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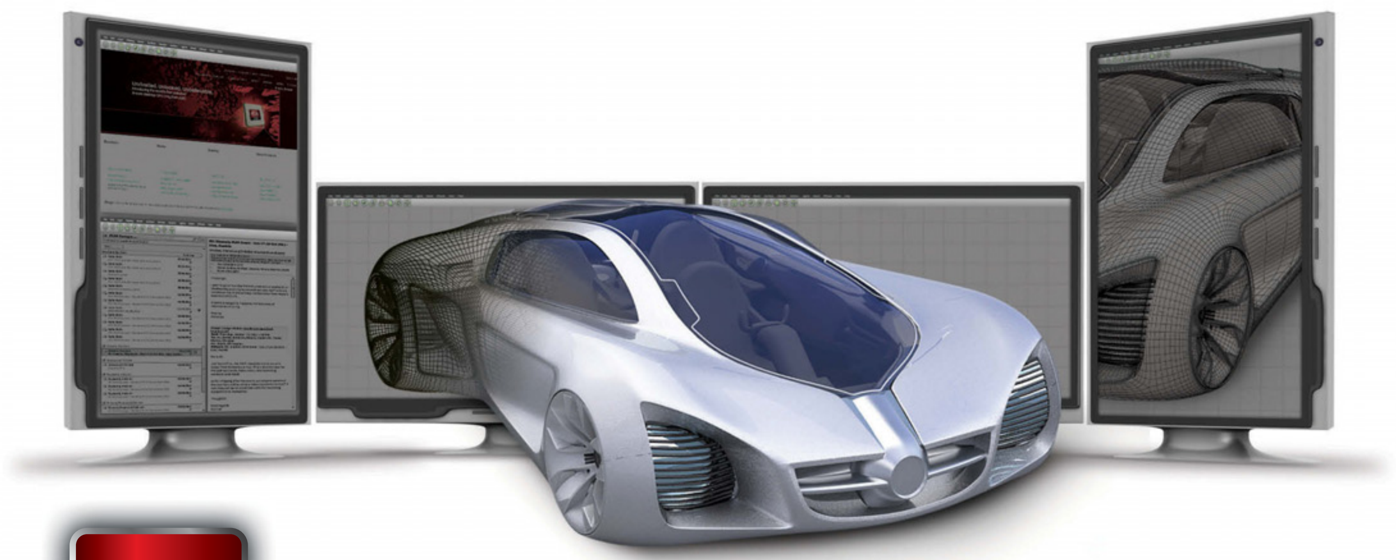

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by Steve Robbins

Will Curiosity Kill the Naysayers?

As you read this editorial, either NASA's Mars Curiosity Rover will have landed on the surface of Mars or, as many naysayers have predicted, it will have crashed. Call me a hopeless romantic, but as I write this in late July, my money is on an amazing landing and a lifespan of successful discoveries emanating from this incredible scientific laboratory designed to measure everything from geology to bio-signatures past life has left behind.

One thing is for sure, just like the moon landing back in the '60s, I will be glued to the television (or maybe my iPad) as Curiosity makes its approach and landing on the surface of Mars. When mankind landed on the moon, all we had was an audio feed. I was in high school and watched the landing from a desk in a classroom. This robotic landing of the Mars Scientific Laboratory promises to be more dramatic. We will be watching the decent from the Mars Descent Imager (MARDI), providing us with an astronaut's view in hi-res at five frames per second, in real time. The landing process is complicated. Many have called it "seven minutes of absolute terror."

That's what I love about this job, working with engineers who change our lives.

Simulation Gets Real

Last year, I was invited to a Siemens simulation event at the Joe Gibbs NASCAR Racing Facility in Charlotte, NC, where I met one of the senior engineers from JPL who had simulated the Curiosity landing. It was an impressive simulation, and was the basis for an article we ran in *DE's* February 2012 issue (deskeng.com/articles/aabdzg.htm). During our conversation, I asked why JPL designed such a complicated landing sequence. Why not just use the previous method, an airbag, which is much simpler and proven. As it turns out, the Curiosity is too large and heavy for an airbag landing, so new technology was needed.

The larger size allows for more instrumentation. We have all been enthralled with the Opportunity and Spirit rovers, but Curiosity is the size of a Volkswagen. It carries an onboard spectrograph that can fire a laser from a distance and analyze rocks, soils, and pebbles for chemical elements, including trace elements and ice. The robot is equipped with four different spectrometers.

It also carries a chemical analysis laboratory that can detect compounds of the element carbon, including methane, which are key indicators of the possibility of past life. Curiosity also has radiation, environmental, and atmospheric sensors on board. These are able to record weather and environmental conditions that have not been available before.

The technology behind the Mars Space Laboratory will not only be useful for future missions to Mars and other celestial bodies, but, like many of NASA's other innovative technologies, they will be available for commercialization.

Amazing Engineering

I watched the video of the Curiosity simulation a year ago, and I will be watching the real thing on August 5.

As the spacecraft approaches the planet, it will position itself for entry into the Martian atmosphere, firing positioning rockets. The ablative heat shield will reach temperatures of more than 2,700°F, and then its parachute will deploy at supersonic speeds. It will eject its heat shield and parachute just before the decent stage rockets fire and then hover over the surface of the red planet. Finally, the rover will be lowered on cables to Mars as the descent vehicle flies away.

I plan on being amazed. That's what I love about this job, working with engineers who change our lives. We should all applaud the dedicated individuals who have brought the Mars Curiosity Rover to realization. **DE**

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Latest Project
Engineer the ultimate storm chaser
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LabVIEW makes me better because the
INTEGRATION
with hardware is so seamless

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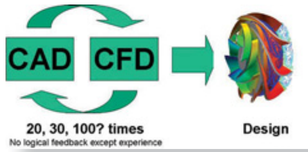

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ON THE COVER: Speed up your work with large 3D models. *Images courtesy of Siemens PLM Software and iStockphoto.*

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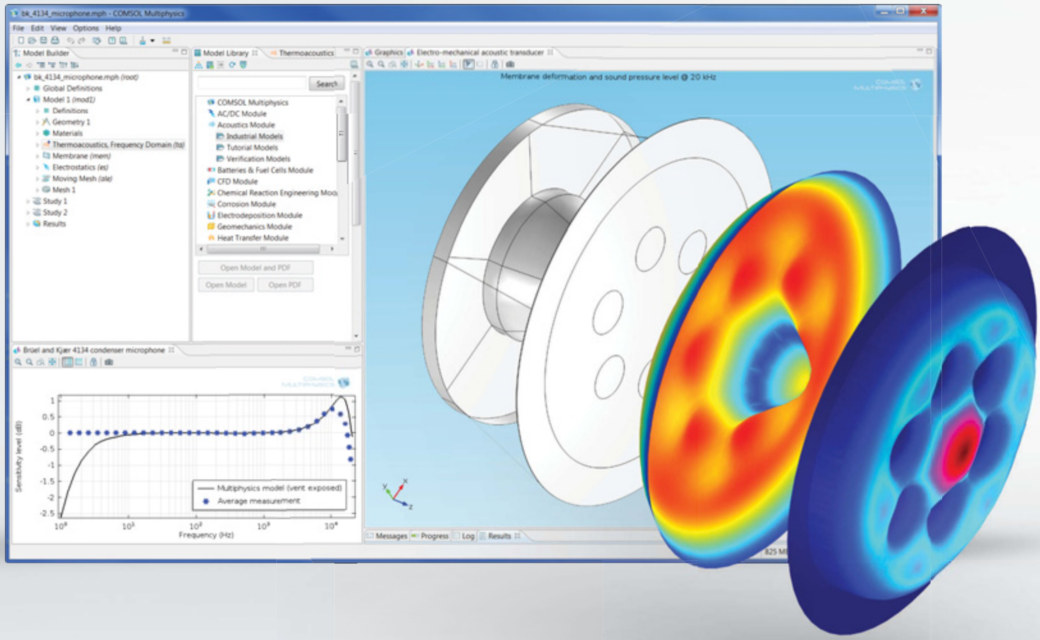
NOISE MEASUREMENT: Electro-mechanical acoustic simulation of a condenser microphone. The model shows the sensitivity level, membrane deformation and sound pressure level. Geometry and material parameters courtesy of Brüel & Kjær.



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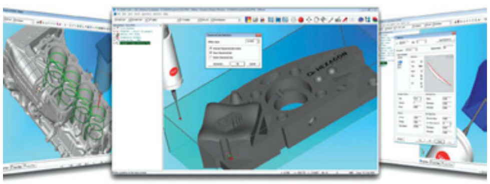

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A LEVEL 5 COMMUNICATIONS PUBLICATION
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ADVERTISING, BUSINESS, & EDITORIAL OFFICES
***Desktop Engineering*® magazine**
Level 5 Communications, Inc.
1283D Main St., PO Box 1039 • Dublin, NH 03444
603-563-1631 • Fax 603-563-8192
E-mail: DE-Editors@deskeng.com
www.deskeng.com

SUBSCRIBER CUSTOMER SERVICE
***Desktop Engineering*® magazine**
PO Box 677 • Northbrook, IL 60065-0677
847-559-7581 • Fax 847-564-9453
E-mail: den@omeda.com

***Desktop Engineering*®** (ISSN 1085-0422) is published monthly by Level 5 Communications, Inc., 1283D Main Street, P.O. Box 1039, Dublin, NH 03444, 603-563-1631. Periodicals postage paid at Dublin, NH, and at additional mailing offices. Desktop Engineering® is distributed free to qualified U.S. subscribers.

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

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

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

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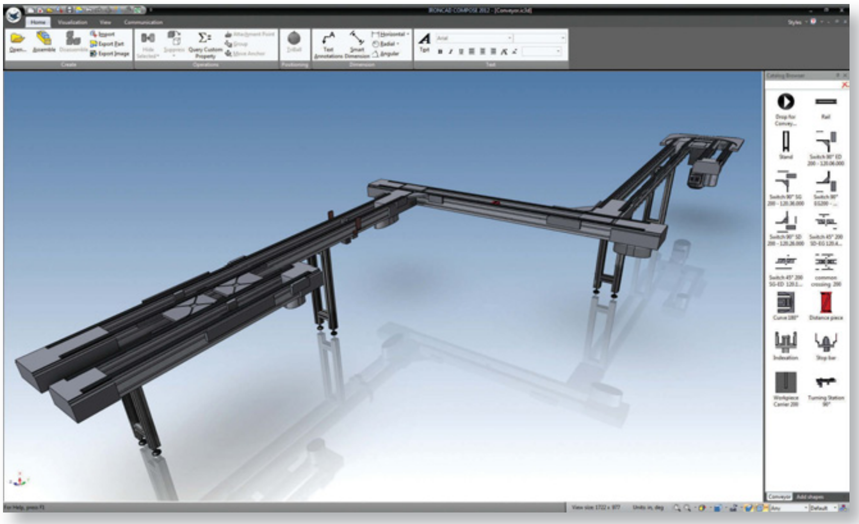
Virtual Desktop

by Kenneth Wong



IronCAD COMPOSE courts manufacturers with catalogs of configurable assemblies. Shown here is a conveyor belt assembly, in rendered view.

IronCAD Courts Configurable Product Market with COMPOSE

IronCAD COMPOSE, a new product from IronCAD, targets manufacturers who need to create configurable assemblies using standard parts and components. According to IronCAD's press announcement, potential customers will come from industries such as "factory automation, office furniture, kitchen layout, shop layout, exhibition stand design, shelving and racking solutions, and even boat building and yacht fit-out."

Preloaded with a collection of standard components used in targeted industries, IronCAD COMPOSE lets you drag and drop standard parts (for example, conveyer belt segments or kitchen appliances) and fit them into a configurable assembly—a convenient way to produce models for client presentation and sales quotes. Components have embedded intelligence that allows them to correctly connect, orient and snap into place with minimum user intervention. (Similar behaviors can be seen in library components in Autodesk's Factory Design and Plant Design suites.) Libraries in IronCAD COMPOSE include press feeder machine components, conveyor assembly, Skyline Exhibit trade show components, piping samples, and office layout and shop fixture components.

IronCAD COMPOSE comes with a viewer, driven by IronCAD's direct editing tools. The viewer lets you open IronCAD files, take measurements, and inspect their structures. You also have the option to purchase a file translator to make the viewer operate with more mainstream CAD formats. The rendering option in the software lets you create photorealistic images of your design.

A viewer with rendering tools, a collection of library components, and a direct modeling environment to build configurable assemblies add up to a lot of software, but the best feature of IronCAD COMPOSE is its price: $0. For a video demonstration of the product, visit deskeng.com/virtual_desktop/?p=5757.

PlanetPTC Live 2012

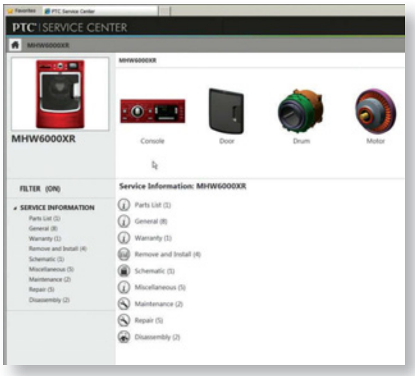
What begins with Life, gobbles up App, then takes aim at Service? The answer to the riddle is: PTC's road map. Well established in product lifecycle management (PLM), PTC took a shortcut into application lifecycle management (ALM) with its May 2011 acquisition of MKS. In June, at its annual user conference (PlanetPTC Live 2012, Orlando, FL), the company indicated that it was redoubling its efforts in the service lifecycle management (SLM) market.

The renewed focus is evident in the company's new tagline: PTC, Product & Service Advantage.

"[The new tagline] is a mission statement that talks about how we can help you gain product and service advantage," declared Jim Heppelmann, PTC's CEO.

PTC has always catered to product developers and manufacturers with its design software (previously Pro/ENGINEER, now Creo) and PLM software (Windchill). Its new solutions targeting the service industry are expected to come from two areas: its Arbortext division, which produces software for creating and publishing technical illustrations and maintenance manuals, and 4C Solutions, a warranty and service delivery solutions provider PTC acquired in September 2011. (PTC's Arbortext division was also the outcome of an acquisition, completed in July 2005.) PTC's SLM segment is led by Kevin Wrenn, divisional vice president and general manager.

"PTC's unique approach to SLM will be product-centric," said Wrenn in a corporate video outlining his mission. "The central construct for ser-



PTC's SLM division will concentrate on delivering solutions that address service professionals' needs, as shown in this example screenshot.

vices will be processes, history and the product itself."

PTC's SLM solutions will focus on technical information, serviceable parts, warranty and contract management, in-service product support, and service-event management.

As a CAD and PLM vendor, PTC works closely with original equipment manufacturers, but remains at a distance from the consumers. For example, it provides solutions to leading automakers, but its solutions seldom come in contact with vehicle buyers. Venturing into SLM may bring PTC closer to its customers' customers.

While PTC has a long history in developing and delivering solutions that help capture design and engineering data, and maintain a single source of the truth (a tenet of PLM), capturing field conditions and managing service events are relatively new territories for PTC.

One of the speakers at this year's PlanetPTC Live was Whirlpool, a PTC customer with vested interest in SLM. Whirlpool is also the owner of the popular Maytag brand. What would the Maytag repairman bring to his next on-site customer visit? If it were up to PTC, it would be a PTC SLM application loaded on an iPad.

Ordinary Malware or Industrial Espionage?

Could your AutoCAD files be going to an email address in China without your knowledge? They may be. Security software developer ESET announced, "Recently, the worm ACAD/Medre.A showed a big spike in Peru on ESET's LiveGrid (a cloud-based malware collection system utilizing data from ESET users worldwide). ESET's research shows that the worm steals files and sends them to email accounts located in China."

ESET senior research fellow Righard Zwienenberg characterized the malware as "a serious case of suspected industrial espionage," adding that "after some configuration, ACAD/Medre.A sends opened AutoCAD drawings by email to a recipient with an email account at the Chinese 163.com Internet provider. It will try to do this using 22 other accounts at 163.com and 21 accounts at qq.com, another Chinese Internet provider."

Vikram Thakur, principal security response manager of Symantec, developers of the popular Norton AntiVirus software, noted, "It's not surprising the creators of this latest sample have moved in that direction. According to Symantec's most recent Internet Security Threat Report, targeted attacks, such as those used for cyber espionage, continue to increase in frequency. In fact, they increased from an average of 77 per day in 2010 to 82 per day in 2011."

But Pierre-marc Bureau, ESET's senior malware researcher, cautioned against drawing immediate conclusions based on the email addresses' location, China.

"It's possible this email account in China is used by someone outside China," he noted. "It could be someone trying to mislead the research community or the intelligence community to blame China."

Stopping the Spread

This virus, Bureau explained, spreads very much like contact-based human viruses. Once you open an infected AutoCAD file, your machine becomes infected, too. Therefore, he pointed out, "It's not surprising the spread is regional [primarily in Peru]. People in the same community, maybe the same company, will trade files and infect each other's computers. Most likely, businesses in Peru do business with others in the same country."

According to the Autodesk press office, "Autodesk is working with ESET and others to help stop the propagation of this malware and unauthorized transmission of AutoCAD drawings. In researching the malware, we have come to the conclusion that this is not a new threat, but a previously identified malware that will be caught and cleaned by existing antivirus solutions."

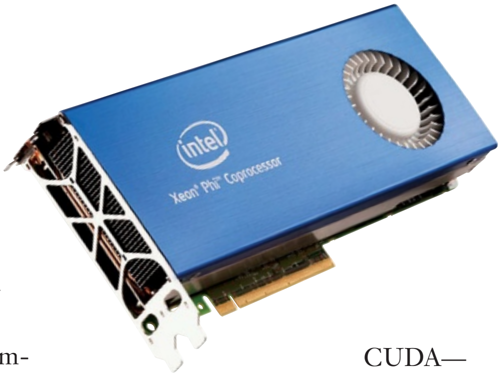
Autodesk's FAQ page on the malware states: "ACAD/Medre.A is an AutoLISP program disguised as an acad.fas file … ACAD/Medre.A is also known as: ALisp/Blemfox.A (Microsoft), Trojan.Acad.Bursted.W (BitDefender), ALS.Bursted.B (Symantec) … [the malware] targets AutoCAD releases 2000 and newer, and other products based on AutoCAD. AutoCAD LT, AutoCAD for Mac and other Autodesk products are not affected."

Bureau said that it seems the AutoCAD malware author wrote it to adapt to a specific environment.

If you suspect your machine might be infected, you could scan it with a standard antivirus software product. You may also use ESET's cleaner tool, downloadable at the company's site, eset.com.

by Kenneth Wong

Intel Xeon Phi Enters Parallel Quest for HPC Dominance



Ever seen three thoroughbreds heading for the same finish line, but running on different tracks? Watch AMD, Intel and NVIDIA go after the high-performance computing (HPC) market. In June, Intel entered an official name into the race, Intel Xeon Phi. The first product to feature Intel's many integrated core (MIC) architecture, Phi is expected to ship with more than 50 cores.

"Made with Intel's innovative 22nm, 3D tri-gate transistors, the Intel Xeon Phi coprocessor, available in a PCIe form factor, contains more than 50 cores and a minimum of 8GB of GDDR5 memory. It also features 512b wide SIMD support that improves performance by enabling multiple data elements to be processed with a single instruction," according to Intel.

By Intel's own classification, Phi is a not a central processor but a coprocessor, just as AMD and NVIDIA's GPUs are graphics coprocessors. In the case of Phi, however, it's not restricted to graphics tasks only. It's a general-purpose coprocessor, aimed at handling highly parallel computing jobs (simulation and rendering are the Top 2 types for engineers).

AMD Announces Hybrid Plans

Though originally developed as graphics coprocessors, AMD and NVIDIA's GPUs are also well on their way to tackling general-purpose computing jobs. In the case of AMD, the path to parallelism is its heterogeneous system architecture (HSA), a computing environment that fuses CPU and GPU functions into a single device.

In his keynote at AMD Fusion Developer Summit, AMD Corporate Fellow Phil Rogers said he believes GPU computing should be available to a broader audience, to the common programmers who make a living churning out code in C, C++, JAVA, and Python. In fact, Rogers may even object to the term GPU computing. If it were up to AMD and Rogers, GPU and CPU computing could be one and the same, fused together into HSA.

Accordingly, AMD announced HSA Bolt, a parallel primitive library that uses "a single source code base for CPU and GPU," according to Rogers. "We made it possible to write a single version and compile it both ways.

"The future is going to have more parallel workload as more and more media is processed both on client devices and up in the cloud," Rogers continued.

NVIDIA's Approach

Taking a slightly different path, NVIDIA proposes compute unified device architecture (CUDA) as the programming environment to write general-purpose applications (not just graphics applications) that take advantage of the GPU's parallel processing power. This will allow computing intense applications, like simulation, to run on GPU clusters.

Both AMD and NVIDIA must have realized asking programmers to master a whole new programming language to write parallel-processing code for their products would put a roadblock on the race to HPC. So both are working hard to make their respective architecture—HSA and CUDA—easier to work with for programmers who use more common programming languages.

In that respect, Intel's Phi may have an advantage over its rivals. Intel's MIC is basically a small cluster of CPU cores in a single chip. Therefore, programmers are expected to be able to write parallel code for Phi using standard programming languages compatible with CPUs.

The first test cluster built with Xeon processors and the Phi coprocessor is already up and running, the company announced, and is delivering 118 teraflops of performance. The real test of Phi's parallel processing prowess will come when Stampede, a supercomputer located in the Texas Advanced Computing Center (TACC), goes online in early 2013. Stampede is expected to run at 10-petaflop speed, powered by thousands of Intel's MIC coprocessors.

As parallel processing eventually goes mainstream, the increased processing power is expected to facilitate more sophisticated applications, such as Kinect-style gesture computing, automatic face recognition, and simulation. **DE**

Kenneth Wong *is* Desktop Engineering's *resident blogger and senior editor. Visit his Virtual Desktop blog at deskeng.com/virtual_desktop, email him at kennethwong@deskeng.com or share your thoughts on this article at deskeng.com/facebook.*

Engineering on the Edge

Future Focus

Volvo Tests Autonomous Vehicle 'Road Train'

Volvo's vision of unified, collective highway driving is being tested on public roads in Spain. Dubbed Safe Road Trains for the Environment (SARTRE), the project is based on the idea that platoons of self-driving cars could operate in unison on public highways.

Here's how it works: A lead vehicle with a professional driver heads up a "platoon" of cars in a "semi-autonomous control mode" so that the drivers can take their hands off the wheel and tend to other in-vehicle activities. The cars use cameras, radar and laser sensors to monitor the lead vehicle and the other vehicles nearby, and mimic the lead vehicle's movements using wireless communications and autonomous controls from Ricardo UK Ltd.

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U.S. Snags Top Spot

A U.S.-based supercomputer has reached the top of the TOP500 list of the world's most powerful systems for the first time since 2009. The Sequoia system (an IBM BlueGene/Q unit) at the Department of Energy's Lawrence Livermore National Laboratory reached 16.32 petaflop/s on the Linpack benchmark, using 1,572,864 cores. That bumped Japan's K Computer, which had held the No. 1 spot for the past two lists, down to No. 2.

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Climbing the Walls

The wall has been a standard part of military defensive structures since the first human figured out how to build one. The U.S. Air Force recently challenged universities around the country to come up with a new method of ascending walls without using a grappling hook.

Though it isn't quite up to Spider-Man standards, Utah State University's Personal Vacuum Assisted Climber (PVAC) allows a soldier to scale walls.

The PVAC uses two large suction pads, with tubes running to a vacuum that generates 4.5 ft./lb. per inch. Release valves let the pads to be moved up the wall, allowing the user to climb up walls. A pair of foot stirrups is attached to the pads with cables to assist climbing. Once a single soldier has made it up a wall, he or she can lower a rope to the rest of the team.

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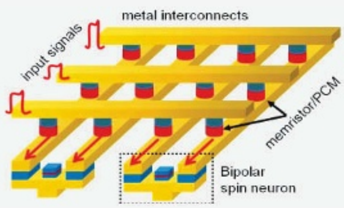
Intel Working on Computers that Learn, Mimic Brain



Intel wants to give computers a way to learn. Maybe not in full-on Skynet (we hope) mode, but at least in a way that can be helpful to users.

"Machine learning is such a huge opportunity," said Justin Rattner, Intel's chief technology officer. "Despite their name, smartphones are rather dumb devices. My smartphone doesn't know anything more about me than when I got it. All of these devices will come to know us as individuals, will very much tailor themselves to us."

Research into this area of technology will be conducted at the Intel Collaborative Research Institute for Computational Intelligence in Israel. The new technology will be aimed at wearable and portable electronics that can learn about their owners, reminding people of things they might forget—such as reminding you where you left your keys.

Other scientists at Intel are working on a chip that actually mimics how the brain operates. Even though you might not be able to recall the amount of information available to a supercomputer, your brain still operates in ways that can't be duplicated by even the most sophisticated electronics—and does so in a much more energy-efficient manner.

Our brains use neurons to conduct business. Thus far, every attempt to create some sort of neuron-silicon hybrid has required excessive amounts of power. They simply aren't capable of the parallel processing that allows your brain to process drinking coffee and reading at the same time, for example.

Neuromorphic chips seek to solve this dilemma by copying the human brain, using new technologies, rather than just building on silicon. Intel's Circuit Research Laboratory has based its design on lateral spin valves and memristors. Intel says the new architecture mimics the movement of neurons, and can be used to test methods of reproducing the brain's processing power. What's more, the chips created using its architecture use less power.

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3D Printing Fuels Prodrive Rally

Prodrive produces rally cars from Mini Countryman Cooper S stock. Paul Doe, chief designer — rally, told the RAPID 2012 attendees about how the company leverages AM.

Rally season begins in January and continues through November, which doesn't allow for much of an off-season to prepare next year's vehicle. This is the sort of atmosphere in which AM thrives, Doe notes. Rather than waiting a week to get a prototype back, a 3D printer produces the part in hours. This is particularly important for the process that goes into converting a stock vehicle into a rally-capable car.

The team creates a CAD version of what they'd like the car to look like when they've finished, then they create a prototype to give them a hands-on feel. Prodrive selected a Stratasys Dimension 12000 es for its needs, looking for a 3D printer that could produce durable parts.

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Stratasys and Oak Ridge Partner for 3D Printing

Additive manufacturing (AM) is on plenty of people's minds these days, including those in the U.S. government. Stratasys and Oak Ridge National Laboratory (ORNL) have partnered to further AM research. The partnership intends to improve Stratasys' fused deposition modeling (FDM) process.

The joint venture is backed by the Department of Energy (DOE) and will use ORNL's Manufacturing Demonstration Facility to propel FDM into a more widely used manufacturing process. The DOE is pursuing AM research to reduce manufacturing energy consumption, increase global competitiveness of U.S. manufacturing, and reduce time to market for new consumer goods. The main objectives of the project are to develop in-process inspection to assure part quality and suitability for service, and to develop carbon-fiber-reinforced FDM feedstock materials to produce strong, lightweight components.

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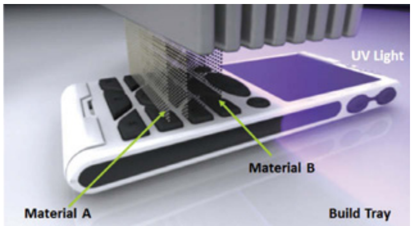
Objet Advances Multi-material Printing

Objet is continuing to develop new ways its materials can be used, particularly when it comes to multi-material printing. The company calls the procedure of combining materials "Digital Materials." According to Objet, customers have the option of 17 base materials and 90 digital materials, bringing the grand total of available materials to 107.

The number of materials offered has been buoyed recently by the development of 51 new digital materials, created by



combining the bases of VeroWhitePlus and the full complement of Objet's rubber-like materials. The results include 20 rubber-like digital materials with wide Shore scale (hardness) values that range from 40 to 95. The company says applications for the new materials include medical and artistic purposes.

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3D Printing in Space

NASA is always looking for ways to improve the capabilities of aerospace vehicles—and the on-board support systems that go along with them. Additive manufacturing (AM) is one technology being investigated for use in the future.

NASA is looking at using AM from a number of angles. First, as an additive technology, 3D printing requires less space than, say, a computer numerically controlled (CNC) machine. Creating useful objects without associated fumes and debris is also a plus. Another plus, from a conservation of materials viewpoint, is that broken parts could be recycled to produce raw materials.

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Solidscape's New 3Z Pro

Solidscape, a Stratasys company, has announced the release of its newest 3D printer, the 3Z Pro. It continues the use of Solidscape's drop-on-demand thermoplastic ink-jetting technology, along with precision milling of each layer.

The 3Z Pro is a desktop printer, weighing in at 80 lbs. with a 21.4x18x16-in. footprint. It has a build envelope of 6x6x4 in., with a resolution of 5000x5000 dpi and an accuracy of ±.0254 mm.

The new system uses Solidscape's 3Z Works software and accepts .stl and .stc file formats. The 3D printer includes a touchscreen with language neutral icons, offers wireless connectivity, and has self testing and auto-calibration functions.

The manufacturer's suggested retail price for the 3Z Pro is $45,650.

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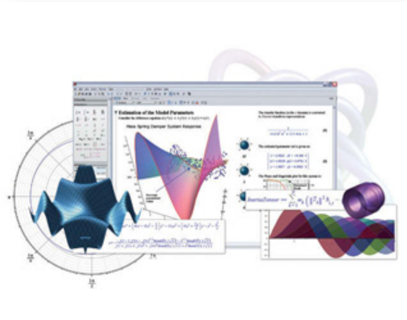
by Anthony J. Lockwood

Editor's Picks

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



Maplesoft Releases Maple 16

Technical computing software includes a point-and-click interface.

When Maplesoft announced version 16 of Maple, its technical computing system for mathematicians, engineers, and scientists, they exhibited the engineer's propensity for understatement. They simply called Maple 16 "a major release."

Well, yes, Maple 16 is a major release. Still, after learning that it offers more than 4,500 additions and improvements across the entire product, and looking through the huge amount of detail the company offers online about this release, I chuckled at the understatement. The depth and breadth of what Maplesoft has introduced in version 16 seems more than "major."

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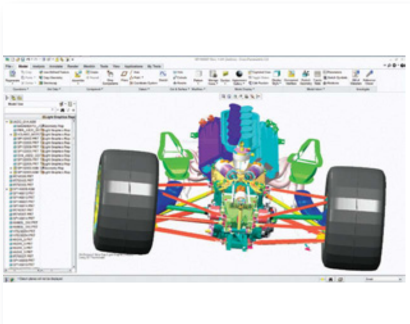

PTC Updates Creo

New app for creating or validating modular product designs in 3D.

When PTC announced Creo, they set the bar high for themselves — which, of course, means good things for you — so I've been interested to see where they'd go with it. Well, PTC recently released version 2.0 of the Creo product design system, and the company seems to have moved the bar up yet again. Version 2.0 sees more than 490 enhancements across the Creo app family — much more than I can hope to mention here. Suffice it to say, whether your gig is parametric or direct modeling, moving from 2D to 3D design, or all the above, Creo 2.0 has some goodies for you. Here's a few that turned my head.

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Apps Bring Mobile Computing to NI LabVIEW

National Instruments releases mobile apps for iOS and Android devices.

National Instruments has released three data acquisition applications for Apple iOS and Android devices: Data Dashboard for LabVIEW, Data Dashboard Mobile for LabVIEW, and NI cDAQ-9191 Data Display. These no-cost apps enable you to get at measurement data from data acquisition and embedded monitoring systems wherever you happen to be. Data Dashboard for LabVIEW and Data Dashboard Mobile for LabVIEW allow you to remotely view PC or embedded measurements from LabVIEW and create dashboard displays of network-published shared variables and deployed LabVIEW Web services.

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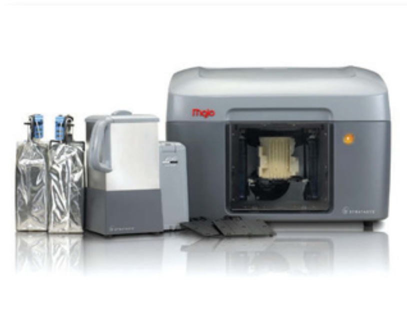

Stratasys Announces Mojo 3D Printer

Small footprint 3D printer comes as complete 3D printing system.

The Mojo 3D Printer is the heart of the Mojo 3D Print Pack. The latter goes for $9,900. (You can also lease Mojo in the US for $185 a month.) So what does $9,900 get you? Well, a professional-grade 3D printer that leverages Fused Deposition Modeling (FDM) material extrusion technology, system software, and a support-removal system. It also comes with something called a QuickPack print engine, which is an integrated package that contains the ABSplus thermoplastic spool and the print head. When it's time to reload materials, you insert a new QuickPack.

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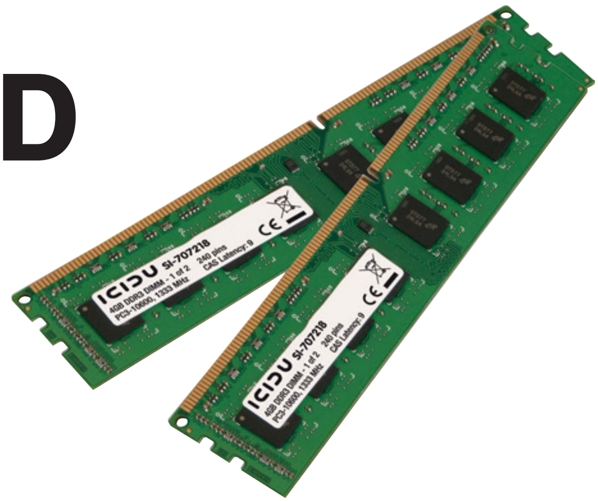
Your Next CAD Workstation



Buying or upgrading a workstation involves decisions and trade-offs.

BY PETER VARHOL

Just about every engineer would like the newest and most powerful workstation available. Alas, we can't have everything we would like.

Budget realities and corporate cultures largely determine when upgrades and new purchases occur. But with a little research, engineers can often make a case for a specific upgrade at a specific time—or even an entirely new computer.

An informal Internet survey done by CAD software vendor SolidWorks indicates that upgrades and new machines run the gamut from annually to when the computer is no longer able to run new software.

All of this raises the questions of how often to buy, what to buy, what can be upgraded, and when should a system be replaced completely. As might be expected, there is no single correct answer, but there are ways to help engineers weigh the pros and cons to make a good decision for their circumstances.

The Learning Curve

Upgrading existing workstations, and buying new ones, doesn't automatically confer a productivity advantage in engineering work, even if it is faster. In addition to the downtime needed to perform and upgrade, or to provision a new workstation, there is always a learning curve involved if the upgrade involves new software or more recent versions of existing software.

All of that slows you down. According to Eurocom President Mark Bialic, you have to take downtime and the learning curve into account in any upgrade situation. In addition to the upgrades or new systems, taking a workstation out of service is a loss to the engineer and the project. If the project consists of many engineers, the loss of productivity can be enormous.

There are upgrades that are intended to be a band-aid, lasting perhaps six months or at most a year, and others that may last two or three years, or even longer. The trick is to manage your upgrades and new systems to make effective use of your budget, while also minimizing engineering downtime. This requires planning ahead and looking at the entire lifecycle of your hardware and software, rather that doing ad hoc upgrades when requirements and prices dictate.

On the Hardware Side

The most important hardware components include:

- Video—If you choose the highest-performing video card with the most video memory, you can make that last three or four years. Even a mid-range professional card can last a couple of years, and these are relatively easy to replace.

In a podcast with *DE*'s Senior Editor Kenneth Wong, HP's Marketing Manager for Workstations, Tom Salomone, indicated that CAD work alone rarely makes use of the most powerful graphics cards. "If users are doing basic 2D CAD or just a little 3D CAD, low-end is enough," he said. "But if they're doing more sophisticated CAD work ... then they can certainly benefit from mid-range graphics cards."

- Storage—Physically replacing a disk drive is relatively easy, and can typically be accomplished in an hour or less. However, the existing disk drives usually have the operating system, applications and data files—all of which have to be backed up and reinstalled. Imaging disks can take some of the pain out of the reinstallation process, and regular backups are essential under any circumstances.
- Memory—Essentially a short-term upgrade, additional memory can be installed in an hour or less (typically) without changes to other hardware or software. Memory upgrades can involve adding more single in-line memory modules (SIMMs) if the slots are available, or replacing existing SIMMS with higher-density ones. Depending on the size of the assemblies you work with, memory may or may not speed up your work, but it can make your overall system more stable. Even for smaller assemblies, many users report that more memory can make an existing system more stable.

"We think the typical user today needs at least 8GB of RAM," said Salomone. "A lot of people I talk with have 16GB of RAM and in the near future, 32GB won't be unusual for a CAD user."

- Processor—Processor upgrades are more difficult, often because the pin configurations between them are different. Processors are also relatively expensive, and new state-of-the-art Intel Xeon processors can cost $1,000 or more. Given these factors, according to Eurocom's Bialic, it's best to think of processors as a long-term upgrade—or even better, consider it as a part of a complete system replacement.

"If you are replacing the motherboard, you might as well also replace the system, to make sure everything works together well," he adds.

Many workstations have dual processor slots, but design organizations often don't fill the second slot because CAD software tends to be single-threaded. After a couple of years, it's not uncommon to look to filling that second slot as an easy upgrade. If your workload has changed during that time, it's worthwhile investigating whether there would be an advantage.

Software Upgrades

Generally speaking, CAD software and other applications are versioned on an annual basis. Not all engineers upgrade when new software is released, often waiting until they need the new capabilities, or when support for previous versions expires.

Software upgrades can be more complex than hardware changes, because of the dependencies among different applications, as well as the need to learn new features and ways of working. This makes it imperative to plan software upgrades at least as carefully as hardware upgrades, and include training and other ways of supporting new ways of working.

Because software upgrades usually involve new features, they should be balanced between necessity and desirability, done often enough so that engineers have new capabilities at hand, but not often enough to disrupt ongoing engineering work.

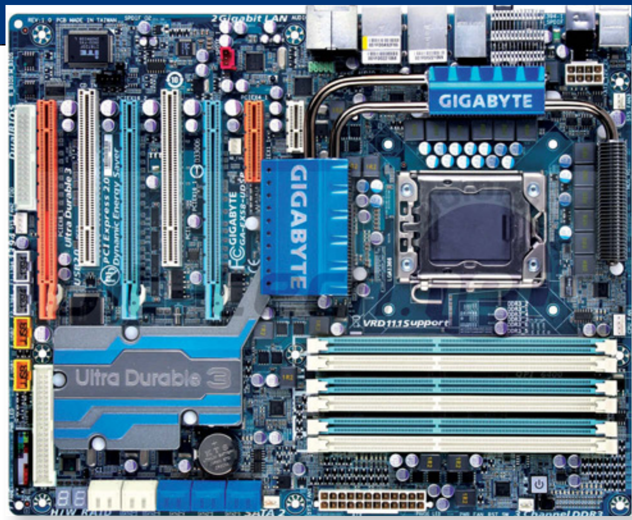
Multiple applications should be updated at the same time—a new CAD version combined with the next Microsoft Office suite, for example. These configurations often require testing by IT and engineering ahead of the actual upgrade, so that applications work with a given hardware setup.

Should You Go for a Drive?

Faster spinning drives or solid-state drives (SSDs) load applications and CAD files faster, but will they make a difference in regular work?

The answer is yes. Every operating system stores a part of every running application on disk, and swaps into memory what is needed at that particular moment of execution. Conventional drives that spin at 10,000 rpm or more will improve access times during work.

SSDs are entirely electronic, and have no moving parts to slow down access. However, they are still more expensive than rotating disks, and their capacities tend to be less. This leads to using both types of drives in a single workstation—installing operating system and engineering applications on the SSD, and storing data files and non-essential applications on the rotating disk. The approach can improve overall application performance, while keeping costs manageable.



If you're considering replacing the motherboard, it's likely time to purchase a new system altogether.

Stack vs. Stagger

Upgrades and replacement are a function of both hardware and software. Is it better to stagger these upgrades, so that engineers are offline for relatively limited periods of time, or stack them together so that they are performed all at once?

While circumstances vary among organizations, stacking upgrades is usually the approach that results in the least amount of total downtime, says Bialic. While staggering can involve shorter periods of downtime, those periods will be more frequent, possibly three or four times a year. By incorporating multiple upgrades into a single cycle, you can take advantage of IT efficiencies—while also losing less engineering time.

While buying new hardware and software can be expensive, planning your upgrades and knowing when you need to do so can both save money and provide a way to maximize computer performance and engineering productivity for many years. This includes determining what hardware requirements drive your applications, and what applications you need in order to perform your engineering activities.

When the workstation is new, the engineering or IT group should have a complete plan for its lifecycle. While that plan could change over time because of new technologies or workloads, there shouldn't be any surprise on when to upgrade, and what upgrades to undertake. **DE**

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

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→ **Eurocom Corp:** Eurocom.com

→ **HP:** HP.com

→ **Podcast:** deskeng.com/virtual_desktop/?p=5852

In Search of a More Natural Way to Design

BY KENNETH WONG

The mouse-and-keyboard combination that most CAD users employ today is but a legacy of the text-display era, dating back to the times you had to type in a command line (often in DOS) to tell your computer to do something. Even as computer graphics were rapidly transitioning from plain text to photorealism, few challenged the paradigm that was obviously flawed for interacting with 3D geometry.

But the iPad generation may finally be forcing hardware makers to reinvent themselves, to come up with better alternatives for visualizing digital objects and navigating 3D scenes. At the very least, touch responsiveness in display screens may become the norm, not an exception.

Touchable by Default

At both the Siemens PLM Connection and PlanetPTC Live conferences this year, crowds lined up for a chance to, quite literally, get their hands on the 82-in. LCD panel mounted in HP's booth. The display allows people to pull down, anchor, rotate, zoom, pan, peel off and brush away images with fingertips and two-handed gestures, with a finesse that would have been virtually impossible with mouse and keyboard. (The same technology is available in HP TouchSmart tablet products in smaller sizes, more suitable for personal use and desktop deployment.)

"We worked with a partner called Perceptive Pixel," explains Tom Salomone, HP's workstation marketing manager. "It uses projected capacitive technology—the same that was used on the iPad and Windows tablets."

One of the advantages of the Perceptive Pixel's device is its capacity to interpret and respond to more than a single-touch input. Several pairs of hands could be interacting with data displayed in different areas. It has built-in algorithms to detect and reject unintended input. The device is also capable of receiving pen-style input, which allows you to create fine-line drawings and handwritten markups.

Dara Bahman, AMD's senior manager for workstation graphics marketing, points to the proliferation of smartphones and mobile devices as a sign of the times.

"If you're on the [manufacturing] shop floor, and you have a mobile pad, it's so much easier to just pull up the drawing you need on that pad," he says. "You're not going to use a keyboard and a mouse. These tablets are going to fundamentally change how people work."

Efrain Rovira, executive director of Dell Precision workstations agrees. "Touch could enable a more natural creation model," he says. "That said, there are limitations around precision," noting that fingers are thick and when your hands are in

HP and Perceptive Pixel partnered to produce the oversized touch-responsive LCD display system. *Images above and on opposite page courtesy of Perceptive Pixel.*

the way, they create a screen obstruction.

Four-finger multi-touch display support for drawing, writing, editing and zooming onscreen is available in the Dell Precision M4600 and M6600 mobile workstations.

Space Immersion

One way to solve the solve the problem of hands blocking the screen is to get the hands away from the screen. Infinite Z develops the zSpace display system, which is described as a "virtual holographic experience." It uses a combination of high-res display panel, eye-tracking cameras, polarized eyewear, and pen stylus to deliver holographic imagery with simulated depth of field.

"We've been working diligently with application developers in many realms, quite a bit in the CAD space," says Dave Chavez, Infinite Z's vice president of research and development.

The system has been demonstrated to work with Autodesk Showcase, Autodesk Alias, Siemens PLM Software's NX, Dassault Systèmes' CATIA, and SolidWorks, among others.

In normal displays (stereoscope or otherwise), to view an assembly from a different angle, you'd have to rotate the 3D model using a mouse—or fingers, if operating on multi-touch surfaces. With zSpace, the head-tracking cameras interpret your movements and recalibrates the 3D image accordingly, so inspecting a model from another angle in its holographic space is more consistent with how you would do the same task in the real world. Compared to stereoscope displays on flat screens, zSpace's holographic environment creates an illusion of depth of field that's more convincing.

Design Review in Stereoscope

Though a reality-mimicking display style is preferred for design reviews and presentations, for most engineers creating the CAD model, a less-realistic display style with "clown colors" may be quite sufficient, says David Watters, NVIDIA's senior director, manufacturing & design. By clown colors, he means high-contrast colors that lets you clearly see edges and geometric volumes.

Antoine Reymond, AMD's senior strategic alliances manager for professional graphics, also observes that we'll see stereoscope and holographic visuals more in consumption of product information than in creation, adding, "It'll take some time to get the core designers to move away from 2D flat screens, because they need the precision."

Presenting 3D data in a much more realistic mode is also challenged by processing power. To render and display millions of polygons and pixels—twice as many, in the case of stereoscopic, as it must render a pair of images to address the left- and right-eye views—the CPUs and GPUs must sweat a lot more.

To satisfy the increased computing needs, "you'll need devices with more processing power, lower energy, smaller form factor," observes AMD's Bahman. He says he believes accelerated processing units (APUs), which combine the features of CPUs and GPUs, are better positioned to address the requirements: "With an APU, you don't split memory—[you don't need] some on the CPU, some on the GPU—so the memory bandwidth is wider. So processing power improves and power usage drops."

A Digital Future Rooted in the Past

HP's Salomone points to his granddaughter and her sketch pad as an example of what's driving the future of computer input.

"She's an artist. She wants to draw on the monitor. She wants the device to be natural. That's how professional [engineers] want to work, too," he says. "They want to draw on the screen, mark them up, use both hands, not worry about using a keyboard unless they need to type. If you think about it, before computers came around, that was the natural way to design."

The move to multi-touch screen, stereoscopic display, and gesture-based computing is, in a sense, a return to the past, an attempt to remove the intermediary input devices that interfere with the natural approach. **DE**

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

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→ **NVIDIA:** NVIDIA.com

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All-in-one May be One for All

The new HP Z1 all-in-one workstation combines elegant design and workstation performance.

BY DAVID COHN

Back in June, we reported on the Las Vegas-based launch of the latest additions to the HP family of Z-series workstations. While the headliner was the flagship Z820, a workstation we'll review in a future issue, the star of the show was clearly the new HP Z1 all-in-one workstation—and we couldn't wait to get our hands on one. That wait finally ended recently when HP sent us our own fully loaded Z1 to review.

There are other all-in-one computers out there, a design initially made popular by Apple's iMac. But most pretty much lock you in—they're a nightmare to upgrade. Not the Z1. Its tool-less chassis makes swapping out components nearly effortless. We were impressed when we first watched HP engineers do this in Las Vegas, and we were no less impressed when our Z1 arrived and we got to try it ourselves.

Sleek Setup

The Z1 arrived in a large, flat box, similar to what you'd receive if you bought a new flat screen display. And at first glance, it appears that the box contains nothing but a monitor on a folding stand. But pressing the green button in the center of the stand's hinge releases the screen so it can swivel into an upright position. It takes considerable force and a bit of practice to expand the Z1 to its full, upright position, but we soon got used to this maneuver.

Also in the box we found a 104-key wireless keyboard, wireless mouse, and a power cord. The receiver for the keyboard and mouse were already installed in the Z1's internal USB port; both proved to be very responsive and comfortable to use.

Fully extended, the Z1 stands approximately 23 in. tall, with the display panel enclosure measuring 26x23 in. and around 3 in. thick, little more than other LCD displays. The 16x13-in. base is a bit larger than the base of a typical monitor, however, owing to the overall 47-lb. weight of the system.

While the Z1 looked beautiful sitting on our desk, with nothing but a power cord hanging almost unnoticeably, it was even more gorgeous once we powered it up. The 27-in. in-plane switching (IPS) LED backlit LCD provided one of the best-looking images we've ever seen. With a 16:9 aspect ratio and native 2560x1440 resolution, the monitor is big, bright and crystal clear—with a viewing angle of 178°, a contrast ratio of 1,000:1, and more than 1 billion on-screen colors when paired with a graphics card capable of outputting 10-bit content.

Neat Package

Seated comfortably in front of the Z1, all you see is the monitor. But its other components are readily available. An HD webcam is centered above the monitor; a dial directly behind on the top edge lets you adjust the camera angle—and, in a nice touch—a white LED lights up when the webcam is active. A pair of digital microphones are hidden on either side of the camera, and two pairs of cone speakers below the display provide great sound.

Along the right side of the panel, HP has placed the power button, hard drive activity light, a slot-load optical drive and eject button, a 4-in-1 (xD/MMC/MS/SD) card reader, an IEEE-1394a FireWire connector, two USB 3.0 connectors, and headphone and microphone jacks. On the left side, a small plastic protrusion turned out to be a plastic serial number pullout card.

The HP Z1 combines a sleek industrial design with workstation performance in a package that outwardly consists of little more than a display and keyboard.

Across the rear of the panel, in a somewhat awkward position behind the hinge, the Z1 also provides a subwoofer connector, audio line-in and line-out jacks, a DisplayPort connector, power cord connector, four USB 2.0 ports, an optical S/PDIF audio port, and an RJ-45 network jack. There's also a slot for a cable lock in the lower-left corner of the case, and a handle centered across the top. The DisplayPort can be used to either enable the Z1 to power a second monitor or allow the Z1 LCD to serve as the display for a separate workstation.

Lifting the Lid

While we were anxious to put the Z1 through its paces, we also couldn't wait to peer inside. With the Z1 folded down and locked into a horizontal position, you slide a pair of latches on the bottom edge of the panel to unlock the chassis. Once freed, the entire LCD panel hinges open to reveal the Z1's interior, the panel held open by a hydraulic shock absorber.

And once open, changing out components is a breeze. There's barely a screw or cable in sight. Instead, green touch-points indicate where to grab and release components, including the power supply, graphics card, hard drives, optical drive and cooling fan assembly. Blind mate connectors ensure that everything hooks up correctly. Just about everything in the well-organized interior, with the exception of the CPU, can be quickly and easily replaced.

Speaking of CPUs, HP has ensured that the Z1 is a true workstation. Options include the 3.3GHz dual-core Intel i3-2020 in the base model, a 3.3GHz quad-core Xeon E3-1245, and the 3.5GHz Intel Xeon E3-1280 quad-core "Sandy Bridge" processor included in our evaluation unit. But while that CPU offers a maximum turbo frequency of 3.9GHz and an 8MB cache, it's already a year old. It will be interesting to see whether HP offers the Z1 with any of the newer "Ivy Bridge" CPUs later this year.

While the Core i3 CPU includes integrated Intel HD graphics (and a Z1 so equipped starts at $1,899), that configuration would only be suitable for entry-level CAD. At that price, the base system also comes with 4GB of RAM and a 500GB hard drive.

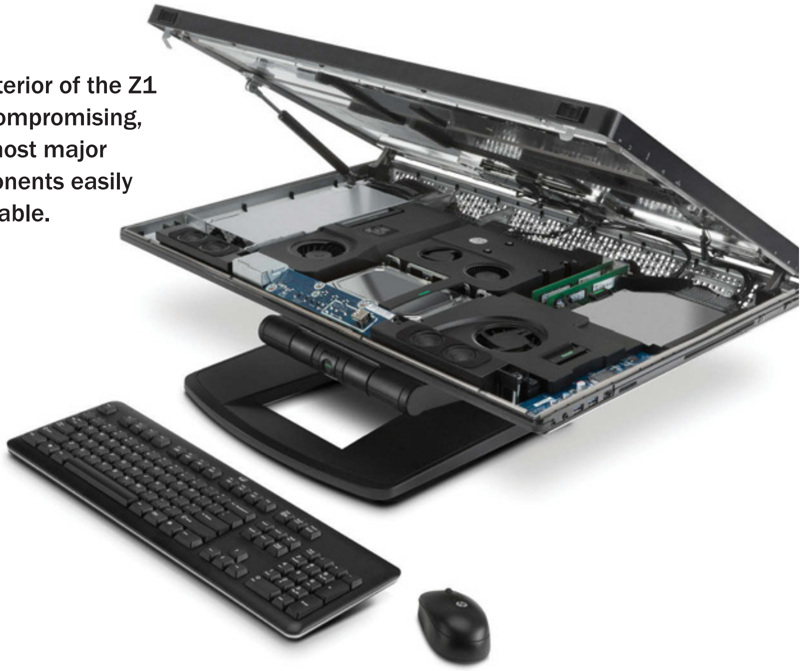
For more serious users, HP offers four choices of NVIDIA Quadro graphics boards: the 500M, 1000M, 3000M and 4000M. All four are really mobile GPUs, but they're mounted in a custom housing that makes the diminutive board look much larger. Our system came with the top-of-the-line Quadro 4000M, with 336 compute unified device architecture (CUDA) cores and 2GB of dedicated GDDR5 memory. Here again, it will be interesting to see whether HP adds the newer Kepler-based NVIDIA GPUs to the Z1 lineup.

The system can support up to 32GB of memory in four easily accessible memory sockets. Our Z1 came with 16GB of RAM installed as four 4GB DDR-3 ECC memory modules.

For onboard storage, HP offers a choice of hard drives. The Z1's drive bay is yet another of those removable components, a special caddy that supports either a single 3.5-in. drive or a pair of 2.5-in. devices (with redundant array of independent disks [RAID] 0 or 1 available for dual-drive configurations). HP offers 3.5-in., 7,200 rpm SATA drives ranging from 250GB to 2TB, as well as 300GB and 600GB, 2.5-in., 10,000 rpm SATA drives. The company also offers Intel solid-state drives (SSDs). Our evaluation unit came with a pair of 300GB SSDs.

The final option is a choice of optical drives. The slot-load 8X SuperMulti DVD+/-RW drive we received comes standard, or you can choose a slot-load Blu-ray Disc writer.

Also hidden away inside are three miniPCIe slots, one of which housed a card for the integrated Intel 802.11 a/g/n wireless LAN and Bluetooth combo card that comes standard on the Z1. So if you don't want to see a network cable hanging off the back of your Z1, you can go wireless.



The interior of the Z1 is uncompromising, with most major components easily removable.

Good Performance

Once we were done poking around inside, we closed the lid. Fear not, the hydraulic shock absorber ensures that it comes down slowly and safely, and the case shuts with a satisfying click. We then powered the Z1 back up and put it through its paces.

On the SPECviewperf test, which focuses only on graphic performance, our Z1 did quite well. It beat the results of all single socket-based workstations we've reviewed, except for those equipped with over-clocked CPUs. That's quite a testament to the power of NVIDIA's mobile GPU.

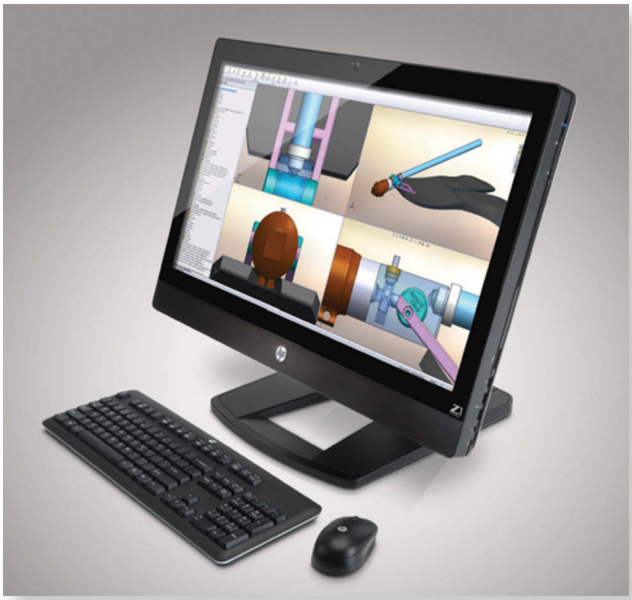
On the SPECapc SolidWorks benchmark, which is more of a real-world test (and breaks out graphics, CPU and I/O performance separately from the overall score), the results of the Z1 were also quite good. Because we previously tested systems using an older version of this benchmark under Windows XP, and have since moved to a newer release under Windows 7, the ratio results are not directly comparable. Looking at the times, however, the Z1 did well—again performing just a bit slower than systems with significantly over-clocked CPUs.

On the AutoCAD rendering test, however, the Z1 lagged a bit. Because AutoCAD's rendering engine is multi-threaded, this test clearly shows the benefits of multiple CPU cores. Yet the Z1, with the equivalent of eight cores (with Hyper-Threading enabled), took nearly 88 seconds to complete our test rendering.

Engineering Workstations Compared

		HP Z1 workstation (one 3.5GHz Intel Xeon E3-1280 quad-core CPU [3.9GHz turbo], NVIDIA Quadro 4000M, 16GB RAM)	Lenovo E30 workstation (one 3.2GHz Intel Xeon E3-1230 quad-core CPU [3.6GHz turbo], NVIDIA Quadro 600, 4GB RAM)		HP Z210 workstation (one 3.36GHz Intel Xeon E3-1245 quad-core CPU [3.7GHz turbo], NVIDIA Quadro 2000, 8GB RAM)		BOXX 3DBOXX 3970 EXTREME workstation (one 3.4GHz Intel Core i7-2600K quad-core CPU over-clocked to 4.5GHz, NVIDIA Quadro 4000, 8GB RAM)	Dell Precision T1600 workstation (one 3.4GHz Intel Xeon E3-1270 quad-core CPU, NVIDIA Quadro 2000, 4GB RAM)		BOXX 3DBOXX 8550XTREME workstation (two 3.33GHz Intel Xeon X5680 six-core CPUs over-clocked to 4.2GHz, NVIDIA Quadro 5000, 24GB RAM)		Dell T5500 workstation (two 3.33GHz Intel Xeon X5680 six-core CPUs, NVIDIA Quadro 5000, 6GB RAM)	
Price as tested		$5,625	$1,099		$2,269		$4,048	$1,875		$11,396		$9,242	
Date tested		6/29/12	4/21/12		2/12/12		10/12/11	9/11/11		3/20/11		1/14/11	
Operating System		Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit	Windows XP	Windows 7 64-bit
SPECviewperf	higher												
3dsmax-04		82.83[1]	79.01[1]	77.43[1]	80.67	79.46	99.03[1]	83.61	81.72	95.97	95.44[1]	76.05	78.72
catia-02		98.89[1]	77.80[1]	77.68[1]	94.20	91.47	124.75[1]	96.38	93.28	120.44	121.1[1]	98.48	100.25
ensight-03		90.20[1]	48.20[1]	49.27[1]	75.78	73.57	109.56[1]	76.62	74.16	132.41	130.13[1]	118.29	121.70
maya-02		330.32[1]	156.64[1]	157.63[1]	291.17	270.83	399.43[1]	297.27	270.53	529.89	476.95[1]	490.95	435.44
proe-04		97.22[1]	60.66[1]	60.79[1]	88.48	84.83	120.33[1]	89.24	85.86	113.84	113.24	92.19	90.61
SW-01		196.11[1]	94.38[1]	94.68[1]	168.06	161.45	231.44[1]	169.31	160.61[1]	221.31	214.06	180.49	169.75
tcvis-01		62.98[1]	34.25[1]	34.22[1]	56.41	54.43	79.05[1]	56.76	54.24	98.58	94.17	93.99	90.34
ugnx-01		44.98[1]	29.01[1]	29.16[1]	43.41	42.49	65.91[1]	43.40	42.47	89.32	86.90	89.31	87.95
SPECapc SolidWorks	lower												
Score	seconds	110.61[1,2]	127.48[1]	n/a	110.91	n/a	n/a	106.63[1]	n/a	106.56[1]	n/a	146.86	n/a
Graphics	seconds	38.31[1,2]	48.40[1]	n/a	35.71	n/a	n/a	34.24[1]	n/a	35.33[1]	n/a	58.42	n/a
CPU	seconds	30.52[1,2]	27.90[1]	n/a	25.89	n/a	26.44[1]	25.05[1]	n/a	25.99[1]	n/a	32.27	n/a
I/O	seconds	41.32[1,2]	55.17[1]	n/a	50.74	n/a	47.01[1]	48.26[1]	n/a	46.51[1]	n/a	60.76	n/a
SPECapc SolidWorks	higher												
Score	ratio	4.46[1,2]	6.25[1]	n/a	7.92	n/a	n/a	8.04[1]	n/a	8.23[1]	n/a	5.32	n/a
Graphics	ratio	5.06[1,2]	3.89[1]	n/a	5.78	n/a	n/a	5.74[1]	n/a	6.08[1]	n/a	3.23	n/a
CPU	ratio	4.01[1,2]	11.57[1]	n/a	12.46	n/a	12.20[1]	12.88[1]	n/a	12.61[1]	n/a	10.00	n/a
I/O	ratio	3.42[1,2]	5.74[1]	n/a	6.24	n/a	6.73[1]	6.56[1]	n/a	6.81[1]	n/a	5.21	n/a
Autodesk Render Test	lower												
Time	seconds	87.92[1]	85.66[1]	71.75[1]	71.66[1]	62.33[1]	45.6[1]	82.2[1]	60.5[1]	34.0[1]	19.0[1]	42.0[1]	28.0[1]

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



Style Worth Paying for

Our system came with Windows 7 Professional 64-bit, although Windows 7 32-bit and several versions of Linux are also available. HP backs the Z1 with a standard three-year warranty that covers parts, labor and support. Four- and five-year warranties are also available. Like other HP workstations, the Z1 is fully independent software vendor (ISV)-certified for most CAD/CAM/CAE software.

There's a lot to love about the Z1, and we definitely fell for this amazing workstation. What's more, at $1,899 for the base configuration, the Z1 is actually less expensive than a similarly equipped workstation tower and separate high-end 27-in. monitor. Of course, when you're ready to retire most workstations, you can continue to use the monitor with its replacement. While you could use the Z1 as a monitor, that's not as likely—one drawback of even this amazing all-in-one.

As configured, our Z1 priced out at $7,031, but an HP online discount that included free ground shipping dropped the cost to $5,625. Even at that price, the Z1 is still the most expensive single-socket workstation we've ever tested. But it's difficult to put a price on style, and the Z1 is certainly stylish. There's nothing else like it. I'd want one on my desk—and many design firms are likely to feel the same way. The HP Z1 is pretty revolutionary, and definitely sets a new standard for workstation design, performance and serviceability. **DE**

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

INFO ➔ HP: HP.com

HP Workstation Z1

- **Price:** $5,625 as tested ($1,899 base price)
- **Size:** 23x26x16 in. (HxWxD) all-in-one
- **Weight:** 47 lbs.
- **CPU:** Intel Xeon E3-1280 3.5GHz quad-core with 8MB cache
- **Memory:** 16GB (32GB max) DDR3 1600MHz ECC
- **Graphics:** NVIDIA Quadro 4000M w/2GB GDDR5
- **Hard Disk:** Two Intel 300GB SATA SSD
- **Optical:** slot load 8X SuperMulti DVD+/-RW
- **Audio:** High-definition audio, dual-cone speakers, SRS Premium Sound
- **Video:** HD webcam
- **Network:** integrated Intel 82579 Gigabit LAN, integrated Intel 802.11 a/g/n wireless LAN, Bluetooth
- **Drive Bays:** two internal 2.5 in.; or one internal 3.5 in., one external 5.25-in. bays
- **Ports (side):** two USB 3.0, one IEEE 1394a, 4-in-1 Media Card reader, one headphone, one microphone/line-in
- **Ports (rear):** one DisplayPort, four USB 2.0, one RJ-45 to integrated LAN, one subwoofer output, one optical S/PDIF output, one audio line-in, one audio line-out
- **Keyboard:** 104-key HP wireless keyboard
- **Pointing device:** two-button optical HP wireless scroll mouse

Power *and* Portability

Eurocom gets it all right in its newest notebook computer, the P150H Racer mobile workstation.

BY DAVID COHN

Eurocom continues to build some of the world's most powerful portable computers. Last year, the Canadian company sent us several impressive models that set new performance records—albeit with impressive price tags to match. A year later, Eurocom is back with a system it claims as the world's first 15.6-in. notebook with a 100-watt GPU. While that higher power consumption is sure to reduce battery life, the result is a mobile workstation that once again raises the benchmark bar, while at the same time lowering the cost.

The 7-lb. (plus a sizable 2-lb. power supply) Eurocom Racer came housed in a nicely sculpted black plastic case that measures 15x10.24x1.72 in. Raising the lid reveals a full HD, 1920x1080-pixel LED backlit display.

The display in our Racer was powered by an NVIDIA Quadro 5010M, that company's latest high-end GPU, equipped with 384 compute unified device architecture (CUDA) cores and 4GB of dedicated GDDR5 memory. That graphics option added a whopping $1,968 to the Racer's base system price, and accounts for the 100-watt GPU power claim. Other, less-expensive choices include various AMD Radeon and NVIDIA GeForce cards, as well as a complete lineup of NVIDIA Quadro boards.

Lots of Choices

If that sounds like a lot of options, you're right. The company offers lots of choices. The base model Racer comes with a 2.2GHz processor, an AMD Radeon Mobility graphics card, 4GB of memory, a 320GB hard drive, a DVD+/-RW drive, wired and wireless networking—plus Bluetooth and a 9-in-1 card reader, although the operating system is optional.

Eurocom equipped our evaluation unit with an Intel Core i7-2960XM Extreme, the latest generation of Intel mobile processors based on the Sandy Bridge architecture. The 2.70GHz quad-core CPU has a 3.7GHz turbo speed, 8MB of L3 Smart Cache, and a thermal design power (TDP) rating of 55 watts. This configuration added $783 to the base price. Eurocom also offers a choice of 10 other CPUs.

Our evaluation unit also came with 16GB of memory, installed as four 4GB DDR3-1600 small outline dual in-line memory modules (SO-DIMMs), which added another $257. Other memory options range from 8GB to 32GB (which could add as much as $1,615 to the base price). And while the standard primary storage drive is a 320GB, 7,200 rpm SATA drive, our evaluation unit came with a 120GB Intel solid-state drive.

Big on Performance

With all of the top-of-the-line components, we expected great performance, and the Eurocom Racer rose to the occasion. On the SPECviewperf test, which looks solely at graphics performance, the Eurocom P150HM Racer beat every other mobile workstation we've tested to date.

For our SolidWorks benchmark, which is more of a real-world test and additionally breaks out graphics, CPU and I/O performance separately from the overall scores, we've recently switched to the newer SPECapc SW 2007 version, which runs properly under Windows 7 64-bit. Here again, the Eurocom Racer surpassed all previous mobile workstations—with the exception of last year's Eurocom Panther.

On the AutoCAD rendering test, in which the competitive edge clearly belongs to fast CPUs with multiple cores, the Racer proved to be the fastest quad-core mobile system we've tested.

Even the results of our battery rundown test were respectable. The standard eight-cell, 76.98WHr battery powered the Racer for 1 hour and 50 minutes.

Of course, all of the Racer's power comes with a fairly hefty price tag attached. Our evaluation unit priced out at $4,933. Customers could easily lower that figure by opting for some

INFO → Eurocom Corp.: Eurocom.com
Eurocom P150H Racer

- **Price:** $4,933 as tested ($1,467 base price)
- **Size:** 15x10.24x1.72-in. (WxDxH) notebook
- **Weight:** 7 lbs. as tested, plus 1.9-lb. power supply
- **CPU:** 2.70GHz Intel Core i7-2690XM quad-core with 8MB L3 cache
- **Memory:** 16GB 1600MHz DDR3 SDRAM (32GB max)
- **Graphics:** NVIDIA Quadro 5010M with 4GB memory
- **LCD:** 15.6-in. diagonal (1920x1080)
- **Hard disk:** 120GB SSD
- **Optical:** 8x multi DVD+/-RW dual layer
- **Audio:** line-in, SP/DIF-out/Surround-out, microphone, headphone, built-in microphone and speakers
- **Network:** integrated Gigabit Ethernet (10/100/1000 NIC); Intel 802.11 a/b/g/n wireless LAN; optional integrated Bluetooth 2.0
- **Other:** two USB 2.0, two USB 3.0, one mini IEEE 1394 Firewire, eSATA/USB 2.0 combo, 9-in-1 card reader, DVI-out, HDMI-out, 2MP webcam
- **Keyboard:** integrated 98-key keyboard with numeric keypad
- **Pointing device:** integrated two-button touchpad

less-expensive options. However, that price is more than $2,500 less than the Eurocom Panther we reviewed last year.

Our system price included Windows 7 Professional 64-bit edition. Eurocom also offers Windows 7 Premium and Ultimate. The price includes just a one-year warranty, however, and requires owners ship the system back to a factory depot for repairs. Extending the warranty for a second year adds $151, or $271 to extend it out to three years. But Eurocom continues to offer lifetime upgradability, as well as credits of up to 20% if you trade in an older system when purchasing a new Racer.

The Eurocom Racer, while definitely designed as a desktop replacement, provides a balance of power and portability at a price that should appeal to engineers, designers and graphic professionals on the go. DE

David Cohn *is the technical publishing manager at 4D Technologies. He also does consulting and technical writing from his home in Bellingham, WA, and has been benchmarking PCs since 1984. Contact him at david@dscohn.com or visit his website at DSCohn.com.*

Engineering Mobile Workstations Compared

		Eurocom P150HM Racer (2.70GHz Intel Core i7-2960XM quad-core CPU, NVIDIA Quadro 5010M, 16GB RAM)	**HP EliteBook 8560w** (2.30GHz Intel Core i7-2820QM quad-core CPU, NVIDIA Quadro 2000M, 16GB RAM)	**Eurocom Panther 3.0** (3.46GHz Intel Xeon 5690 six-core CPU, NVIDIA Quadro 5010M, 12GB RAM)	**Eurocom D900F Panther** (3.3GHz Intel Xeon X5680 six-core CPU, NVIDIA Quadro FX 3800M, 12GB RAM)		**HP Elitebook 8540w** with DreamColor display (1.60GHz Intel Core i7 QM720 quadcore CPU, NVIDIA Quadro FX 1800M, 8GB RAM)		**Dell Precision M6500** (2.00GHz Intel Core i7 X920 CPU, NVIDIA Quadro FX 380M, 4GB RAM)		**HP EliteBook 8530w** (2.53GHz Intel Core 2 Duo T9400 CPU, NVIDIA Quadro FX770M, 4GB RAM)		**Lenovo ThinkPad W700** (2.53GHz Intel Core 2 Quad Core Q9300 CPU, NVIDIA Quadro FX3700M, 4GB RAM)
Price as tested		$4,933	$4,063	$8,027	$7,467		$3,657		$4,430		$2,822		$3,524
Date tested		5/1/12	5/1/12	8/20/11	1/14/11		12/13/10		4/23/10		12/18/08		10/22/08
Operating System		Windows 7	Windows 7	Windows 7	Windows XP	Windows 7	Windows XP	Windows 7	Windows XP	Windows 7	Windows XP	Windows Vista	Windows XP
SPECviewperf	higher												
3dsmax-04		77.46	71.23	74.50	75.97	79.11	43.31	56.10	49.56	52.35	33.38	32.21	34.23
catia-02		104.07	80.96	95.31	85.23	82.83	53.08	59.43	64.31	61.72	42.41	39.75	45.01
ensight-03		108.74	63.97	101.50	66.02	60.10	41.52	41.05	58.28	47.75	37.42	34.24	43.31
maya-02		413.45	233.93	407.90	290.35	236.55	204.12	159.95	283.64	212.05	149.21	108.33	165.87
proe-04		111.08	74.69	95.73	84.84	77.09	57.51	57.06	70.91	61.96	42.92	39.33	45.67
SW-01		203.03	138.60	198.76	178.01	163.34	109.6	102.93	152.41	132.68	67.98	59.75	90.01
tcvis-01		94.65	47.24	91.18	47.36	42.28	29.84	27.15	47.71	39.44	21.42	19.19	28.34
ugnx-01		86.39	37.16	86.62	43.18	39.34	27.75	28.10	39.60	33.64	19.85	18.11	30.91
SPECapc SolidWorks	lower												
Score	seconds	123.33[2]	131.17[2]	n/a	135.63	n/a	198.16	n/a	175.72	n/a	182.63	n/a	187.27
Graphics	seconds	42.36[2]	44.76[2]	n/a	51.94	n/a	67.55	n/a	58.99	n/a	62.16	n/a	60.87
CPU	seconds	38.78[2]	39.37[2]	n/a	29.22	n/a	45.42	n/a	37.62	n/a	39.99	n/a	44.40
I/O	seconds	42.19[2]	47.04[2]	n/a	58.76	n/a	89.8	n/a	83.48	n/a	83.69	n/a	96.66
SPECapc SolidWorks	higher												
Score	ratio	3.67[2]	3.67[2]	n/a	5.66	n/a	4.08	n/a	4.75	n/a	4.75	n/a	4.47
Graphics	ratio	4.21[2]	4.37[2]	n/a	3.61	n/a	2.69	n/a	3.09	n/a	3.26	n/a	3.15
CPU	ratio	3.16[2]	3.11[2]	n/a	10.19	n/a	7.1	n/a	8.58	n/a	8.07	n/a	7.27
I/O	ratio	3.35[2]	3.01[2]	n/a	5.14	n/a	3.53	n/a	3.79	n/a	3.78	n/a	3.65
Autodesk Render Test	lower												
Time	seconds	76.66	89.83	53.3[1]	57.16	51.83	188.5	146.81	168.33	180.16	318.4	324.60	162.00
Battery Test	higher												
Time	hours: min	1:50	2:37	0:38	n/a	1:17	1:28	1:21	2:06	2:05	3:21	3:00	2:15

Numbers in blue indicate best recorded results. Numbers in red indicate worst recorded results. 1=Hyper-threading enabled. 2=Results based on SPECapcSW2007 benchmark.

Working LARGE

CAD models are growing, in both size and complexity.

BY KENNETH WONG

A design engineer for Dallara Automobili, developed a social routine based on the length of time it took to load an assembly into his CAD program. He knew his file, the 2012 IndyCar assembly, would take considerable time to open. In fact, he had enough time to go to the office kitchen, make himself an espresso, and check in with his coworkers before the 3D model appeared on his monitor.

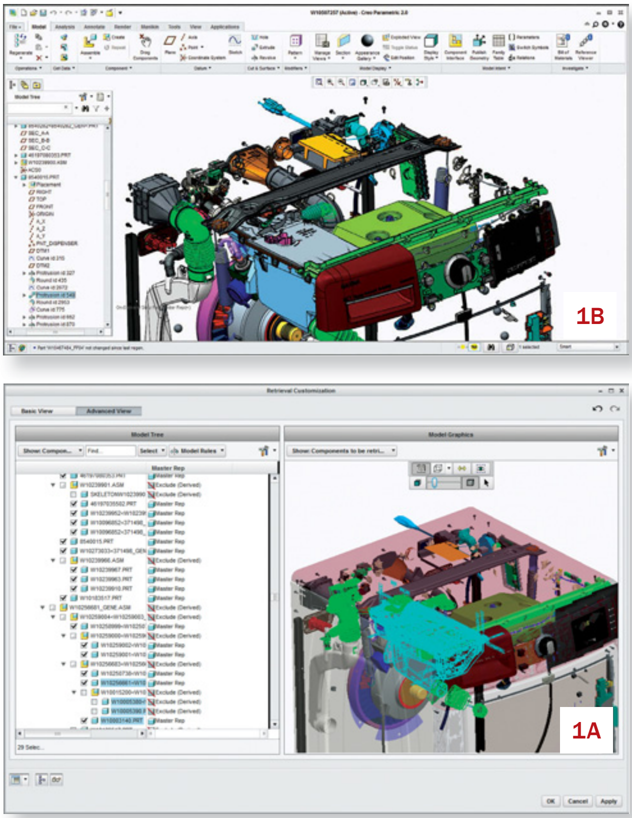
Dallara's experience is not an isolated incident. It's a common phenomenon among people who regularly interact with highly detailed digital assets.

"There's a ship builder who stopped by our booth [at a trade show]," offers Bill Barnes, general manager at Lattice Technology. "He told us he can't open his model of the entire ship in his CAD system. We've heard this before—usually from people who work with vehicles, ships and heavy equipment."

Paul Brown, Siemens PLM Software's marketing manager for NX, recalls, "A couple of years ago, I went to a customer who makes satellites. He told me, if he loaded a model with everything, with all the solids, it would easily take two hours before he could get started. Before, if you've got 1,000 parts, that was big. Now, we're talking about [assemblies with] 10,000, 15,000 or hundreds of thousands of parts. That has become the norm."

Loaded with metadata, specifications, material properties, manufacturing options and cost estimates, today's CAD models have evolved into something greater than simple geometric representations of products. Rather, they function as digital replicas of the products, embedded with sufficient intelligence to mimic their physical counterparts. These CAD models allow engineers to run stress, thermal, fluid flow and electromechanical experiments on them, as though they were physical mockups. But this digital realism has a price—as seen in the growing frequency with which assembly files routinely bring powerful workstations to their knees.

The shift from physical to digital prototypes in manufacturing is now as irreversible as the move from faxing to emailing. As reliance on digital models grow, so do the size and complexity of the models. How can you remain productive if, every time you load or rotate a model, you're forced to take a coffee (or espresso) break? It's a question that continues to plague CAD users and software developers.



In many CAD programs, selective or filtered loading has become an option to cope with large assemblies (1A). With PTC's Creo Parametric, you can load a subset of the data that provides the context, and start working in just a few seconds (1B). You may also filter what you load by size, internal/external parts, or using other rules.

Borrowing a Page from Google Maps

The engineer at Dallara, whose employer uses PTC's Pro/ENGINEER, must now find other ways to maintain his interoffice social life. With the latest visualization improvements in PTC's Creo Parametric 2.0, his assembly files are loading much faster.

The credit, along with the blame for depriving the Dallara engineer of his routine, goes to John Buchowski, vice president of product management at PTC. He and his team were largely responsible for the display performance boost in the software.

"The 64-bit Windows OS helps tremendously," says Buchowski. "Before, in 32-bit systems, you only have 2GB of addressable memory. It doesn't take a very large assembly to hit that memory limit. After that, you'd have crashes because the application has run out of memory."

One of the things PTC has done to improve assembly display, according to Buchowski, is to incorporate the lightweight 3D display technology from the company's annotation and viewing applications (like Creo View) into the main CAD products.

"What we start to do is almost like the Google Maps approach," he explains. "If you're looking at your model at a distance, [the software] is not loading all the internal content. It just loads the graphics and the structure. Then, when you zoom into a portion of the model, it starts loading the geometry and feature histories of that portion."

JT, from the Ground up

"Years ago, we concluded the way to address this problem was to give customers the option to load some components only as visual representations, as faceted data, which is very light," notes Siemens' Brown.

That worked—for awhile. Eventually, customers' model sizes outgrew the solution, forcing Siemens to revisit the issue. This, according to Brown, led to the decision to integrate the company's lightweight JT format into NX's data structure.

Initially developed by Siemens, JT uses a combination of faceted geometry, NURBS data, and manufacturing information to display 3D assemblies. The format has been accepted as one of ISO's publicly available specifications. It's also supported by many professional design software programs.

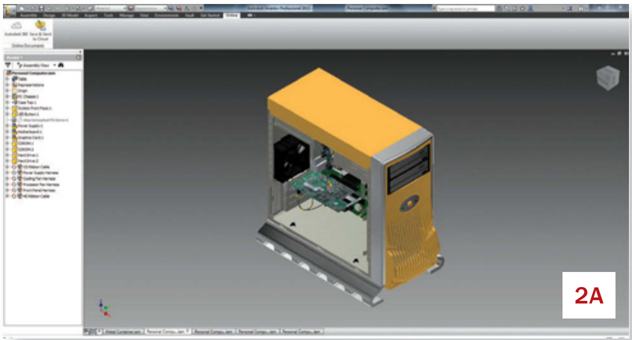
Siemens' recommended approach is to load assemblies in JT by default until you have identified the sections or components on which you need to work. Then, you may load the necessary parts as solids for editing, refining and meshing.

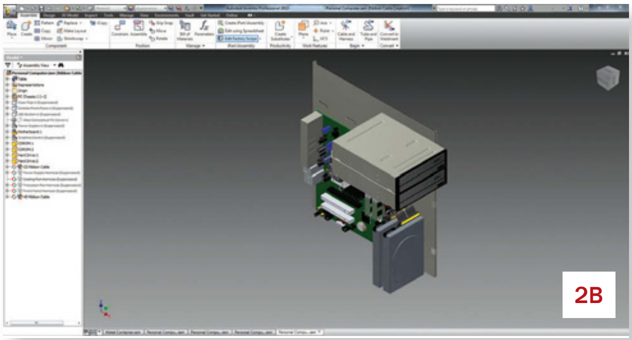
Most CAD software packages now offer the option to open large assemblies without some of their internal components, or with a reduced level of details. The aim is to improve model response by reducing the memory overhead. Such methods work especially well when you need to inspect the assembly visually, or study its outer surfaces and structure. However, if you need to perform an operation that affects the entire assembly, you'll most likely be loading it fully, with its subcomponents and inner details.

Lightweight Loading

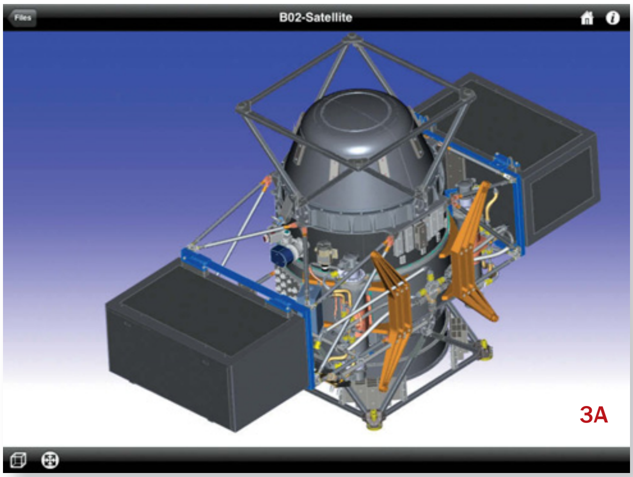
Another way to solve the heavy assembly issue is to work with lightweight data formats—formats developed specifically for displaying large 3D assets with minimum memory overhead. It's a specialty of Lattice Technology, Barnes' employer.

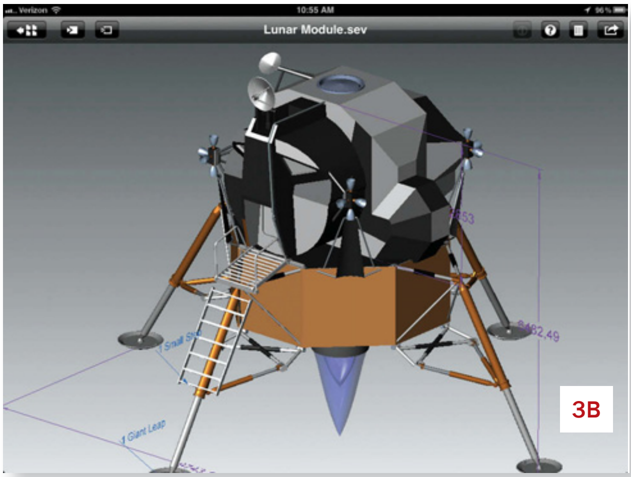
"Even with our lightweight format [XVL], we still have to offer [a selective loading option] for some of our customers now," says Barnes. In other words, Lattice now offers a lightweight viewing option for an assembly that's already in its lightweight format.





(2A) Compare the master-level detailed assembly of a personal computer and (2B) the same model shown in a reduced level of details. Level of detail helps suppress unneeded components or replace multiple parts with a single part representation to reduce memory consumption.





Delivering complex information in lightweight formats on mobile apps, such as XVL Viewer from Lattice Technology (3A) and Solid Edge Viewer from Siemens PLM Software (3B), provides a way to bypass the memory hog caused by large assemblies in native CAD formats.

"One of the reasons Toyota likes working with XVL is because they can load the entire vehicle with it," Barnes says. "Well, now they're no longer content with just loading one vehicle. They'd like to have revisions one, two and three, and so on."

Simultaneous display of multiple vehicle models is desirable because, short of building multiple physical mockups, it's the only way to compare and contrast the visual appeal and functional advantages of the different versions of each vehicle design. Lattice products, such as XVL Studio, accommodate this compare and contrast process by allowing design engineers to pick and choose which components to load—and, perhaps more importantly, which to omit when displaying assemblies.

In native CAD formats, according to Barnes' estimate, a full vehicle assembly typically reaches 2GB.

"With XVL, it could be reduced to 100 to 150MB to represent a full vehicle," he says.

Cloud Streaming

Autodesk is looking toward streaming data from the cloud as one possible solution for heavy datasets. In late 2009, the company experimented with streaming a number of its professional design programs from the cloud, under the Project Twitch initiative.

According to the company, "the goal of Project Twitch was to enable you to instantly try AutoCAD, Autodesk Inventor, Autodesk Revit and Autodesk Maya software without having to install or download the applications. These applications ran remotely on our servers and were delivered to you over the Internet … We have taken what we have learned during the technology preview and applied it to running an AutoCAD LT trial remotely."

Because remote servers can house many more CPU or GPU cores, they can also deliver far more computing power than what's typically available in desktops, laptops and workstations. Therefore, in theory, you could send your assembly model to the cloud for faster processing, then retrieve the results back as simple visual data on your local machine.

This workflow works well for rendering still images or simulation, but may not be ideal for interactive design work, as the bandwidth connection between the local machine and the cloud-hosted server may inhibit how fast the assembly responds to commands.

"With the Synch Component [technology] we have today, a lot of the data is cached to your system, with a mirror copy in the cloud," notes Randall Young, Autodesk's product manager for cloud platforms. "That gets around the latency issue you might have, because while you're working on the model [from the cached file], you can download other files in the background."

RAM Boost is Only a Partial Fix

In computer systems, random access memory (RAM) serves to temporarily house the data in active use. Therefore, the quickest fix to hiccups associated with large assemblies is to increase RAM, keeping it well in excess of the assembly's size. Or so it seems.

"Big chunks of RAM helps, but I don't think it's that simple," says Lattice Technology's Barnes. "As computers get more powerful, people want to do more and more."

Autodesk's Young agrees: "Your system is only as fast as your slowest component, so you're still dependent on the graphics card bus speed, hard drive performance [the speed at which the drive allows you to read data from it and write data to it], and other factors."

"If you add more RAM, your system probably won't crash as often," says PTC's Buchowski. "But a CAD model is a pretty heavy artifact. You've got full graphics, metadata stored in it, product structure, geometry, boundary conditions, and feature histories. That's massive amount of content."

When RAM proves insufficient and the system begins using the paging process—borrowing hard-disk space to make up for the memory shortage—newer solid-state drives (SSDs) with faster read-write speed seem to make a difference.

"The performance you get in retrieval, which is a big part of this [assembly response], helps quite dramatically with solid-state drives," notes Siemens' Brown.

The Breakup Fix

One way to avoid unwieldy assemblies is to break them up into smaller subassemblies. In doing so, you reduce the amount of work required to compute the relationships among top-level assembly components (often called top-level mates) at load time. It also makes collaboration easier, especially where different teams must work on separate areas of the same assembly over LAN or WAN.

"It's good modeling hygiene, so to speak, to use a modular structure, to subdivide the assembly into subgroups," says PTC's Buchowski. "Built into Creo, we have lots of capabilities, such as reference control and external simplified representation. We have ways of partitioning a large model so different people can work on portions of the model without stepping on each others' toes."

Similarly, Autodesk's Young suggests, "With Autodesk Inventor, you can take a small number of parts and make them into an assembly. For example, the drivetrain is one assembly, and the engine another, and the shell another."

Multicore Promise

Though 3D modeling operations in most CAD software programs remain single-threaded, some CAD programs have incorporated multi-threaded processing in selective functions to take advantage of the additional processing power available in multicore workstations.

In Lattice Technology's XVL Studio, the software runs faster with dynamic interference and other operations on multicore processors, according to Masaru Hatakoshi, solutions engineer, Lattice Technology.

Siemens' Brown notes, "We've been working on ways to take advantage of multiple cores for faster display, data retrieval, and navigation of large assembly structures." He anticipates multicore support will be evident in NX 8.5, featuring advancements that tailor to the shipbuilding customers, among others.

Autodesk's Young says, "A lot of products added to the Autodesk portfolio in the last few years, like Autodesk Showcase [for rendering and visualization] and Autodesk Moldflow [for simulation injection-molding operations], are built to take advantage of multicore processors."

At least for the foreseeable future, assembly performance will likely remain a cat-and-mouse game. The bag of tricks employed by CAD developers will provide customers with relief in large-assembly bottlenecks, but only for awhile. Eventually, CAD users' insatiable demand will push the software to its limit, forcing the developers to seek relief elsewhere once more. **DE**

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➜ **Dallara Automobili:** Dallara.it

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➜ **PTC:** PTC.com

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Designing for Short-Run Production Needs

Fast builds with no tooling make direct digital manufacturing increasingly attractive.

BY PAMELA J. WATERMAN

Any time a product or service forms 30% of a business, it demands attention. That number is typically reported by service bureaus operating additive manufacturing (AM) equipment, as the percentage of their projects now involving direct digital manufacturing (DDM).

Distinct from rapid prototyping, DDM creates real parts for real end-use products. The term encompasses single-use models for lost-wax casting, multiple-use molds and tools for casting or injection molding, "on-demand" one-off consumer-customized pieces (produced through services such as Shapeways and Sculpteo) and short-run actual parts.

In this article, *DE* examines the benefits and challenges of the latter topic: DDM as a game-changing technical and business approach to high-end professional part production. Across the board, service bureaus and a number of manufacturing companies see this tactic as a growing part of their operations, even commanding a competitive advantage.

Confirming this trend, in his 2012 Additive Manufacturing and 3D Printing State of the Industry report, consultant Terry Wohlers says 24% of all money spent on AM products and services is tied to direct part production. (*Editor's Note: Although the term "direct digital manufacturing" is not officially acknowledged by ISO or ASTM International, we use it here for simplicity.*)

Never Know Until You Try

Awareness of AM's possibilities is (finally) growing faster now than it has in the past 25 years. Chuck Alexander, a veteran of the AM business for 23 of those years, helped usher in the industry at 3D Systems—and continues to push its limits as AM product manager at Solid Concepts, a California service bureau with broad experience and equipment in this arena. He says the growth of the 3D printer lower-end market has made more people aware of AM in general, and the capabilities of high-end DDM in particular.

Solid Concepts currently fills about 25% of its customer projects via AM. Alexander says he sees the technology's freedom of design as a great plus, giving the example of forming zip-tie mounts into ductwork to eliminate assembly steps and simplify installation. He adds, however, that "there's a lack of knowledge regarding both the benefits of AM and the need to define process specifications such as part orientation."

Dental models in a custom proprietary SLA resin built by In'Tech Industries on a fleet of 3D Systems' IPro 8000 and 9000 SLA machines. *Image courtesy of In'Tech Industries.*

Benefits that bureaus and their customers see include opportunities to:

- eliminate tooling production costs, both for initial designs and for revisions;
- quickly modify or customize a product during the production lifecycle;
- save time vs. ordering tooling;
- create parts with curves that are difficult to machine;
- hold tolerances better than with injection molding;
- consolidate assembled parts into a single unit, eliminating the time and cost of assembly labor, number of parts to be kept in inventory, and the accompanying traceability paperwork;
- provide cost savings when producing internal parts, where aesthetics may not be important; and
- compete directly with overseas manufacturers, because the pricing of AM systems, parts and operation is the same for them as for U.S. users.

Challenges when using AM for end-part production may include the following:

- A lack of knowledge of control processes, which is important for reproducibility, especially for aerospace—designers must be educated to add them to specifications.
- Tolerances may be harder to hold, compared to traditional production methods such as machining.
- Currently, there is a limited material selection.
- Costs are higher for equipment, consumables, labor and maintenance, although this is very quantity-, system- and design-dependent.
- Possible infrastructure issues may arise with managing massive amounts of data, when hundreds of unique files are involved—with dental applications, for example.

For a growing number of manufacturers, however, the benefits clearly outweigh the challenges. *DE* spoke to companies across the country to hear why this approach works so well for them.

Axon Styrotech Corp.

In Raleigh, NC, Axon Styrotech manufactures machinery and systems for heat-shrink sleeving, tamper-evident banding and stretch-sleeving, as placed on a wide range of products—from lipsticks to ice-cream cartons to plant fertilizer bottles. In December 2010, the company purchased an Objet Eden 260V system, primarily to make custom tooling for its own machines.

One DDM part used in Axon's sleeving equipment widens out a flattened shrink-sleeve label to conform closely to the final container's shape (an oval plastic shampoo bottle, for example). The sleeve is then cut from the feed-roll and ejected down to surround the product prior to the shrinking step. Pre-shaping the sleeve helps eliminate jamming the wrapper-feed process.

Ken Nyren, an Axon engineering manager, says his company chose the Objet printer because the parts (generally built in Objet FullCure 840 Vero Blue polymer resin) come out homogeneous, with uniform strength in all directions. In addition to building the custom shrink-sleeve forms, Axon uses the AM system to quickly make spacers and guides that also go into its custom machinery.

Nyren says they find more uses every day for the Objet printer, and about 65% of those parts are for end use.

"It's expensive to stock a part, but we can stock material and print a part in 20 minutes," he explains. "Every day, we find something else to do with it."

C.ideas

C.ideas of Crystal Lake, IL, has been heavily involved in AM beta testing and development efforts since 1998. Already offering more than 17 in-house AM machines and a choice of 24 materials, C.ideas has seen its orders for DDM parts steadily increase over the years.

"This incline is driving us to invest in more 'production-ready' based RP and AM systems," notes Mike Littrell, C.ideas' project manager, with the process now accounting for 30% of the company's AM output.

Hearing-aid ear shell built by In'Tech Industries on 3D Systems' Viper Si SLA system, with thousands built daily. Biocompatible material is Dreve Fototec; gloss finish is net-proprietary finished (no post-polishing or lacquering). *Image courtesy of In'Tech Industries.*

DDM's benefits have been the deciding factor for a number of recent C.ideas projects. For example, the bureau recently helped the sales force of a turbine-manufacturing customer save time and back pain by creating 80 scaled-down plastic models for trade show travels.

Littrell has high praise for the results produced on the recently acquired sPRO60 HD HS selective laser sintering (SLS) system from 3D Systems.

"Even though it's not the biggest build, it's a phenomenal machine," he says. "We produced four turbine designs, 20 parts each, in 48 hours."

For another C.ideas client, the option of redesigning an assembly as a single AM-built part paved the way for building 60 sets of complex aircraft ventilation ducting, whose odd shape couldn't be produced any other way. C.ideas also supplies low-quantity motor covers for an agricultural baling company that builds and customizes each of its customers' $2 million to $3 million machines with different motors and controls.

In'Tech Industries

Medical and dental DDM applications may not seem flashy, but by volume, they're the solid foundation of this field. At Ramsey, MN-based In'Tech Industries, about 20% of AM is for end-use products—mainly direct-fit consumer-based ear appliances done via SLA. If one includes SLA dental models for making final appliances (replacing plaster models), that number increases to 50% of its AM business.

Randy Stevens, *Virtual Translation Manufacturing* (VTM) division operations manager at In'Tech, explains that his com-

Close-up of shrink-sleeve tooling built on Objet Eden 260V additive manufacturing system, for Axon Styrotech shrink-sleeve packaging equipment. *Image courtesy of Axon Styrotech*.

Hold/Release "fingers" for gripping bottles prior to shrink-sleeving, made on Objet Eden 260V equipment in Objet FullCure 840 Vero Blue polymer. Built by Axon Styrotech and used as final parts in its shrink-sleeve, tamper-evident banding equipment. Previously built in sheet metal, which was too springy and difficult to machine. *Image courtesy of Axon Styrotech*.

pany started with SLA in 2000 to support its injection modeling/tooling business. By late 2004, it was solidly in the digital hearing aid ear-shell and dental model markets.

"It's fairly easy to manufacture hearing aid shells, but it involves handling massive amounts of data," he says. "Some bureaus make 10 tools per day; we can make thousands of consumer parts a day. Also, dental files are extremely dense, involving massive FTP transfers. This requires high-end PCs, high-speed data lines, and planning for continued growth."

Stevens points out that back in 2005, uploading an entire tray of dental items could shut down his AM equipment, because the internal PC controlling the system couldn't handle that much data and had to be reprogrammed. Even today, that data load in a single build-run could be a problem for some machines, but In'Tech has it mastered.

Met-L-Flo

Originally formed in 1969, service bureau Met-L-Flo of Sugar Grove, IL, has employed AM since 1990—and uses 3D Systems' SLA and STRATASYS' Fused Deposition Modeling (FDM) equipment for plastics DDM.

President Carl Dekker, who somehow makes time to participate in every trade show and working group in this field, says about 20% of his company's work creates end parts. Examples include inspection gauges and go/no-go devices, fixtures for ultrasonic welding (some for themselves, some for customers), masks that can be used for painting an object, and flight-qualified hardware.

For this field to expand even more, Dekker says, the challenge still comes down to education.

"People have not yet recognized the specialty niche market," he adds. "They are not taking advantage of trying to replace a part [using AM]. For the most part, outside of the current AM community, people in the design community are just not aware of the possibilities. If someone is working in the development phase of a new part, they can realize tooling savings and logistics savings."

Rapid PSI

It's just this type of savings that led service bureau Rapid PSI to try FDM as the replacement process for a urethane-casting project begun in 2009. Rapid PSI operates four Fortus FDM 3D production systems, and is aerospace AS9100-certified. Based in Wichita, KS, the company makes production parts for global business-jet manufacturers.

Customer Kelly Manufacturing, a worldwide producer of general aviation instruments, was concerned about holding tight dimensions on the housing for a small toroid in a turn-and-bank indicator gyro. Moreover, the cast parts required manual sanding—and any new versions meant expensive retooling.

Wolfgang Struss, business development manager at Rapid PSI, switched to building the toroid housings on the Fortus

RapidFit+ Fixtures: Modular Fixturing Systems

One unusual end-use application of additive manufacturing (AM) comes from Materialise. The Belgian company, known for its many AM-related products and services, operates RapidFit+, a division that produces custom fixturing via AM technology.

Customers can buy or rent a standard inspection "base," then add modular snap-fit/clamp locators custom-made for holding a given part. Check out the distinctive orange and black structures at RapidFit.Materialise.com. —PJW

machines using SABIC's Ultem 9085 flame-retardant thermoplastic. By starting a run in the evening, Struss could have 500 parts ready in the morning—parts with better dimensional accuracy, usable directly off the machine with no hand-sanding. Per-piece price was reduced 5%, order-to-delivery time dropped to three days, and retooling costs were eliminated.

"The fact that FDM is a direct manufacturing technology has become the determining factor in the price/volume calculation that governs a substantial portion of the decision-making process for our customers considering tooling cost as a part-revision parameter," says Struss. The impact of that consideration is reflected in his company's usage of its Fortus systems: a 70/30 percentage mix of end-user- to prototype-parts.

Consider AM Metals, Too

Plastics may form the better known side of AM, but metals form a growing presence. Long known for creating AM parts from various metals for medical and industrial applications, EOS is expanding its direct-metal laser sintering (DMLS) technology into more end-use businesses. Recently, the German-based company signed a strategic development partnership with Cookson Precious Metals (CPM), a worldwide supplier for the precious metal industry. The two companies will introduce and further develop precious metal-based applications in the luxury goods industry, with products and services involving DMLS.

"The particular beauty of this technology is that it can be used to produce both one-off pieces as well as large-scale production, eliminating many process steps and tooling costs we see today," says Stella Layton, global vice president at CPM.

The partnership plans to utilize various special metal alloys and install a custom solution chain for high-volume jewelry production. Cookson is initially offering production of 18-carat yellow gold designs for custom jewelry and watch components.

Solid Concepts also uses EOS systems for DMLS production, typically of small, intricate designs for the firearms aftermarket.

Influencing Company Strategies

You know a technology has reached critical usage when end users don't want it known that AM is their key to shipping product in two days instead of two weeks. For example, Vista Technologies of Vadnais Heights, MN, uses a wide range of AM technologies, including Objet PolyJet and Stratasys FDM, to create about 30 parts a week. Yet, as proof of the importance of this approach, its DDM customers feel the technology gives them such a competitive advantage they are not willing to be named or discuss their applications.

According to Met-l-Flo's Dekker, standards (and lack thereof) continue to be a sticking point for expanded AM production use. "No one wants to put out a product with a one-year warranty and find it falls apart in eight months," he points out. "Since manufacturers don't yet have enough data to know whether parts will last 20 or 30 years, they're trying to put them into non-critical applications. They often don't want to make it known they're using AM parts until they get more data from experience."

Rapid PSI openly admits to DDM as a game-changing experience. "FDM technology has transformed Rapid PSI's core business from rapid prototyping with custom manufacturing to rapid manufacturing with custom prototyping," says Struss. "We are participating firsthand in the direct manufacturing sea change, which is displacing traditional prototyping and relatively low-volume production processes."

Designing for AM vs. tooling is a growing trend that up-front design engineers should keep an eye on. DE

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INFO → **3D Systems:** 3Dsystems.com

→ **Axon Styrotech Corp.:** AxonCorp.com

→ **C.ideas:** BuildParts.com

→ **Cookson Precious Metals:** CooksonGold.com

→ **EOS:** EOS.info

→ **In'Tech Industries:** InTech-Ind.com

→ **Met-L-Flo:** Met-L-Flo.com

→ **Objet Geometries:** Objet.com

→ **Rapid Processing Solutions Inc.:** RapidPSI.com

→ **Sculpteo:** sculpteo.com

→ **Shapeways:** shapeways.com

→ **Solid Concepts:** SolidConcepts.com

→ **STRATASYS:** STRATASYS.com

→ **Vista Technologies:** VistaTek.com

→ **Wohlers Associates:** WohlersAssociates.com

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Designers Go Turbo

An aerodynamic design approach has a definite impact on the commercial drivers facing turbomachinery manufacturers.

BY MEHRDAD ZANGENEH

Many turbomachinery manufacturers are facing common commercial drivers such as global competition, price pressure and margin compression, reduced time to market, skill shortages and new developments in manufacturing and materials technology.

The method used for turbomachinery components design has an impact on the extent to which manufacturers can deal with these commercial drivers. Conventional or direct design approaches are typically based on CAD representations of blade geometry—and iterative changes to the geometry using feedback from analysis codes (see Figure 1). These design processes rely on the previous experience of designers, gained over many years, as any changes in geometry can affect the flow at other locations.

Experienced designers can achieve good performance. But because of the nature of the design process, designers tend to stay within their comfort zones and therefore restrict the design space. This inherent restriction in design space is limiting the ability of designers to meet the commercial drivers affecting the global turbomachinery industry.

An alternative approach for aerodynamic design is the so-called inverse design method in which the 3D blade geometry is computed for a specified distribution of blade loading and pressure distribution (see Figure 2). This approach to design provides more direct control over the design process because 3D pressure distribution on the blade controls all the main flow phenomena, such as secondary flows, shock losses, tip leakage flow, etc. Hence, it removes the need for empiricism and trial-and-error in the design process. It enables designers to use the results from computational fluid dynamics (CFD) more directly to arrive at optimum choices for design specifications, to minimize the effects of particular flow phenomena.

TURBOdesign1, commercialized by Advanced Design Technology (ADT), is an example of a 3D inverse design method that has been applied to a variety of turbomachinery applications. The following examples show how the 3D inverse design approach can not only help designers become more in control of the design process, but can also help turbomachinery manufacturers compete.

Performance Improvements

One of the key challenges turbomachinery manufacturers face is efficiency improvement. This is not only to make their products more competitive, but also to meet the challenges posed by new energy-efficiency legislation in many countries. The application of TURBOdesign1's 3D inverse design code has resulted in improvements in efficiency over methods in many applications, such as axial turbines, centrifugal or mixed-flow pumps, centrifugal compressors, axial fans and radial-inflow turbines.

In many of these cases, efficiency improvements were possible because the inverse design approach helps to reduce key losses—in the impeller or diffuser for example, in secondary flows or shock losses. In the case of shock losses, the baseline impeller was a turbocharger compressor for a heavy-duty diesel application, the performance of which had not been improved upon via conventional design approaches for more than 10 years. By using the inverse design approach, impeller geometry was designed that showed three-point improvements in performance across the compressor map, based on the test results. In pump and fan applications, typically between three- to five-point improvements in efficiency have been achieved by using the 3D inverse method.

Manufacturing Cost Reduction

Many turbomachinery manufacturers need to reduce manufacturing costs to stay competitive. In many applications, such as pumps or multi-stage compressors, manufacturing costs are directly dependent on volume or size of turbomachinery components. For example, a pump stage was redesigned to achieve a 61% reduction in volume (see Figure 3). The stage's tip radius had to be reduced substantially to achieve this aim. As a result, in order to achieve the same head, the pump stage loading coefficient (Ψ) had to be almost doubled from 0.33 to 0.6.

Comparing the resulting normalized measured efficiency for the compact stage design with the conventional stage performance showed that the new compact stage performance is similar to that of the original conventional stage, despite having 39% of the volume. The performance of the stage had the same meridional shape as the conventional stage, but redesigned by TURBOdesign-1 it was found to have a peak efficiency 5.8 percentage points higher than the conventional one.

In another application, a radial vaned diffuser was redesigned via the 3D inverse design method to reduce its radial chord by 30% and the number of blades by 25%. Despite the

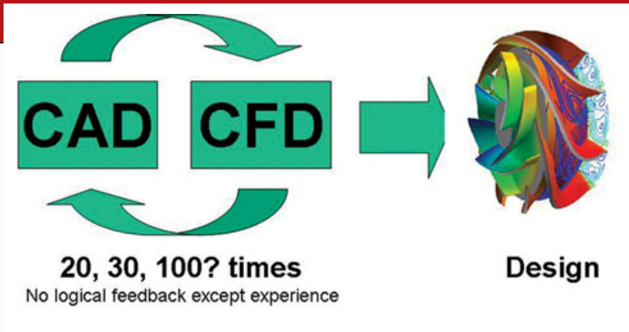

FIGURE 1: Schematic of conventional design.

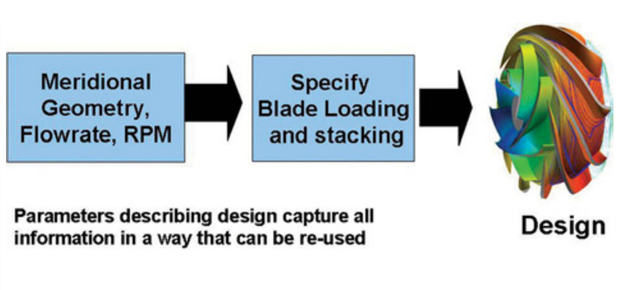

FIGURE 2: The inverse design process.

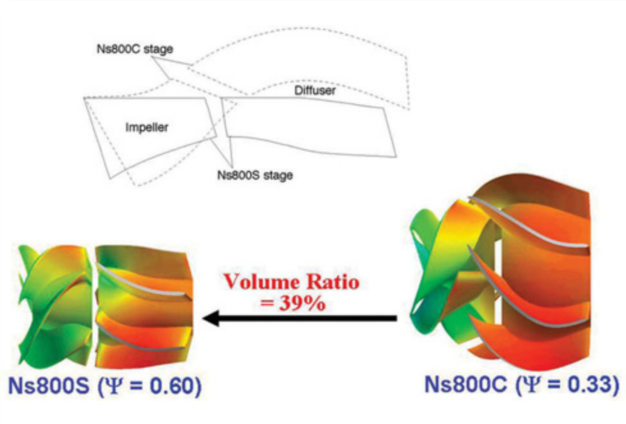

FIGURE 3: Compact pump stage design.

significant reduction in solidity, test data confirmed that the new inverse designed diffuser provides similar pressure recovery as the much larger vaned diffuser it replaced.

Reduced Time to Market

Reduction in development time can have a significant effect on more than just costs. It also provides for important competitive advantages in cases where time to market is important. The 3D inverse design method can result in significant improvements in development time.

For example, consider the development of a new centrifugal compressor stage. In general, there are two main steps in the design process:

1. Cover the points. The design should satisfy the basic duty points — correct pressure ratio, specific work at the design flow rate. Initially, a meanline (1D) design code is run, which provides the basic meridional shape and initial inlet and exit blade angles.

In a conventional design approach, the distribution of blade angle from leading to trailing edges needs to be assumed, and then used together with CFD computations to confirm whether the design produces the correct pressure ratio at the correct flow rate.

By comparison, in the case of 3D inverse design code, all designs produced by input of the relevant design information automatically provide the correct specific work and flow rate, so considerable savings can be made as no CFD iteration is required at this stage of the design process.

2. Optimize the design. Again, the flow-related design parameters in the inverse approach offer advantages in speeding up the optimization of the geometry by allowing designers to explore the design space using their understanding of flow physics.

Multi-objective Optimization

In many applications, providing customized solutions that meet customer requirements—in terms of performance, operating range, cavitation in pumps or noise in fans—can provide competitive advantages. Because of relatively long development times using conventional or direct aerodynamic design approaches, many manufacturers find it difficult to provide customized solutions that are competitive in terms of costs and time to market.

One of the key advantages of inverse design is that the optimum choice of blade loading to minimize particular flow phenomena has generality. For example, in one case, it was shown that the same type of loading distribution could reduce secondary flows in centrifugal compressor and mixed flow pumps. Furthermore, by coupling the 3D inverse design method with automatic optimization strategies, one can develop new know-how and expertise in terms of optimum loading that satisfies multi-point /multi-objective requirements.

Turbomachinery design based on a direct approach relies on empiricism and long periods of trial and error. To train new engineers in aerodynamic design based on the direct approach can take many months, or even years. Also, it is generally difficult to directly pass the considerable design knowledge of experienced designers to younger staff.

In the 3D inverse design approach, the choice of optimum design specification is less reliant on trial and error, and is based on a knowledge of flow physics. Therefore, it is easier to train new engineers in the design of particular applications. DE

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Implementing Mechatronic Testing Technologies

BY DEBBIE SNIDERMAN

AAM's disconnecting AWD system actuator.

Mechatronics, systems that contains both mechanical components and electronics with controlling software, have become increasingly common. The systems typically include components from multiple vendors, and often are used as the basis for a product family with many variations and configurations. The same system can be used in vastly different applications, some of which are mission-critical.

Integrating computers, controls, and electronics into products that perform mechanical functions makes testing more difficult, and changes the way it is approached. Here are two ways companies are integrating current testing technologies while developing new mechatronic products.

NVH and Performance Testing: AAM Drivelines

American Axle & Manufacturing (AAM), a global Tier 1 automotive supplier of driveline and drivetrain products, is developing a new torque transfer device and an electronic disconnect for an all-wheel drive (AWD) driveline. It provides the capability for full torque vectoring, front to rear and left to right, and is able to mechanically disconnect rotating components when not in use.

Thanks to a series of electronic actuators integrated into the mechanical device, this new mechatronic product allows AWD systems to have both high performance and high fuel economy, according to Dr. Glen Steyer, AAM's executive director of Analytical System Engineering. The actuators themselves are also mechatronic systems, having onboard control circuits, an electric motor that drives a gear train, and a mechanism that moves shifter boards to allow for disconnection.

There are also intelligent sensors that confirm the shifter board's position—considered safety critical parts. There's physical motion in the gear train, mechanical motion of the actuator, and electronic signals from the onboard controller and smart sensors.

Physical Test Motivations

Steyer explains that simulation technologies are used to define a robust design, allowing them to enter into the prototype phase with a high degree of confidence in the performance. During the development phase, in addition to design optimization and experimental validation, physical testing is done to confirm that the design is correct, that the assembly is to spec, and that all parts work well together.

AAM also tests prior to launch to ensure the quality of components. Steyer notes that the industry drives the company toward high levels of reliability for mission-critical components such as drivetrains, where individual components have to reach fractions of incidents per thousand vehicles (IPTV).

"It takes confirmation with physical testing that we're meeting the performance and reliability targets," he says. "We need higher levels of assurance and confidence that we will pass testing at the end of the design phase, to proceed with the launch without impact or delay."

Testing Technologies

A series of highly automated software tests are conducted on the controllers to confirm electrical functionality. Hundreds of thousands of test cycles and possible command states and operational state combinations are tested.

"We need positive confirmation that when asked to engage or disengage, it does," Steyer says. "Testing involves sending computer command signals to cycle through the engage and disengagement, and monitoring whether the position is achieved through onboard smart sensors."

In addition to functionality testing, AAM incorporates noise, vibration and harshness (NVH) testing to verify the durability of components mounted on the powertrain that will see road shock, adverse vibrations and thermal environments. Components are subject to shaker tests, where they are mounted to a shaker table and must continue functioning after a prescribed number of hours.

AAM's actuators are also subjected to thermal chamber testing to ensure electrical and mechanical functionality is maintained before, during and after cycling through extreme temperatures.

Implementing NVH Testing

Steyer reports that AAM's new product has the ability to sense and disconnect its rotating components when needed while driving. The onboard controller will anticipate when this functionality is needed, which depends on many factors, such as the driving state, speed and recent driving history. It can even gauge weather conditions to anticipate wet roads if the windshield wipers are on. When the system anticipates a need, it brings the rotating components from standstill up to speed within a fraction of a second to fully engage with the driveline. This action needs to be totally transparent to the user, however—there can be no noticeable shock or vibration.

Much effort is spent calibrating the system to engage it through tremendous acceleration as smoothly as possible. Testing is done on the vehicle with instruments measuring NVH and the "subjective feel" of the driver. An AWD NVH dynamometer is used to test the full system, including the power takeoff unit, prop shaft, torque transfer device and rear drive assembly, along with half shafts that go out to the wheel ends.

Transients of engagement and disengagement are tested, and measurements are taken of the driveline components, radiated noise, torsional acceleration, speed differentials and response times of the system, under a variety of operating conditions and hardware build variations.

"It is important for AAM to do testing outside of the vehicle, without an expensive prototype available. This way, we have lead time in the program to do calibration prior to having the integration vehicles available," Steyer says. "This type of driveline testing on a dynamometer system allows for evaluation of the numerous powertrain combinations in a compressed product development schedule, with fewer prototype vehicles."

AAM's "dynos" acquire 40 channels each of high-fre-

A Siemens fire panel.

quency sampled data and slow-speed functional data, measuring nominal speeds, torques and temperatures. A couple gigabytes of data can be acquired each test day characterizing the system, requiring sophisticated algorithms to understand the performance. In addition, high-level accelerometers, microphones and other instruments such as telemetry systems measure detailed physical parameters. NVH algorithms process the data into psychoacoustic metrics that attempt to predict the driver's subjective impressions about loudness, roughness, sharpness or other qualities.

The subjective aspect of NVH testing is important, Steyer says, because AAM's designs, components and systems interact with humans who have different perceptions and expectations, and make judgments about acceptability and quality.

"As much as we have moved the science to objectively quantifying those metrics, there is still subjectivity involved," he points out. "For those areas, we need physical testing, to make sure to satisfy the concerns of the customer."

2. Testing Siemens Fire Alarm Systems

A second example of mechatronics testing can be found in how Siemens produces and tests fire alarm systems for large buildings. These mechatronic systems contain buzzers, alarms, smoke detectors and sprinklers controlled by a central machine. They open and close doors, control and diverge air flow, provide actions for egress, and emit voice messages to direct people to certain rooms. They have electrical sensors and actuators, mechanical interactions and intelligent software controls.

In the past, testing these systems was done manually. A board would be created containing the sensors, smoke would be emitted over them, and testers would look at the control panels to see whether the sensors responded and whether they were configured properly.

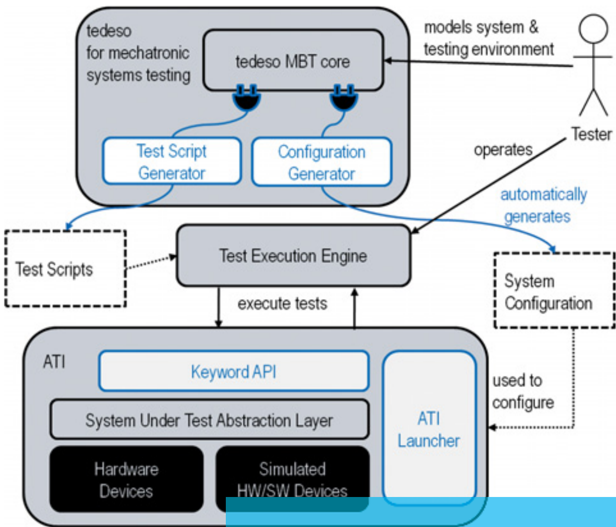
Because fire alarm systems are almost always custom-configured for each customer, testing can be complicated. There are different scale systems for a small deployment, such as a store with a fire control system and 12 sensors, or a large deployment, such as an entire building with many floors and doors. Also, customers may need one type of fire system to handle a single building and another to handle an entire university campus, for example.

With such a high level of complexity at the component, system and configuration levels, automated testing technologies are needed not only to run operational tests, but to determine which tests are needed and how they should be configured.

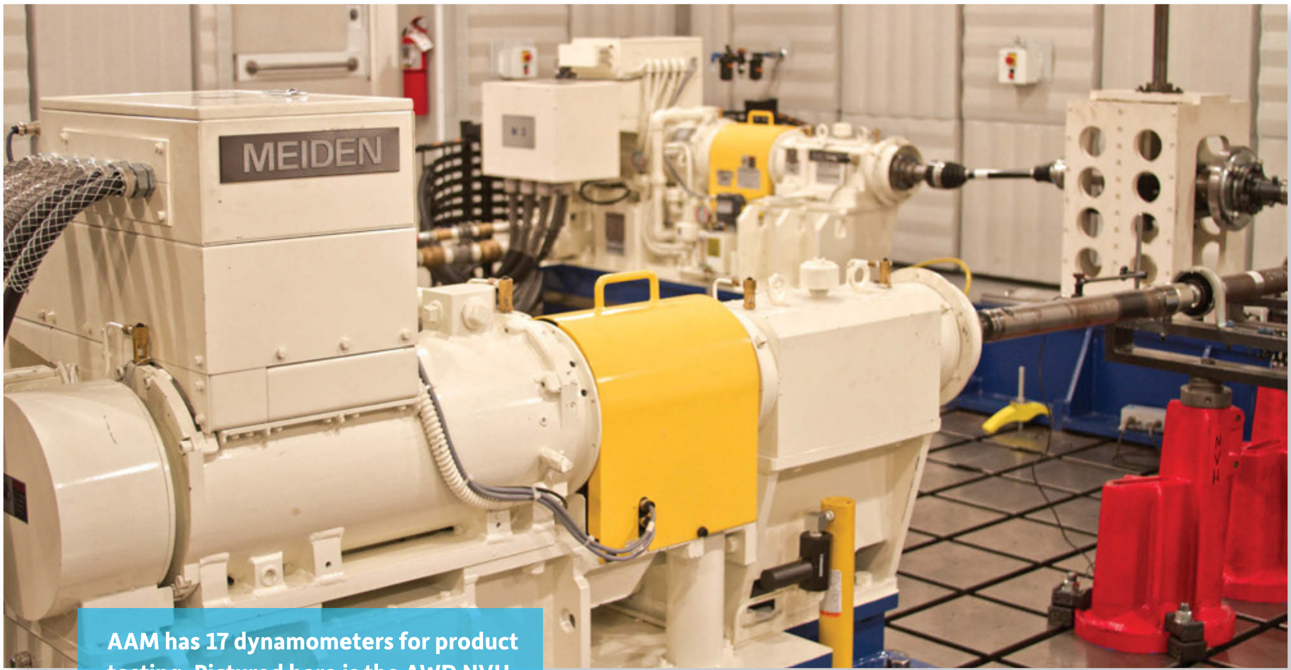
iMBT: A New Approach to Integrating Tests

Roberto Silva-Filho and Christof Budnik, engineers at Siemens Corporate Research and Technology in New Jersey, describe a new approach the company is using to test complicated mechatronic systems like fire alarms. Their paper, "An Integrated Model-Driven Approach for Mechatronic Systems Testing," was presented at the Fifth IEEE International Conference on Software Testing, Verification and Validation (ICST) in Montreal.

Siemens Corporate Research and Technology uses test design studio (tedeso), a model-based testing (MBT) technology, to automatically create test scenarios of its customers' fire alarm systems based on their specifications. When one of their customers, who are other Siemens companies, desire to modify or upgrade a fire alarm system or add new siren sounds, tedeso generates tests for the entire system



The automated process of Siemens' iMBT approach.



AAM has 17 dynamometers for product testing. Pictured here is the AWD NVH driveline system dynamometer.

with the modifications.

The new approach, integrated MBT (iMBT), combines MBT using tedeso with automated test generator and test execution engines. Adding a modeling description of the deployment configuration allows testers to generate both tests and different system configurations.

"There is now a unified view of all components of the system," Budnik says, adding that test cases no longer need to be manually developed.

The main benefit of this type of testing is that it allows thorough system testing, which is hard to do manually on a large scale. Because software determines the configurations and runs the tests automatically, the system can be tested under a wider range of configurations—reducing the chance of faults.

Testing Implementation

Simulations are made of all the internal system components, so they can be directly interacted with and put into different states. Simulations are used to test configurations as early as possible. Instead of purchasing and setting up devices, extremes are tested under various operational conditions using simulations.

In addition to simulations, the testing environment can either consist entirely of "real parts" or be a mixture of simulated and actual sensors. "Smart hardware" can simulate multiple clients, and the software helps set up the test environment. When comparisons are desired, mixing physical testing with software can test pieces of a system that haven't yet been developed, or were developed by multiple vendors.

Many different types of functional tests are run to see that all sensors respond. For example, operation of the fire panel controller is verified even if the power supply is cut off, or if sections are destroyed or disconnected. Operation is verified for simulated hardware failures or situations where many alerts arrive at once, and how the system scales during peak demand is observed.

Despite being combined with simulated parts, Budnik says, physical testing of real hardware components is still relevant. It is important to test the optical smoke detector, for example, to ensure it triggers correctly by spraying smoke in a room. Even though audio system testing can be automated with tone patterns, it is still crucial to listen to the actual output to make sure the right pattern is played and that it is understandable, he says. **DE**

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

INFO ➜ American Axle & Manufacturing Inc.: AAM.com

➜ **Siemens USA:** USA.Siemens.com

➜ **"An Integrated Model-Driven Approach for Mechatronic Systems Testing":** Awareness.ics.uci.edu/~rsilvafi/papers/Conferences/ICST-2012.pdf

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

Gravity and Sensor Calibration Accuracy

Location, calibration and application influence inertial sensors.

BY MIKE BAKER

The calibration accuracy of many sensors is dependent on the force of gravity at the site of operation. The sensitivity of accelerometers, inclinometers, force transducers and load cells is proportional to the force of gravity where they are being used. Their absolute sensitivity may differ when in use somewhere other than where they were manufactured. The gravity across the Earth's surface may translate to a variation of up to 0.5%, depending on where in the world it is measured.

For example, electronic weigh scales that use load cells as weight sensors measure the force of gravity acting upon a mass. If on-site gravity compensation is not taken into consideration, the scales will have an error proportional to the difference in gravitational acceleration between the installation and calibration sites.

Universal Laws

Sir Isaac Newton's Law of Universal Gravitation stated that: "Every point mass attracts every other point mass by a force pointing along the line intersecting both points. The force is proportional to the product of the two masses, and inversely proportional to the square of the distance between them." Mathematically, the force due to gravity is expressed by the formula: F = Gm1m2/r2, where F is the force between masses, G is the Gravitational Constant, m1 and m2 are the first and second masses, and r is the distance between the centers of the masses.

Although Einstein's Theory of General Relativity has since superseded this law, it continues to be applied, unless there is a need for extreme precision or when dealing with gravitation for extremely massive and dense objects.

The Gravitational Constant G is actually very difficult to measure, but in 2010, the Committee on Data for Science and Technology (CODATA) recommended the value of G = 6.67384 x 10-11 m3 kg-1 s-2, with an uncertainty of one part in 8,300. Thus, with knowledge of the mass of Earth and its radius, the force due to gravity can be ascertained.

The Law of Universal Gravitation defines a mass as a point mass; Earth is neither of uniform shape nor even mass distribution. Indeed, Earth is also not spherical, but actually takes the form of an oblate spheroid, the equatorial diameter being larger than that at the poles. Gravity, therefore varies in proportion to latitude (see Figure 1).

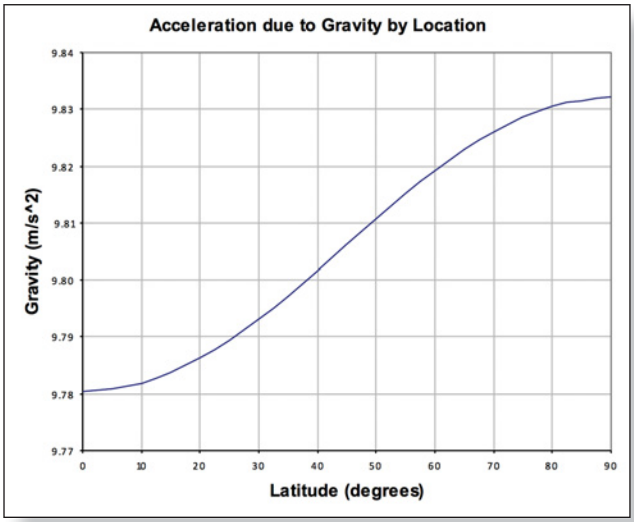


Figure 1: The Earth's gravity varies in proportion to latitude, which can affect sensor measurements.

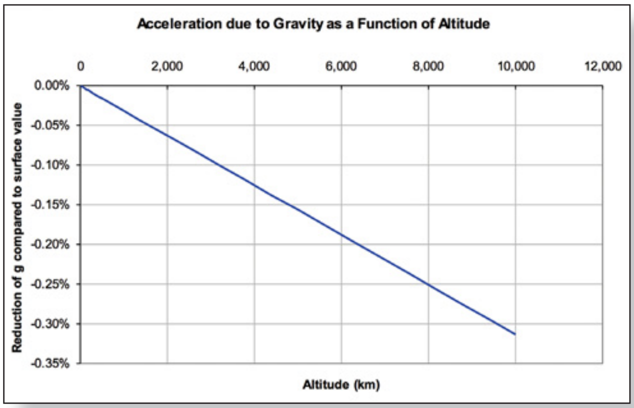


Figure 2: Gravity, and therefore its impact on sensor measurements, also changes with altitude.

Secondly, the height above sea level of the Earth's surface varies according to location. Consequently, the acceleration is proportional to altitude, too (see Figure 2).

Thirdly, Earth is spinning on its axis—and consequently, the force of gravity at the Equator is reduced by the centripetal force, the effect diminishing to zero at the poles.

By way of example and using the Law of Universal Gravitation, the force due to gravity acting on a mass of 1kg, at sea level and at the Equator, is 9.7958N. However, at an elevation of 2,000m, the force reduces to 9.7897, a reduction of 0.06%. Similarly, due to Earth's geometry, the force acting on a mass of 1kg at the poles increases by 0.70% compared to that at the Equator.

Complicating matters further is the effect of centripetal acceleration due to Earth's rotation that varies from a maximum at the Equator to zero at the poles. Varying according to latitude, this reduces the apparent force due to gravity at the Equator by 0.35%, compared to that at the poles.

What It All Means

The application of force transducers in relation to weighing is perhaps the easiest to relate to when reaching an understanding of the effects of gravity on sensor calibration and accuracy. Typically, a weighing instrument is calibrated using test masses. But as has been shown, the forces produced by test masses will vary according to location—and it is commonplace for accurate weighing systems to have a means of adjustment built in to allow for multi-location deployment throughout the world.

Inertial inclinometers and accelerometers also use gravity as their fundamental calibration reference, but it is important to note that the calibration will only be truly valid when the sensors are used at the original calibration site.

When making accurate measurements, and unless the sensors can be calibrated locally, it is essential to consider the latitude and the altitude at which the sensors will be installed, and adjust the sensitivity of the sensors accordingly if the manufacturer's calibration data is to be the sole source of reference.

Fortunately, there are several sources of gravitational data available for reference that may be used for this purpose. One is on the website of Physikalisch-Technische Bundesanstalt (PTB), the German metrology institute providing scientific and technical services: PTB.de/cartoweb3/SISproject.php.

The use of a value for g of 9.81m/s2 is commonplace, but when high accuracy is required from a sensor that is reliant upon gravity for its function, it is important to correct for variations in gravity between the original calibration site and that where the sensors are installed. Sensor manufacturers should always provide users with the value of g at the calibration site so that variations can be taken into consideration. DE

Mike Baker *is managing director of Sherborne Sensors. His knowledge and experience within the engineering and sensors field spans more than 40 years. Contact him via de-editors@deskengcom.*

INFO → Sherborne Sensors: SherborneSensors.com

Space Equipment Gets in the Loop

MapleSim breaks new ground in HIL real-time simulation for planetary rovers.

BY PAUL GOOSSENS

In the space industry, the design, building and testing of rover prototypes is extremely expensive. System testing typically does not occur until late in the design/testing process, leading to a long development period. In response to this, Dr. Amir Khajepour, Canada Research Chair in Mechatronic Vehicle Systems and a professor of engineering in the Mechanical and Mechatronics Engineering department at the University of Waterloo (UW), and his team worked with the Canadian Space Agency (CSA) and Maplesoft, to develop a hardware-in-the-loop (HIL) test platform for solar-powered planetary rovers.

Their approach allows component testing within a simulation loop before a full rover prototype is available. It essentially creates a virtual testing environment for the component under test, "tricking" it into thinking it is operating within a full prototype. Using MapleSim, the modeling and simulation tool from Maplesoft, high-fidelity and computationally efficient models were created for this real-time application.

Using this test platform, scenarios that are hard to replicate in a lab setup, such as the Martian environment, or components that are not yet available, can be modeled—while hardware components that are available can communicate with these software models for real-time simulations. The goal is to progressively add hardware components to the simulation loop as they become available. In this way, system testing takes place even without all the hardware components, bridging the gap between the design and testing phases.

The main advantage of this approach is that it significantly reduces the overall development time in the project. In addition, it allows for component testing under dangerous scenarios without the risk of damaging a full rover prototype.

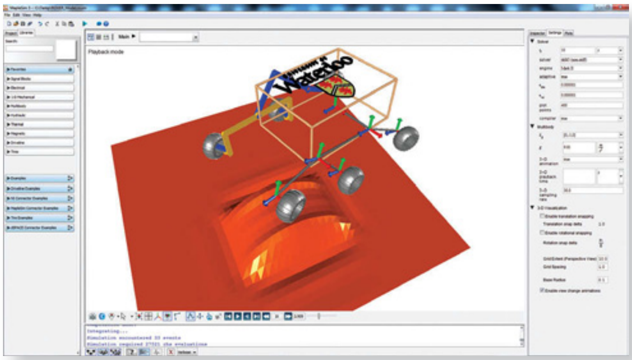
An artist's concept of the rover on Mars, which is scheduled to land this month at the foot of a layered mountain inside the planet's Gale crater.

Rover Kinematics

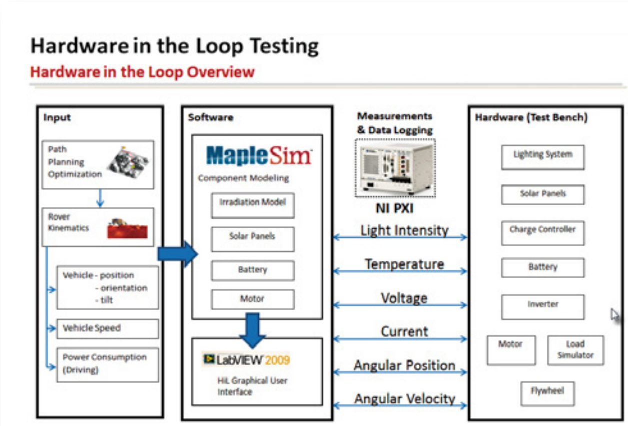
In addition to simulating the rover dynamics, the MapleSim modeling environment was used to automatically generate the kinematic equations of the rover. These equations then formed the basis for other tasks in the project, such as HIL simulations, path planning and power optimization. The modular system setup enables users to quickly change the rover configuration and explore different approaches in a short time.

The diagram to the right shows an overview of the test platform. Information regarding the rover's position, orientation, tilt, speed and power consumption (obtained from dynamic models of the rover) is used as input to the software models. A library of rover components was developed within MapleSim, then imported within LabVIEW Real-Time, where the HIL program and graphical user interface of the simulations were developed. The program was then uploaded to the embedded computer within National Instruments PXI, where communication between the hardware components and the software models was established and the real-time simulation was run.

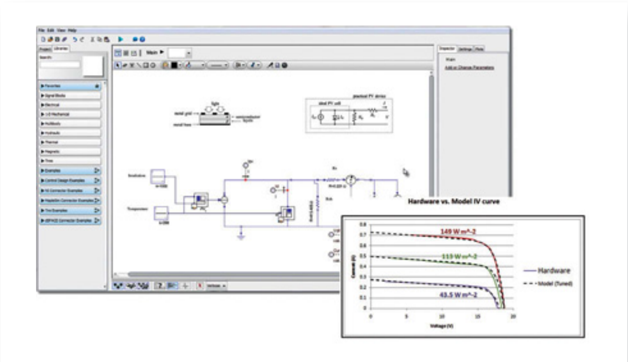
"Due to the multi-domain nature of the system (mechanical, electrical and thermal), it was desirable to model all the components within one modeling environment such that critical relationships can be easily discovered. In addition, computational efficiency is crucial in real-time simulations," notes Khajepour. "MapleSim was found to be the ideal environment for this application due to its multi-domain abilities, use of symbolic simplification for higher computational efficiency and ease of connectivity to LabVIEW."



This screenshot shows the automatic generation of kinematic equations.



A library of rover components, developed in MapleSim, was imported within LabVIEW RealTime.



The solar array model in MapleSim.

In addition to making use of MapleSim's built-in component library, custom components were also easily developed. A model to estimate the solar radiation that a tilted surface would receive on Mars was implemented using MapleSim's Custom Component Block. This model took into account the sun's position, the rover's latitudinal and longitudinal position, and its orientation and tilt as it traveled from point A to point B. This was used together with a solar array model to estimate the power generation of a rover throughout the day.

"The intuitive nature of MapleSim allowed my team to create high-fidelity models in a short period of time," said Khajepour. "This played a key role in the success of this modular HIL test platform, which allowed for component testing, power level estimation, and the validation of power management and path planning algorithms."

Power Management

The team also used MapleSim as a key tool in an earlier part of the project to develop a full solution for the power management system of autonomous rovers. They used MapleSim to rapidly develop high-fidelity, multi-domain models of the rover subsystems. The goal was to develop a path-planning algorithm that took rover power demands (and generation) into account. Using the models developed, the path planner found the optimum path between point A and point B, such that the rover maintained the highest level of internal energy storage while avoiding obstacles and high-risk sections of the terrain.

Khajepour and his team were able to create the mathematical model of the six-wheeled rover without writing down a single equation.

"MapleSim was able to generate an optimum set of equations for the rover system automatically, which was essential in the optimization phase," he said, adding that he was also impressed with MapleSim's graphical interface. "In MapleSim, you can simply re-create the system diagram on your screen using components that represent the physical model. The ability to see the model, to see the moving parts, is very important to a model developer." **DE**

Paul Goossens *is vice president, Applications Engineering, at Maplesoft. His group supports Maplesoft's line of engineering modeling products. A mechanical engineer by background, Paul has more than 20 years of experience in both engineering and software business management. Contact him via de-editors@deskeng.com.*

INFO ➜ Maplesoft: Maplesoft.com/products/maplesim

➜ National Instruments: NI.com/labview/

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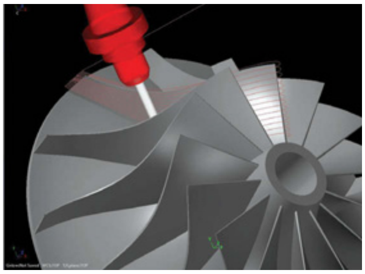
Wide-open, Five-axis Programming

Mastercam software invigorates Turbocam's proprietary five-axis CNC program development.

Turbocam Inc. has been cutting sophisticated turbine and impeller blade geometries on multi-axis computer numerically controlled (CNC) mills for more than 25 years. Over the years, its team has developed many specialized software modules to execute dozens upon dozens of specialized operations and toolpaths associated with this complex work. By 2007, this software, which had captured and encapsulated two decades of specialized manufacturing experience into a programming environment, became both a significant competitive advantage and a valuable corporate asset.

But Turbocam's software development also reached a significant fork in the road. Its software infrastructure, based on a now-unsupported CAM platform, script-based coding and UNIX-based hardware and software, was becoming old and expensive to maintain. Support of the company's current CAM software development and utilization environment was unsustainable.

"We were convinced that taking our proprietary software and transitioning it into a modern CAM programming environment was mission critical," said Rob Bujeaud, Turbocam's vice president of engineering. "We chose Mastercam as the back end for this major step forward because it is a solid and well-supported program that gives us the tools needed to get deep into the program and do whatever we want to do, exactly the way we want to do it.



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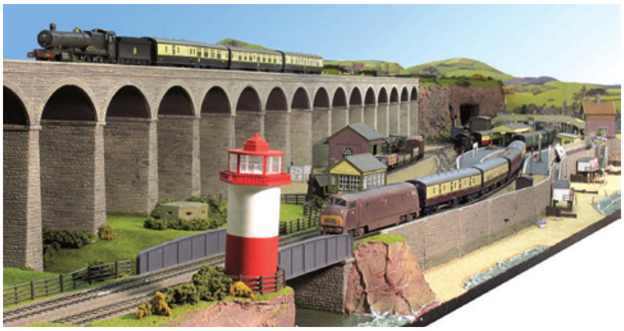
PECO Breaks the Mold

VISI keeps this model railway-manufacturing specialist on track.



Fine, tiny detailing demanded by model railway enthusiasts requires mold-making tolerances in manufacturing scale models that are often tighter than those in the automotive industry.

PECO manufacturers the largest range of model railway track in the world, distributing to approximately 450 model shops across the United Kingdom, and exporting to more than 30 countries worldwide. New Products Development Manager Paul Hitchcock says PECO is renowned for quality and detail on its plastic injection-molded track and accessories.

When a model is scaled down, it becomes miniscule and can be extremely difficult to produce, but he says using Vero Software makes it easier to achieve. Working with a range of VISI modules not only provides greater accuracy, but also saves 30% of design time, while saving the toolroom computer numerically controlled (CNC) programmer even more time during the manufacturing process.

The materials used depends on what is being asked of the finished mold, and include Uddeholm "Orvar Supreme" steel for the insert molded track tools, aluminum, Hasco 2311-2312, and brass for interchangeable cavity inserts.

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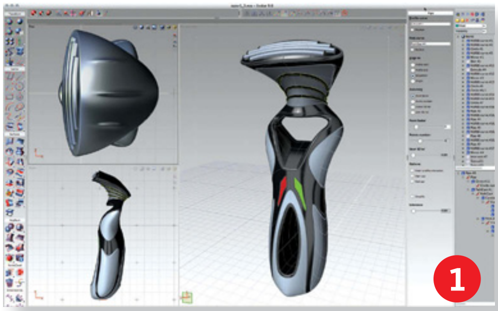
1 solidThinking Evolve 9.0 Released

solidThinking, Inc.'s (solid-thinking.com) solidThinking Evolve 9.0 is a new version of its concept-design and 3D modeling software. solidThinking Evolve 9.0 is said to feature a simplified user interface and workflow, improved comprehensive modeling interaction, interactive photorealistic rendering and additional format and language support.

CyberPower's New Workstations

CyberPower (cyberpower.com) has released its Power Mega II series of Intel Sandy Bridge-E, Ivy Bridge, and Xeon-based professional workstation PCs with NVIDIA Quadro graphics.



2 Contex Enhances HD Ultra Wide-Format Scanners

Contex (contex.com) has enhanced its HD Ultra wide-format scanner series with scans at 8 inches per second in color, or 642 ISO A0 documents per hour. New color spaces, with color accuracy ensured by X-Rite, and full 48-bit color image processing are also available.

Thermal Imaging Camera

Omega's (omega.com) OSXL-T60 (FLIR T620) series of thermal imaging cameras is CE compliant. It has the highest thermal imaging resolution in its class, according to the company. It also features Wi-Fi connectivity.

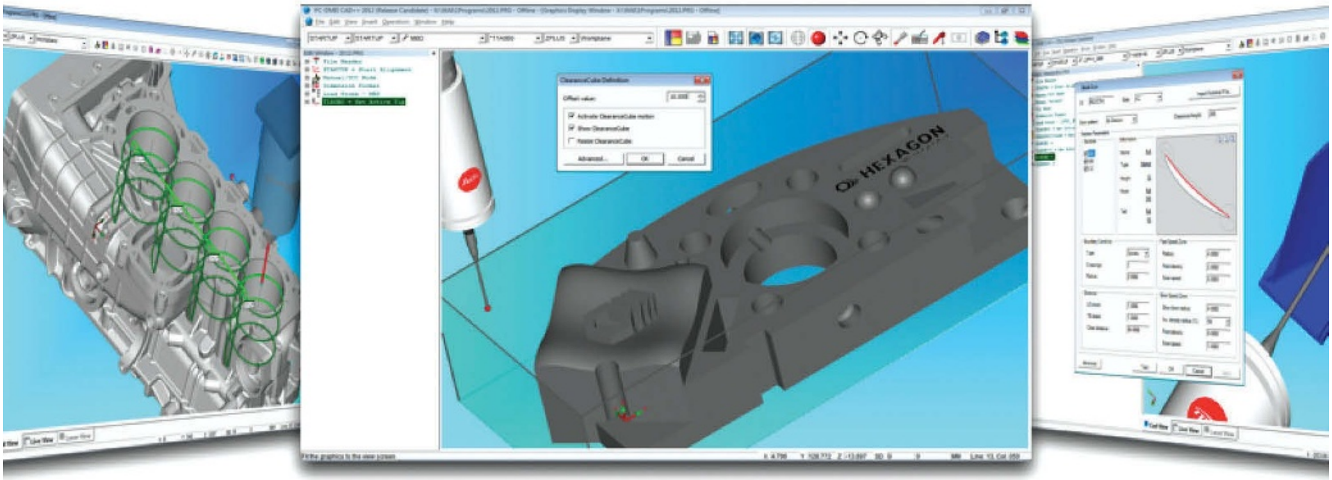
STAR-CCM+ Updated

CD-adapco (cd-adapco.com) has released version 7.04 of its STAR-CCM+ software, which the company says will help users accelerate product development processes by performing more simulations in less time. It introduces Multi-part Solids and a new Solar Loads Calculator that allows solar radiation to be automatically specified by latitude, longitude, time and date. **DE**

SPOTLIGHT

Directing your search to the companies that have what you need.

Hexagon Metrology's PC-DMIS 2012



Manage Data

Hexagon Metrology's PC-DMIS 2012 metrology software focuses on the collection, evaluation, management and presentation of manufacturing data to reduce scrap, improve throughput, reduce costs, and build lean manufacturing operations, according to the company.

Collision Avoidance

The software's ClearanceCube feature is designed to eliminate potential collisions of the part and probe. ClearanceCube attaches a protective virtual envelope around the part being measured and guides the probe to avoid that area. Hexagon says the software automatically completes all safety moves so the operator can simply box-select a group of features, then use the Path Optimizer feature to determine the most effective path. ClearanceCube is assigned to the selected feature, not the plan, which should simplify additions and changes to the inspection routine.

Remember Design Changes

When inspection data is imported into CAD, PC-DMIS 2012 has the ability to "remember" the current translation of assembled components, so the CAD file does not need to be repositioned. Revisions to the CAD file prompt the Change Manager to highlight those design changes automatically. Another enhancement is the new Measurement Strategies for AutoFeatures. Users can now scan planes, circles, cylinders and cones directly from the AutoFeature dialog box with automatic setting of speed, point density, and filtering parameters.

Time-Saving Features

Sortable Features, an addition to the user interface, is designed to provide a fast and easy way to search features by ID, type, program sequence or time in various dialog boxes. The new Summary Mode enhancement adds color-coded and symbolic text to avoid the time spent sorting through an inspection report for dimensional compliance. Specialized options are also available for customers with an Optiv vision system or those involved in the inspection of blades.

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TECH SPECS

While the software can run on less, the *recommended* minimum requirements for PC-DMIS 2012 include:

- 32-bit and 64-bit Windows XP; 32-bit and 64-bit Vista; and 32-bit and 64-bit Windows 7.
- 2GHZ or higher Duo-Core processor.
- 4GB of RAM or higher. You should have RAM equal to 8 times the size of the largest CAD file you will use.
- 2GB of free hard drive space plus allocated Virtual Memory of 8 times the largest CAD file used.
- SVGA graphics card that supports OpenGL shading and that has WHQL certified drivers.
- 64MB of video memory for use without CAD models; 128MB video memory for use with small CAD models; and 256MB+ video memory with CAD files that are larger than 100MB.

For more information, visit Hexagon-Metrology.us