/virtual_desktop/?p=2415.

generation of its Verisurf X software. With Model-Based GD&T Inspection technology at its core, the computer-aided inspection and reverse engineering software inspects parts faster and more accurately without any need for 2D drawings, according to the company.

Verisurf Model-Based GD&T data can be imported from or created on virtually any 3D CAD/CAM model, inspected to manually or as part of an automated inspection process, and reported on in a variety of industry formats

3D Mice Enhancements for Google SketchUp

>**3Dconnexion's** (3dconnexion.com) latest driver update brings 3D navigation and a streamlined 3D mouse user interface to Google SketchUp. 3Dconnexion says these new enhancements give the SketchUp community increased control of their designs and their workspace.

3Dconnexion's new 3D navigation feature automatically follows the point of interest to continuously determine the optimal center of rotation when controlling spin, tilt, and roll motions. The latest driver update also streamlines the 3D mouse user interface with a pop-up menu to centralize all 3D mouse related options. In addition, a new "helicopter" mode provide a more consistent navigation experience with Google Earth.

Agile Engineering Design System 2010 Released

>**Concepts NREC** (ConceptsNREC.com) is now shipping the latest version of the Agile Engineering Design System (AEDS 2010), a turbomachinery design system that integrates the engineering process through to manufacturing. AEDS 2010 includes upgrades to all its major modules

Concepts NREC's AEDS 2010 has integrated computer aided engineering tools help in development of rotating machinery such as turbines, compressors, fans, and pumps from preliminary design, detailed design, computational fluid dynamics, and finite element analysis to optimization.

The Agile Engineering Design System software is available for lease or purchase. Purchase prices per module start at $15,000.

eDrawings Professional for NX Version 7.2

>**Geometric Limited** (geometricglobal.com) has announced the release of eDrawings Pro fessional for NX version 7.2 with support for NX 7.5. eDrawings is an email-enabled collaboration tool designed to ease the sharing and interpretation of 2D and 3D product design data.

It includes support for NX 7.5, functionalities to export bill of materials information from NX to eDrawings, support for measurement of assembly features, surfaces and 3D curves, and an upgrade of eDrawings viewer to eDrawings 2010 SP3.

Bricscad V10 for Linux Released

>**Bricsys NV** (bricsys.com), the developer of Bricscad, has released Bricscad V10, a .dwg-based CAD program, for Linux.

This first release of Bricscad V10 for Linux comes with LISP, DCL and Diesel APIs. Encryption is available for commercial LISP-based applications and users can run their LISP routines without any

modification. Depending on the demand of application developers, Bricsys will extend the set of APIs for the Linux platform.

Initially Bricscad will support three Linux flavors: Fedora 12 or higher, OpenSuse 11.1 or higher and Ubuntu 9.10 or higher.

The English version of Bricscad V10 for Linux is available in the Bricsys e-store.

Eurocom Launches Panther 2.0 Notebook

>**Eurocom** (eurocom.com) has introduced the EUROCOM Panther 2.0 notebook powered by NVIDIA SLI Fermi GPUs and Intel's line of 6-core i7-980x and Xeon 5600 series LGA1366 processors.

EUROCOM Panther 2.0 has up to 3TB of storage with four internal physical hard drives and RAID 0/1/5/10, 3.33 GHz Intel Core i7 Processor Extreme Edition i7-980X; or 3.33 GHz XEON X5680 processors running at 6.4GT/sec bus speed.

The notebook also has a Gigabit Ethernet port on-board (quad port optional), HDMI in and out ports, eSATA, and DVi ports. It also has a 17.3-in. 1920x1080 LED backlit display and full-size keyboard. The Panther 2.0 can accept up to 24GB of DDR3-1600 memory.

Caedium Goes Parallel

>The latest release of **Symscape's** (symscape.com) Caedium (version 2.2) can now

MORE CAD COMES TO THE MAC

> **Autodesk, Inc.** (autodesk.com) has announced AutoCAD for Mac software. Autodesk also announced the AutoCAD WS mobile application, a new app for iPad, iPhone and iPod touch that will allow users to edit and share their AutoCAD designs in the field.

The news follows recent announcements from Graebert (graebert.com) that its ARES Commander software is available for Mac, and Dassault Systemes' free Draftsight (draftsight.com) software, which is powered by ARES, will soon be available for Mac. For more, visit Kenneth Wong's Virtual Desktop post (deskeng.com/virtual_desktop/?p=2349) and see the Graebert announcement at deskeng.com/articles/aaayax.htm.

Using a native OS X user interface (no emulation), ARES on the Mac runs across Microsoft Windows, Apple Mac OS X and Linux, while also being optimized for specific operating system features and capabilities. iPad support is also under active investigation, according to the company.

Autodesk says AutoCAD for Mac and the AutoCAD WS mobile application will be available in North America and Europe beginning this fall.

perform computational fluid dynamics (CFD) simulations in parallel on a single computer with multiple cores or on a cluster running Microsoft Windows HPC Server 2008. Either way it means a reduction in simulation turnaround time compared to previous versions of Caedium, according to the company.

Also available with this release are 64-bit versions of Caedium for Windows and Linux, which can perform larger simulations because they are no longer restricted by the 32-bit memory limit.

Caedium uses a custom version of OpenFOAM to provide high performance computing CFD solvers, presented in a graphical user interface simulation environment for Windows, Linux, and Mac.

Gridgen CFD Meshing Software Updated

>**Pointwise** (pointwise.com) has announced the latest release of its Gridgen computational fluid dynamics (CFD) meshing software featuring a suite of new tools for coupling mesh generation with overset grid assembly (OGA).

Close coupling of meshing and OGA has the potential to reduce the effort required to generate overset grids, according to the company. The goal of OGA software is to compute how to interpolate information from one block to the next and ensure that interpolation is accurate.

Also included in Gridgen V15.16 are improvements to the tet-to-prism cell recombination algorithm used with the T-Rex hybrid meshing technique that can reduce overall cell count. ■

BITS FROM BYTES RELEASES NEW AXON SOFTWARE

>**Bits from Bytes** (bitsfrombytes.com) has developed new software for driving its 3D printers.

Users of the RapMan 3.1 self-build kit and BFB 3000 machines can now use the Axon software to turn their 3D computer drawings into a solid object more easily, according to the company.

Built on the shareware software Skeinforge, the software will be supplied with all RapMan machines in future.

PRODUCT SHOWCASE

> To appear in the next Product Showcase, contact Jeanne DuVal at jduval@deskeng.com

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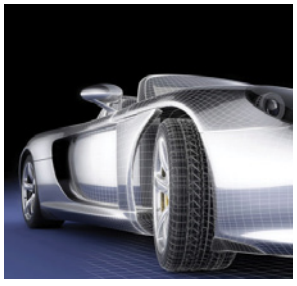

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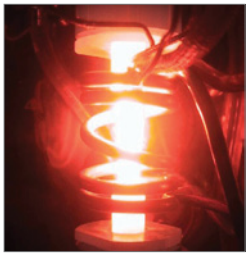

Z-mat provides add-on material modeling capability for many nonlinear FEA solvers to achieve more realistic material simulation. Materials include high temperature metals to polymers, elastomers, and diverse composite materials, and many more. The software is backed up by a production-ready testing laboratory for turn-key data collection, model selection or development, and calibration services.

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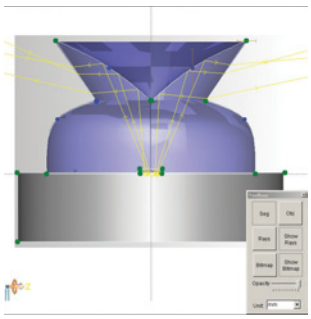

Lambda Research Corporation announces the latest release of its flagship opto-mechanical raytracing software program, TracePro 7.0. TracePro 7.0 features a new interactive optimizer, multi-threaded raytrace and rearrangeable system tree. The interactive optimizer is unique in its capability to sketch in an idea using its built-in digitizer, interactively raytrace it, specify variables, create a target output and optimize the design.

> Lambda Research Corp.

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Mainstreaming InfiniBand with Software Automation

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With the ability to deliver 40Gbps, InfiniBand offers more bandwidth than Ethernet or Fibre Channel for connecting compute clusters or data centers, but it has often been viewed as a technology that is only for geeks. In today's InfiniBand products, however, automated wizard-driven installation, verification and parameter-based monitoring greatly simplify proper configuration and ongoing management of the cluster.

Growing Clusters, Growing Issues

The communications bottleneck in high-performance computing clusters is getting worse as clusters grow larger. A generation ago, InfiniBand switches were limited to a maximum of 288 ports in a single chassis; today, a comparable director class switch provides up to 864 ports. With Moore's Law enabling denser multi-core processors, each of these nodes generates much more data than ever before.

> Fabric tools help eliminate the "geek" factor in InfiniBand ...

InfiniBand delivers 40Gbps with the lowest available latency. The challenge is to make it usable. As clusters grow in size, the volume of communications between cores grows exponentially, and it becomes more difficult to configure and manage the network for optimum performance. With an increase in active cores in the cluster, it is easy to see how fabric efficiency tends to decline as the number of nodes increases.

Fabric Management Software on the Rise

To address these challenges, InfiniBand switch and adapter vendors

have improved fabric management software to simplify the job of optimizing and managing the fabric. Four key capabilities in fabric software contribute to the solution: fabric tools, adaptive and dispersive routing, and virtual fabrics.

Fabric tools help eliminate the geek factor in InfiniBand by automatically configuring and managing the network. They typically include a wizard-driven setup and discovery function that makes InfiniBand as easy to deploy as Ethernet. In addition, the toolkit includes management tools to identify trouble spots in the fabric, including a graphical depiction of the fabric and a real-time congestion monitor.

Every network manager wants to get the best performance from the fabric at all times. Adaptive routing minimizes the impact of congestion on the fabric. Most high-performance computing fabrics are designed to enable multiple paths between switches, but standard InfiniBand switches don't necessarily take advantage of these paths to reduce congestion. Adaptive routing shifts network traffic from over-utilized links to less utilized links so that a bottleneck in one path doesn't cripple the flow of data.

Dispersive routing is another technique used to optimize fabric performance. It distributes traffic over multiple paths to a destination, thereby load balancing the fabric. The most advanced implementations of this capability go beyond simple load balancing by minimizing the potential for out-of-order packets sent via disparate routes so that packets can be reassembled in the proper order for processing at their destination.

Virtual fabrics provide the ability to segregate traffic into different priority classes. A user may have different jobs that require different priorities, or he may decide to separate different traffic types into differing priority classes—such as compute traffic, storage traffic and management traffic.

With the virtual fabrics capability, users can partition traffic flows to make sure traffic with high bandwidth requirements doesn't interfere with traffic requiring low latency.

With the virtual fabrics capability, users can partition traffic flows to make sure traffic with high bandwidth requirements doesn't interfere with traffic requiring low latency.

Automated fabric configuration, optimization, and management tools supplied with InfiniBand switches and adapters can make this technology a logical choice for a broader set of users. ■

David Smith *is Senior Product Manager, InfiniBand Products, at QLogic. Contact him via de-editors@deskeng.com.*

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