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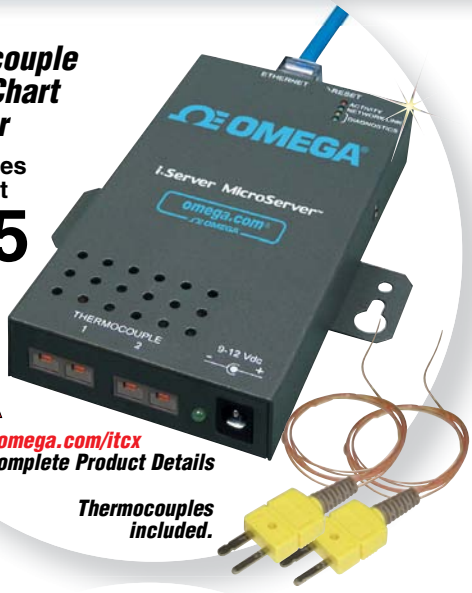

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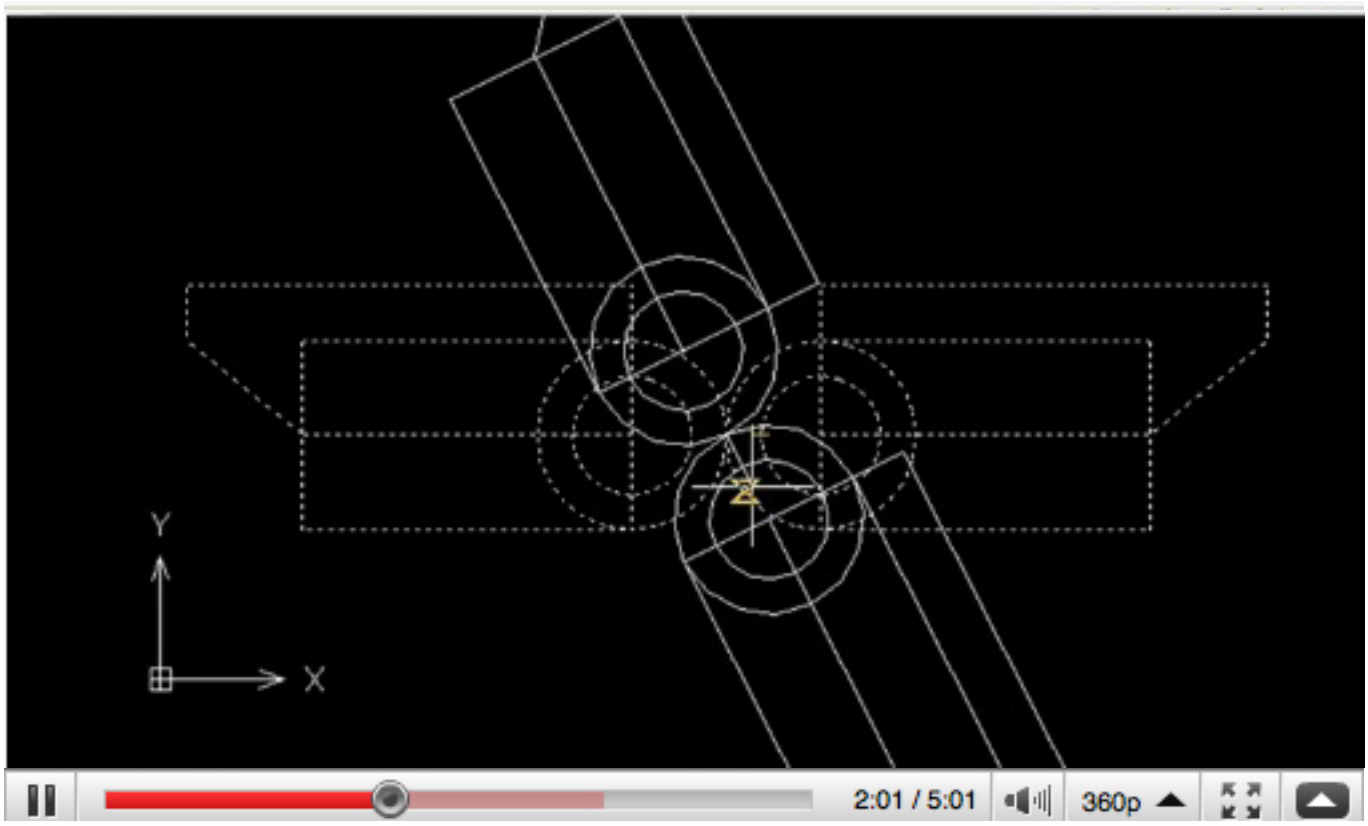
ZWCAD 2010, an AutoCAD Challenger from China

KENNETH WONG
kennethwongsf@earthlink.net

ZWSoft from China taunted the long established standard of DWG. "Time to say goodbye to AutoCAD," it proclaimed on Twitter, along with a link to a YouTube clip showing the latest release of ZWCAD.

The company also sent me a license of ZWCAD 2010 Professional, which I installed and ran. I found the software to be stable, straightforward, and effective. Those who are familiar with AutoCAD or AutoCAD LT would undoubtedly be able to pick up ZWCAD almost immediately.

Click here to learn more and watch a video of it in action. ■



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ARES Takes Aim at AutoCAD; DoubleCAD XT Evolves

KENNETH WONG
kennethwongsf@earthlink.net

Graebert, the German company behind PowerCAD, officially unleashed ARES, another AutoCAD-lookalike. Priced $495 (standard) to $995 (commander edition), Graebert's software represents a less expensive alternative to Autodesk's flagship drawing and drafting program, priced $3,995 to $4,425 in the company's online catalog.

In the announcement, Graebert explains, "The two products are identical with the exception of programmability and 3D support, which are found only in [the higher priced] ARES Commander Edition.".

Watch the video for more information. ■

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STRATASYS

Risk and Teamwork are Keys to Innovation

STEVE ROBBINS
steverobbins@deskeng.com

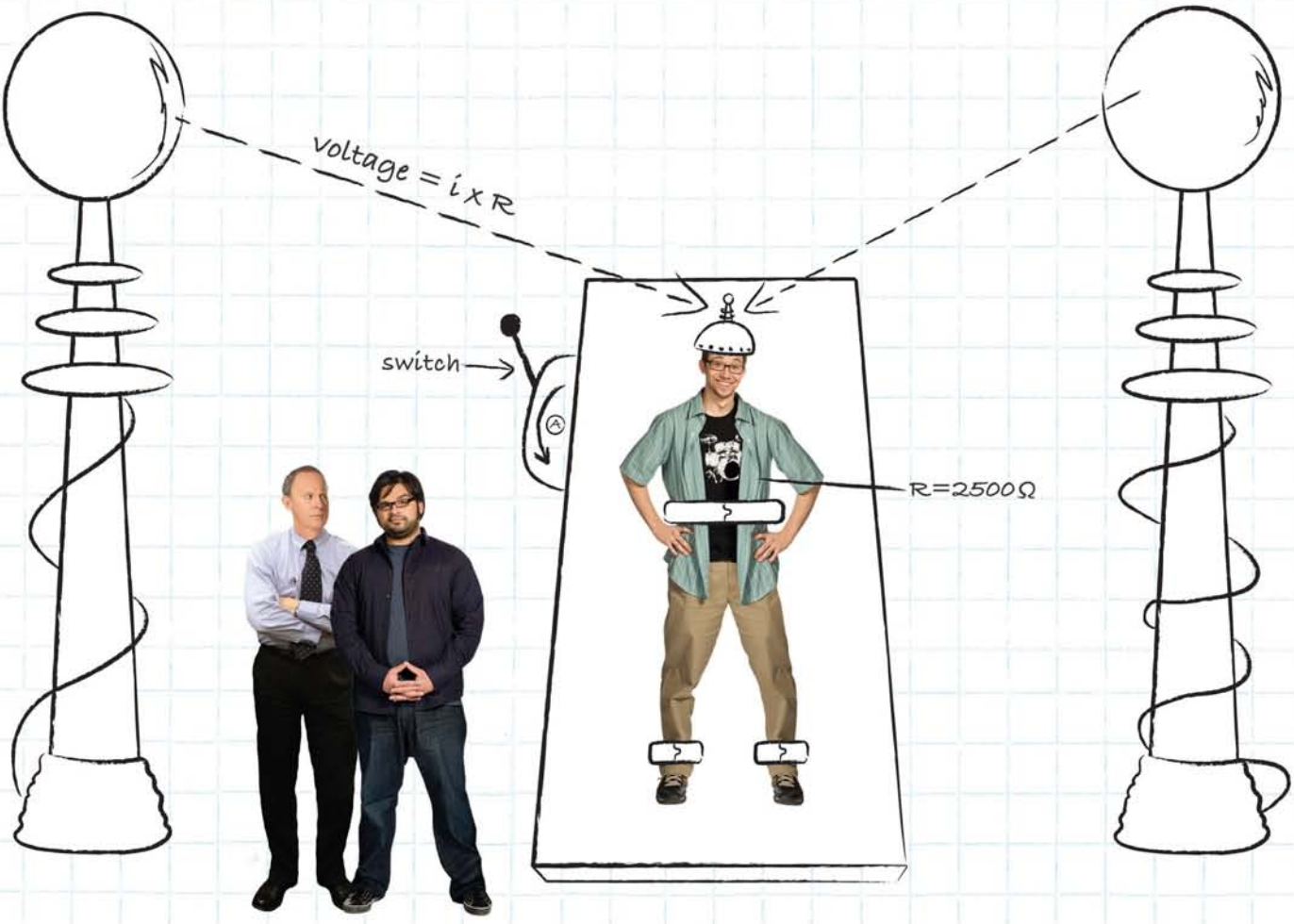
At the beginning of February I attended SolidWorks 2010 in Anaheim, California, and got a good look at how communication, teamwork, and risk lead to real innovation. It was a fun event attended by enthusiastic innovators. When engineers who create innovative products connect with their peers, they almost communicate telepathically. And when you're in an arena with thousands of design engineers, you can just about feel the connections they make with other innovators.

James McLurkin was one of those innovators. He's a roboticist and assistant professor at Rice University in Houston and showed up on stage with a swarm of autonomous robots. He demonstrated how 100 small boxes on wheels could communicate with each other over a wireless network, detect boundaries, and complete assigned tasks. They shared information and followed instructions. A hundred little robots running around a stage talking to each other and coordinating their efforts is a compelling sight.

McLurkin's demonstration came right after we learned about the features SolidWorks would be incorporating into its solution this year. The audience was thrilled with the improvements promised by SolidWorks CEO Jeff Ray and his team, cheering with approval when it heard the top three improvements suggested by users were part of the next version. It confirmed the company viewed its relationship with customers as a valuable collaboration.

> To accomplish truly great things, a little risk is always necessary.

As users help make the tools of their trade better and better, and as software moves to the cloud, access becomes more transparent, files can be shared, and all collaboration improves. And as the universe expands—SolidWorks will now run on a Mac—it's important to note that while tech details are important to users, engineers also love to see their ideas and the ideas of others in action. Robots, automobiles, airplanes, and even James Cameron's latest movie, *Avatar*, are all created using



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SolidWorks

engineering software that helps designers create better products.

I mention James Cameron because he was one of the speakers at SolidWorks 2010 and I found his keynote more exciting than his entertaining 3D movie. Cameron is someone who doesn't mind taking a risk. He spent years and most of his own money working on a project that could have flopped. And he created new tools to bring his vision of an alien world convincingly to the screen, working with a small team to accomplish something that had never been done before. His story about letting the team control the creative process was inspiring and resonated with every engineer in the room who had worked with others to create something new. That's leadership.

After he was done talking about *Avatar*, Cameron sat on a sofa on the stage and declared he was next planning to break a world record by creating a deep-sea diving vessel that he would personally pilot to the bottom of the Mariana Trench in the western Pacific. At a depth of 36,200 feet, the deepest point on the planet, the pressure (15,750 psi) is one thousand times greater than standard atmosphere. Cameron said that while most preceding deep-sea vessels weighed more than 100 tons, he was working on a vessel in Australia that weighted only nine.

Now, I am sure he is using the best FEA and other analysis tools to create this design, but I really wanted to ask him why he wouldn't want to overbuild just a little bit and make the pressure vessel, say, 12 tons. But then, he understands that to accomplish truly great things, a little risk is always necessary. ■

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

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"Documentation is like sex: when it is good, it is very, very good; when it is bad, it is better than nothing."
> Dick Brandon

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ELEMENTS OF ANALYSIS

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> Hardware, software, and publications. Live links connect to suppliers.

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> *Newslink; Editor's Pick of the Week; Check It Out (Videos, White Papers and Webinars); Virtual Desktop; Elements of Analysis and Simulation; Elements of Engineering IT & Computing; Elements of MCAD; and Elements of Rapid Technologies.*

ON THE COVER > ATK used Siemens' TeamCenter PLM to create the first stage of the Ares I Launch Vehicle for NASA as well as the vehicle's Launch Abort System. In addition, many other CAD, CAE, and other products have been used, including HyperSizer composite analysis software to predict the crew module's successful performance under simulated flight conditions. Read Barb Schmitz's article beginning on page 22.

How do you make a driver that's better than bigger?

The answer for Adams Golf: Optimize the driver to swing faster with PLM Software.

Adams Golf® discovered that club head size is just one factor in improving driving distances. The other is increasing club head speed. The company used Siemens PLM software to reduce aerodynamic drag on its new Speedline™ FAST 10 driver by 10 percent. Not only did Adams optimize the club to swing faster, the company brought it to market faster. See the story of the Speedline FAST 10 driver at **www.siemens.com/plm/adams.**

Answers for Industry.

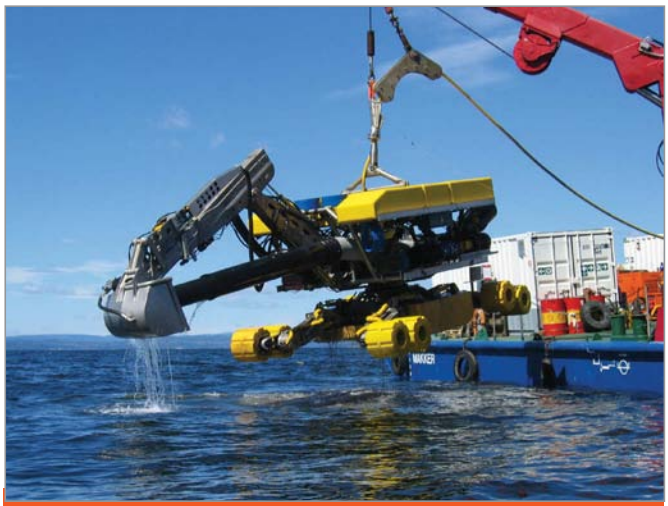
SIEMENS

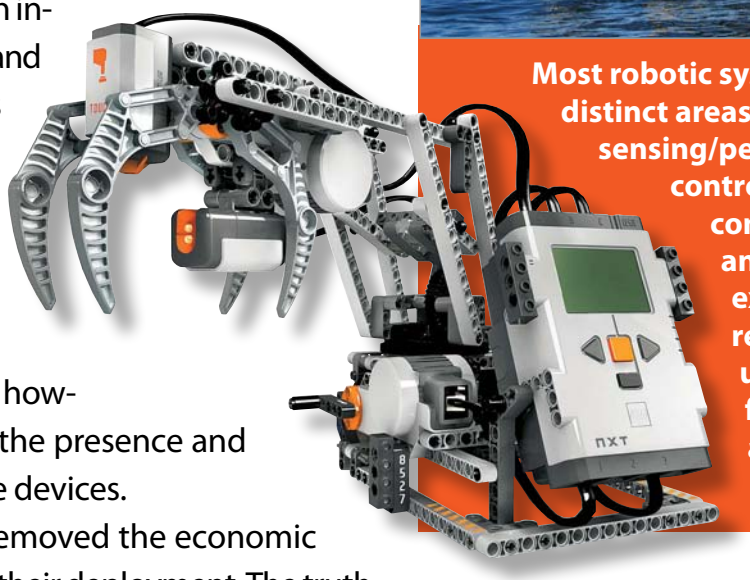
Putting Smarts Into Design

> The growing need to include sensors and embedded systems in products is transforming the product design process in terms of complexity and methodology.

BY TOM KEVAN

Two of the leading hackneyed terms in today's technology lexicon are "smart" and "intelligent." Everything from smart phones to washing machines and automobiles to satellites has some degree of intelligence that enables semiautonomous or autonomous operation. But these well-worn terms are the banners of a revolution that has been a long time in the making. Designers have been incorporating sensors and embedded systems in their designs to give products "smarts" for some time. The quantum shift transforming the design process, however, is the scale of the presence and importance of these devices.





Most robotic systems have four distinct areas of development—sensing/perception, high-level control algorithms, motor control/actuation, and an optional UI. One example is the Spider remotely operated underwater vehicle from Nexans for oil and gas applications.

Moore's law has removed the economic obstacles impeding their deployment. The truth of the matter is that sensors and embedded systems are no longer optional. In fact, the trend is to increase the number of these devices—as well as firmware capability—raising the bar on functionality and performance to differentiate products and increase their competitiveness.

Complexity

Including sensors and embedded systems has shot product and design complexity through the roof. Engineers must select the right mix of sensors, processors, and firmware to bring down cost and increase system performance and en-

ergy efficiency while the bill of materials grows.

The addition of these technological elements introduces a daunting range of design considerations. And these must now be addressed upfront, early in the development process, to avoid rework and problems downstream. The new mix of technologies also requires that all engineering disciplines collaborate on the process.

As embedded systems are required to translate sensor data on internal conditions and environmental factors into actionable information that can enhance operational efficiencies, power and memory become critical, further complicating the overall design. And as form factors of all products shrink, designers must fit all these components into smaller packages.

All this increases the number and importance of choices that have to be made in selecting components. Engineers must choose between traditional analog sensors and chip-based digital-sensing devices and the various forms of memory. They must then settle on a power strategy that can involve main line, battery, or energy-harvesting sources. The power-management requirements of the product can force designers to look for sensors and processors that turn on and off quickly and include sleep modes and automatic shutoff capabilities.

Further complicating the design process, communications are no longer limited to simple hard line buses, but instead can include any number of wireless technologies. Engineers must choose from several wireless protocols and weigh the pros and cons of open vs. proprietary architectures. The new communications media also bring into play antennas and signal propagation.

As the complexity of the component mix increases, interactions can determine the success or failure of design projects. "About 50 percent of development projects fail due to poor system architecture validation. Most of the issues are relative to the poor specification of the interfaces," said Laurent Cherprenet, director of high-tech industry for Dassault Systèmes, "especially the communication between software and electronics."

To get the most from the hardware, the software design must be tied much more tightly to that of the hardware.

New Methodologies

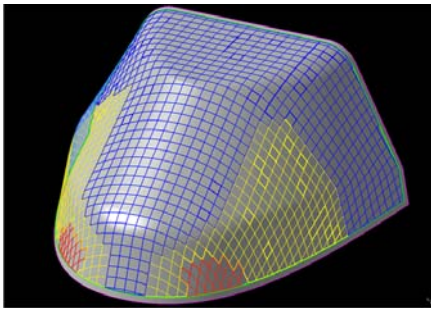
The growing role of sensors and embedded systems is increasing the complexity of products and their design. As a result, design teams are adopting and cultivating methodologies such as mechatronics and systems engineering.

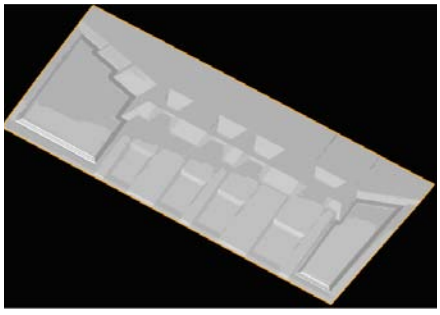
Products are no longer based on mechanical gears and cams. Instead, they are dominated by digital components and interconnected subsystems, whose functionality is defined by the interdependencies of all components. More than ever, these "smart" technologies reinforce the old adage: The devil is in the details. ■

*Contributing Editor **Tom Kevan** is based in New Hampshire and is DE's mechatronics, PLM, and systems expert. Send your comments about this article to DE-Editors@deskeng.com.*

VISTAGY Partners with NIAR Composites

VISTAGY, Inc. has announced a partnership with the National Institute for Aviation Research (NIAR; wichita.edu/niar) at Wichita State University. NIAR's mission is to provide research, transfer technology, and enhance education for the purpose of advancing the aviation industry.





NIAR, a non-profit institution funded primarily by industry and federal contracts, will use VISTAGY's FiberSIM composites engineering software in its Composites and Advanced Materials Laboratory to understand the potential for, and limitations of, composites in the aviation industry. Researchers and technicians in the NIAR Composites Lab perform layup and bonding operations, and conduct research programs to understand the effects of heat, moisture, contamination, and repairs on advanced materials. The results will be used by the Federal Aviation Administration (FAA) as well as the institute's clients.

FOR MORE INFO:

> VISTAGY, Inc.

Kelleher Systems Represents Infinite Graphics DFM Tools in the North American PCB Design Market

Kelleher Systems, a reseller of electronic design automation (EDA) tools, has closed an exclusive agreement for the sales of Infinite Graphics' (igi.com) CheckMate and PAR software products for the printed circuit board (PCB) design market in North America.

CheckMate is a suite of tools enabling the PCB designer to validate the manufacturing data generated during the design phase. Performing this validation before sending the design to the manufacturer can reduce errors in manufacturing and therefore decrease time to market. CheckMate automates verification, conducts a netlist extraction and compare, and gives an analysis of the manufacturability of the design to various specifications.

"I'm thrilled to have Kelleher Systems join us as a strategic sales partner," says Cliff Stritch, CEO of Infinite Graphics Incorporated. "This partnership will enable IGI to deliver value to a wider market, and empower our customers to maximize the manufacturability of their designs while reducing their time to market."

FOR MORE INFO:

> Infinite Graphics

> Kelleher Systems

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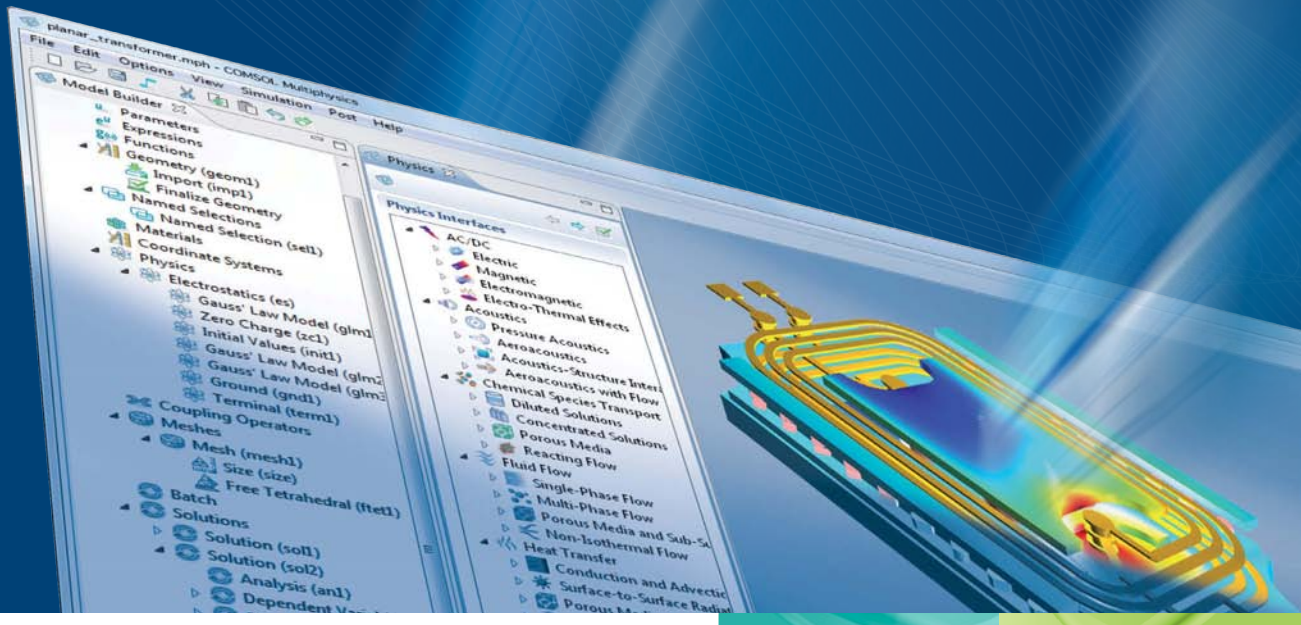

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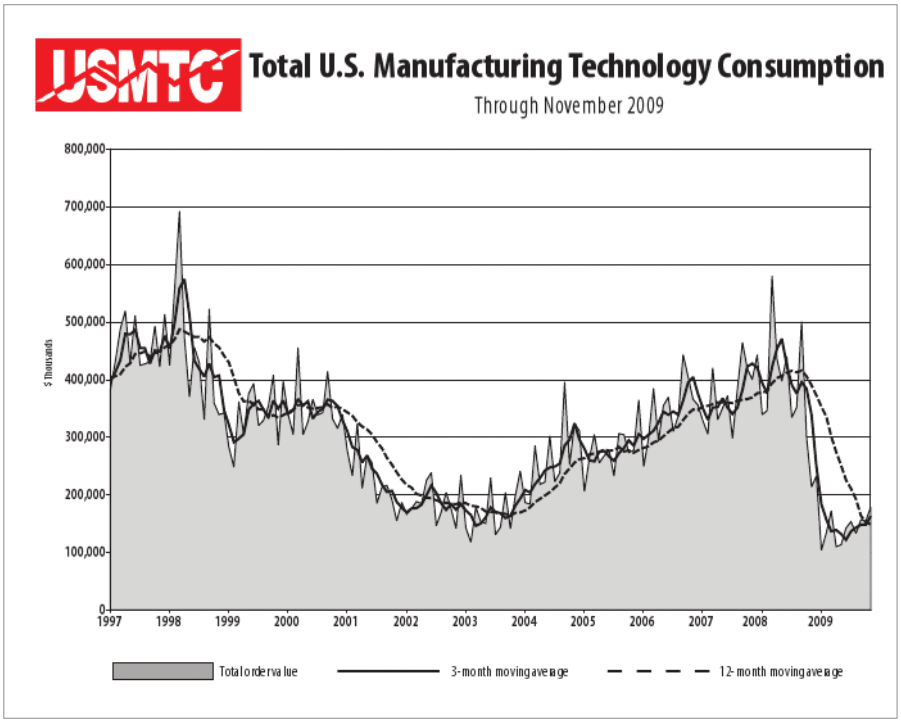
Manufacturing Technology Consumption Rises 16% in November

U.S. manufacturing technology consumption totaled $178.83 million, according to the American Machine Tool Distributors' Association (AMTDA; amtda.org) and the Association for Manufacturing Technology (AMT; amtonline.org).

This total was up 16 percent from October but down 16.2 percent from the total of $213.50 million reported a year ago. Total consumption through November 2009 is down 63.4 percent compared with 2008.

"The three month upward trend in manufacturing technology order values is great news for the industry and the country, despite unit levels stubbornly hovering around 1,000."
– Peter Borden

"The three month upward trend in manufacturing technology order values is great news for the industry and the country, despite unit levels stubbornly hovering around 1,000," says Peter Borden, AMTDA president. "As we turn the calendar and our attention to 2010, we're hopeful that Washington will pass legislation allowing American manufacturing to rebuild not only its employment levels and backlogs, but also to improve our balance of trade and our country's economy."



Regional indicators are as follows:

In the Northwest region, consumption was up 27.1 percent from October, but off 16.5 percent when compared with November a year ago. Southern Region consumption was 26.6 percent above October's, but was 12.6% less than a year ago. Midwest Region consumption was only 2.2 percent higher than October's and down but off 31.5 percent when compared with November a year ago. Consumption in the Central Region was up 39.3 percent over October's and down just 2.2 percent when compared with November 2008. Western Region consumption was 14.1 percent less than October's and down 1.5 percent when compared with the same time last year.

FOR MORE INFO:

> AMT

Voltaire InfiniBand Fabric Accelerates South African Sun Supercomputer

Voltaire announced that the Centre for High Performance Computing (CHPC) in South Africa has selected a Voltaire 40 Gb/s QDR InfiniBand director switch as part of its new Sun Microsystems (sun.com) supercomputer. The CHPC is a division of the South African Counsel for Scientific and Industrial Research.

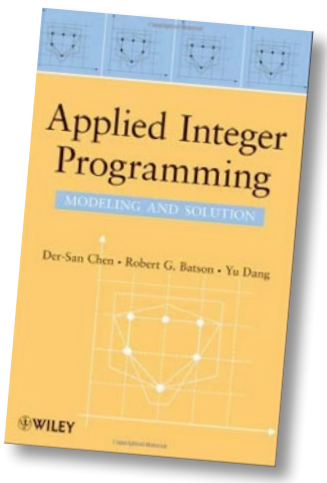
With a peak performance of 27 teraflops, the supercomputer is the fastest in Africa, according to Voltaire. Based on a Sun Constellation System, it includes three Sun Blade 6048s, with 144 Sun Blade X6275 server modules using the Intel Xeon 5500 series, and a Sun SPARC Enterprise M9000 server with 64 SPARC64 VII quad-core processors.

The Grid Director 4700 has 324 ports of 40 Gb/s InfiniBand connectivity, with the option to double capacity to 648 ports using Voltaire's HyperScale fabric boards. It uses Voltaire's stackable architecture for building larger configurations into the hundreds and thousands of nodes.

FOR MORE INFO:

> Voltaire

Quickparts' Dr. Yu Dang Co-Authors New Book



Quickparts' Yu Dang, Ph.D., has released a university textbook titled, "Applied Integer Programming: Modeling and Solution." Dang co-authored the book with Der-San Chen, Ph.D., and Robert G. Batson, Ph.D., a professor at the University of Alabama.

Taking an application-oriented approach, "Applied Integer Programming" addresses the art and science of mathematical modeling related to the mixed integer-programming framework. This book discusses the algorithms and associated practices that enable those models to be solved most efficiently. Organized into three parts, the reference is written to ease the learning hurdles in integer programming with suggestions and guidelines for practice.

FOR MORE INFO:

> Quickparts

Stratasys to Make HP-Branded 3D Printers

Stratasys, Inc. has signed a definitive agreement with HP (hp.com) for Stratasys to manufacture an HP-branded 3D printer.

Under the terms of the agreement, Stratasys will develop and manufacture for HP an exclusive line of 3D printers based on Stratasys' patented Fused Deposition Modeling (FDM) technology. HP will begin a phased rollout of the 3D printers in the mechanical design market in selected countries later this year, with the right to extend distribution globally.

FOR MORE INFO:

> Stratasys, Inc.

Alibre Announces Permanent Price Cuts

Alibre, Inc. has announced price cuts to its line of 3D CAD software. Alibre develops and markets Alibre Design, a parametric 3D/2D design application. The entry level package, Alibre Design Standard, is now $97 (down from $1,000) and includes Alibre Translate (formerly $499), an import/export suite that supports Solidworks, Pro/Engineer, Autodesk Inventor, SolidEdge, Catia, and Parasolid formats in addition to all neutral CAD formats.

All levels of Alibre Design software and software maintenance have been reduced in price, positioning Alibre products as the extreme value leader in the design and manufacturing industries. The product levels, pricing, and optional software maintenance prices are:

Alibre Design Standard: $97 (software), $97 (1 year support/updates). Includes parametric 3D design (parts and assemblies), 2D drafting, import/export options for native CAD formats and neutral formats, and 3D PDF creation.

Alibre Design Professional: $497 (software), $147 (1 year support/updates). Adds sheet-metal design module, push/pull editing, standard part libraries, design configurations, photorealistic rendering, and single part FEA analysis.

Alibre Design Expert: $997 (software), $197 (1 year support/updates). Adds Windows-integrated data/product management, integrated physics-based motion analysis, an integrated CAM solution, and Machinist Toolbox, a shop utility with features like unit conversion, speeds and feeds, trig calcula-

Creaform Purchases InSpeck Scanning

Creaform has acquired InSpeck, a company specializing in human body 3D scanning products.

With headquarters in Montreal, Canada, InSpeck has been involved in 3D scanning since 1994. Applications for InSpeck products include animation, special effects, medical imagery, research, and electronic games. The company's scanners are used by major production and post-production companies.

"This acquisition consolidates our position as leader in 3D scanning, as well as our position in the medical, multimedia and entertainment, and 3D imagery sectors," says Charles Mony, president of Creaform. Following this transaction, all InSpeck activities will be integrated into those of Creaform.

FOR MORE INFO:

> Creaform

tions, and reference materials.

"We tried the very aggressive pricing last year and found the response to be overwhelming," says Paul Grayson, Alibre Chairman and CEO. "We also had many industry experts saying it was completely unsustainable. We are delighted to prove them wrong."

The new price points position Alibre products to enter new markets—primarily the individual and home user—while still providing the professional grade tools higher end users expect. The DIY phenomenon, as covered by many publications such as Wired, The New York Times, and The Wall Street Journal, presents a huge opportunity for vendors willing to cater to lower price points. People are designing things for themselves, either as products or as side projects, and benefit from professional design tools. It's been the case in the past that they simply could not afford them.

FOR MORE INFO:

> Alibre, Inc.

LATEST NEWS

- 3D-Tool Premium Version 9 Incorporates Spatial's CAD Translation Components
- Kontron Introduces its AM5030 AdvancedMC Processor Module
- Tantalum Design Tools from AVX Promise to Speed Product Development
- Siemon Announces New Passive Copper Cabling Assemblies
- Dates Set for electronica 2010
- CAMWorks Speeds Milling for Magnus Hi-Tech
- RealVision Announces DocManager 5.0 Manufacturing Documentation Control and Change Management Solution

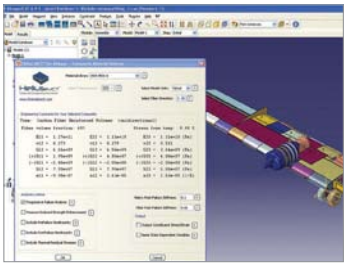
EDITOR'S PICK OF THE WEEK

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

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

Simulation Tool Predicts Composite Behavior, Failure

>Helius:MCT identifies the failure and behavior of general composite structures.



Composites. In the 1967 movie, "The Graduate," Mr. McGuire has a one-word message for Ben: "plastics." If I were to remake that movie today, not only would I rename the lost young soul after me, I would change that one word to "composites" because there is a great future in composites.

Composite materials are all around us. And why not? They can offer terrific structural strength and stiffness compared to their weight. They are very fungible, so designers can be innovative to the edge of their imaginations. Composites can be inexpensive, common, simple, or exotic, and they are flexible and generally easy to manufacture. Of course, all these variables also mean that composite materials challenge designers with endlessly thorny questions about how materials will respond to, say, tension, thermal events, and other real-world dynamic phenomena.

READ MY COMPLETE REVIEW:

>Helius:MCT

VX Corporation Releases Version 14.2 of VX 2009

> Speed boost for CAD/CAM direct-edit tool.

VX Corporation just came out with a point upgrade of its VX 2009 CAD/CAM system. And this is a terrific time for you to check out this unsung powerhouse of design-through-manufacturing solutions. There are two reasons why, and I'll explain why in a minute. First, the cool part of the upgrade.

VX 2009, version 14.2 to make this official, has a cool new Morph feature. Now, what Morph lets you do is directly edit shapes like bend angles quickly. This means that you can use it in non-stylistic applications for bending and unbending parts, repairing models, and applying over bends. It appears quick and easy.

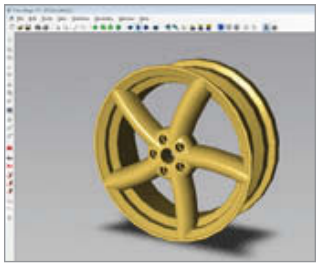
That's not all of the user-inspired upgrades. VX 2009 v14.2 contains all sorts of enhancements in its drafting, modeling, and 2-5 axis CAM functions as well as the ability to section unhealed imported parts, even ones with bends applied to them.

READ MY COMPLETE REVIEW:

>VX Corporation

TransMagic Releases 64-Bit Version of Expert

> New product shows performance gains in large CAD file translation.



Data translation is a tough business. It's a mathematical nightmare, and data translation vendors are constantly faced with re-inventing the wheel as application developers extend and enhance their software and kernel developers add cool new capabilities. It takes a lot of time and effort to get data translation right, which means that application developers are frequently a step or two ahead of the data translation outfits. And that means that you end up hitting the wall and maxing out your workstation's abilities.

A case in point is the spreading ubiquity of 64-bit software. Truth be told, the 3GB memory limitation of 32-bit applications and the ever bigger design files you need to develop have grown so large that 64-bit software had to be. Data exchange, however, was still written for a 32-bit world, leaving developers in a scramble to catch up. Not any more. TransMagic has come through for you with a 64-bit version of its TransMagic Expert data exchange software. This is not a fixed version of a tried and true tool. TransMagic 64-Bit is engineered for modern 64-bit engineering software.

TransMagic 64-Bit offers a 160+ options for translating files, the ability to read and write CATIA and other major MCAD files.

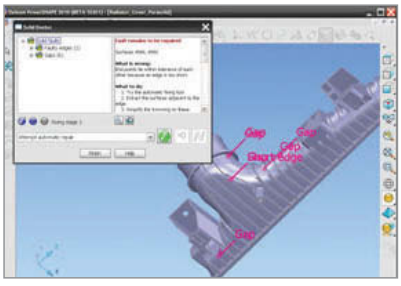
READ MY COMPLETE REVIEW:

>TransMagic

Solid Doctor Repairs CAD Data

> Delcam's interoperability solution enables designers to heal even damaged MCAD data and create Parasolid models efficiently.

Converting a model from one CAD package and then dragging it into your MCAD system can, well, become a drag when you start digging around to find, fix, and repair translation problems. While auto-repair tools take care of most of the inconsistencies in your file, the manual tools at your disposal are not always as user friendly or powerful as they could be. Delcam has taken a big step toward fixing both problems and all those common interoperability hassles you've come to know so well with its new Solid Doctor functionality in PowerSHAPE 2010 and CopyCAD Pro.



The quick lowdown on PowerSHAPE is that it is a concept-to-reality CAD environment offering integrated solid, assembly and surface modeling, reverse engineering, embossing, drafting, morphing, and rendering functionality. PowerSHAPE is designed to be easy to use and now, with the introduction of Solid Doctor, PowerSHAPE also makes coping with the unpleasant realities of today's multi-CAD environments much easier.

READ MY COMPLETE REVIEW:

>Delca

Aerospace Designers Tell Us about Must-Have Tools

> The range of PLM and CAD-integrated solutions are critical for aerospace companies to keep pace with efficiency. BY BARB SCHMITZ

Adept Ltd. used Inventor 3D solid modeling software from Autodesk to design its 320T, a 320-hp general aviation engine with a compact design that offers low vibration levels and high structural integrity.

Build a lighter, stronger, cheaper airframe—with fewer components—and the world will beat a path to your door. Put the right tools into the right hands and you're halfway there.

To help manufacturers toward that end, a myriad of software tools—many closely integrated with CAD tools—are being used to create digital prototypes of entire aircraft, to view and manipulate parts and assemblies of parts in digital design review sessions on the Web, and to simulate the reentry of NASA's next-generation crew capsule into Earth's atmosphere. And all this is taking place while manufacturers meet and exceed the strenuous flight-testing and certification processes required of them as they cut significant time and expense out of the overall design cycle.

To find out how designers are doing that, we asked a handful of them what tools they considered indispensable. Their answers gave us an inside glimpse into the vital issues facing companies designing, building, and supporting aerospace products today.

Jump-Starting the Design Cycle

If the initial conceptual design of a product is not good, no downstream applications will save

Long Design Cycles, Longer Lifecycles

One thing has not changed despite the avalanche of sophisticated tools: it still takes a long time to design and build a new aircraft. For commercial aircraft, estimates range from five to ten years from the preliminary design though final design and certification testing. However, once the new designs take off, they are around for a long time. Civilian commercial aircraft are in service an average of 25-35 years.

While there has been significant progress in both airframe and engine technology over the last decade, the implementation of such technology is limited by the number of opportunities for new projects. In some cases, combinations of improvements are introduced. For example, for one project a new airframe might use an existing engine (McDonnell Douglas DC-10/CF6-50), whereas in another a new engine might be applied to an existing airframe (Airbus 310/JT9D and Pratt & Whitney 4000).

In other cases, design changes are made at the component level, the Boeing's 757-300 using the RB211-535E4 LEC (low emissions combustor) engine and the Airbus 320 using the CFM 56-5B(DAC) (double annular combustor). The Boeing 777/GE90 represents an example of an all-new airframe/engine/combustor technology combination and was also the first commercial airplane to be designed in a completely paperless environment.

— BS

it, making the effective use of flexible 3D solid modeling tools crucial to getting proposed designs off to a solid start.

"The most important tools in our design process are clearly those used for the initial design and design validation," says Richard Schulz, managing director at Adept Airmotive Ltd., a South African manufacturer of general aviation engines for the light aircraft market. "Without sound initial designs and the ability to operate accurately in the design stages, the use of other tools such as FEA would be compromised."

Adept uses Autodesk Inventor 3D solid modeling software, Autodesk Vault data management software, as well as computational fluid dynamics (CFD), thermal analysis, air flow analysis, fluid flow and vibration analysis, static and dynamic finite element analysis (FEA) for validation and analysis of parts and assemblies, and product lifecycle management (PLM).

The company credits Inventor with helping it reduce the weight of the 320T (320 hp) engine by more than 130 lbs. over traditional piston engines of comparable horsepower. That makes the 320T 30 percent more fuel-efficient. Adept engineers produced accurate 3D models of the 320T before any parts were built, so they spent less time making changes and more time creating innovative designs, then simulating those designs under real-world conditions.

"Competitive advantage flows from the ability to drive down manufacturing, R&D, tooling, and prototyping costs," says Schulz. "Good solid modeling tools reduce time-to-market, increase productivity, and reduce scrap and re-work costs. Solid models also facilitate clear inter-departmental and inter-operational communication, allow fluid migration of data to FEA, CAM, and PLM applications."

Simulation Shaves Weight & Maintains Safety

Terrafugia Inc. is in the unique position of having no competition in the aerospace industry. Gregor Cadman, an engineer at Terrafugia, elaborates, "As a startup company creating a new type of product, our biggest challenge is not staying ahead of competitors, but to actually succeed in creating a viable product … and start delivering vehicles to customers."

The Transition roadable aircraft being developed by Terrafugia Inc. is a light sport aircraft that can fold up its wings to become a road-legal vehicle. The aircraft's beta prototype is currently being designed with plans for full production by the end of 2011.

The Woburn, MA-based company has just 10 full-time employees working on a small light aircraft with foldable wings that doubles as a car. The Transition Roadable Aircraft's design allows the aircraft to fold its wings and drive on any surface road. Once at the airport, the wings extend, and the aircraft is ready for takeoff. The company's proof-of-concept vehicle has already completed its drive and flight testing, and the company plans to go into production by the end of 2011.

With such a small staff, the company's engineers are responsible for all systems and structures from preliminary design down to materials selection. To help engineers adhere to its demanding design schedule, the company uses a slew of CAD-integrated tools. The design of the Transition aircraft was created using SolidWorks, FEA is handled by SolidWorks Corp.'s COSMOS software, and CFD analysis takes place with ANSYS Fluent.

"I would say that FEA tools are a great benefit in optimizing the weight of components and assemblies and for easily identifying critical areas and failure points … maintaining the proper safety margin," says Cadman. "With our aerodynamic and weight requirements, CFD and FEA are playing a key role in tackling this challenge," adds Cadman. "Without them, creating a light, robust, and safe vehicle which meets Light Sport aircraft requirements would be a potentially insurmountable challenge."

It's More than Rocket Science

As the manager of engineering tools and analysis at ATK Space Systems, Nathan Christensen knows a bit about computer-based tools. ATK, the maker of rockets for NASA and the U.S. military, uses them all: CAD/CAM/CAE, FEA, CFD, heat transfer codes, multiphysics, computational chemistry, ballistics, trajectory, and shock physics as well as customized internal codes.

As the primary contractor for the first stage of NASA's new Ares I rocket as well as the vehicle's Launch Abort System, ATK Space Systems knows how to deploy leading-edge computer tools to get the job done better, faster, and cheaper.

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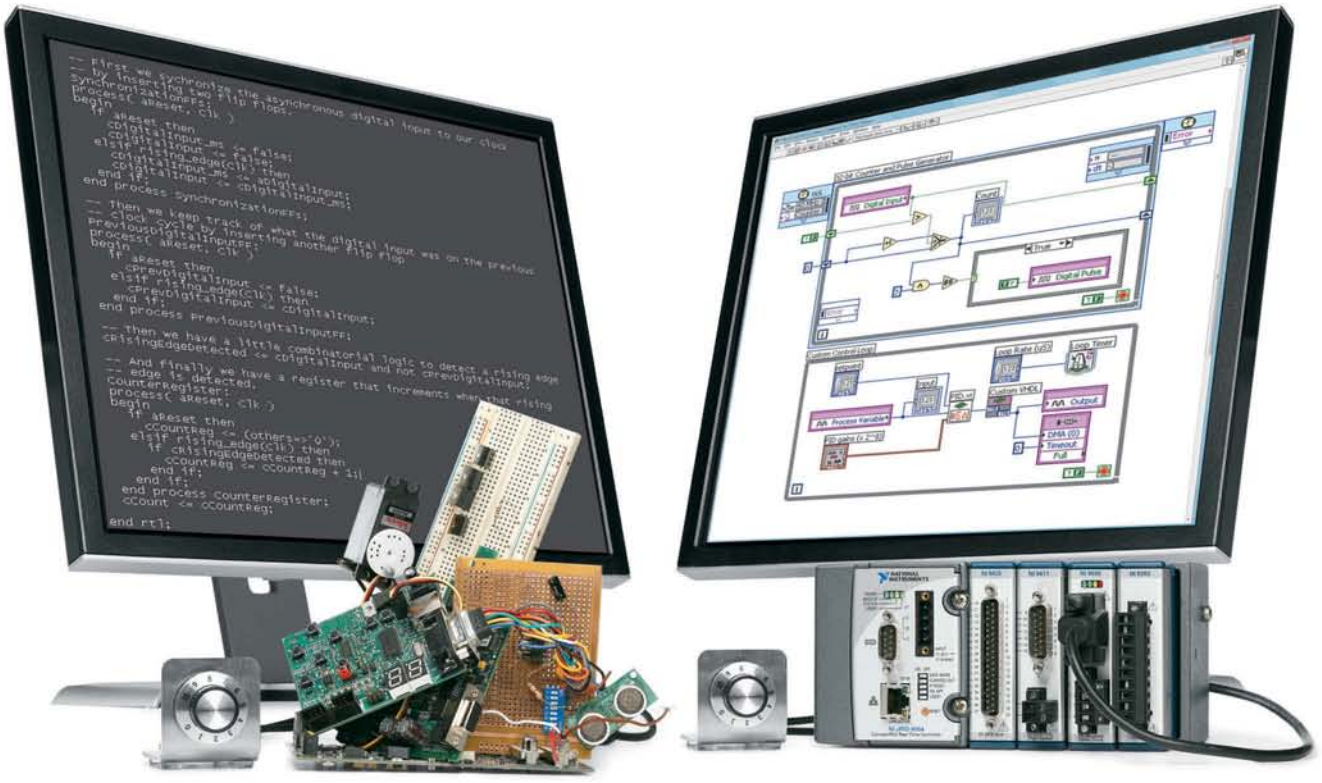

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NATIONAL INSTRUMENTS

And yet the tool that Christensen feels is most important to stay competitive in the aerospace market can be viewed as more of a business tool than an engineering tool.

"Everyone has CAD tools now," says Christensen, "They used to be somewhat of a distinguishing factor, but everyone has them now. We've got a supercomputer, Lockheed has a supercomputer, and Boeing has a supercomputer. That's the price of admission," says Christensen. "It's really the management of data and the ability to efficiently manage your business that gives you an advantage over a competitor now."

While the aerospace industry used to be considered a cost-plus business, this is no longer the case. And that's why ATK has implemented Siemens' Teamcenter PLM system.

"In aerospace today, nothing kills a program faster than an overrun," says Christensen. "The government expects you to hit your targets, and they are not willing to fund the development indefinitely. They have become a lot more

HyperSizer Proves Use of Composites

In a series of critical, full-scale, physical tests recently completed by NASA, Collier Research Corporation's HyperSizer composite analysis software accurately predicted the Composite Crew Module's (CCM) successful performance under simulated flight.

The CCM is the all-composite flight crew module Orion—part of NASA's Constellation program to return man to the Moon or send him to Mars.

HyperSizer was used throughout the almost three-year project to optimize the design, weight, and manufacturability of the CCM, which is constructed of honeycomb sandwich and solid-laminate composites. HyperSizer was the first NASA software to be licensed and commercialized as part of the agency's effort to transfer technology to U.S. business and industry.

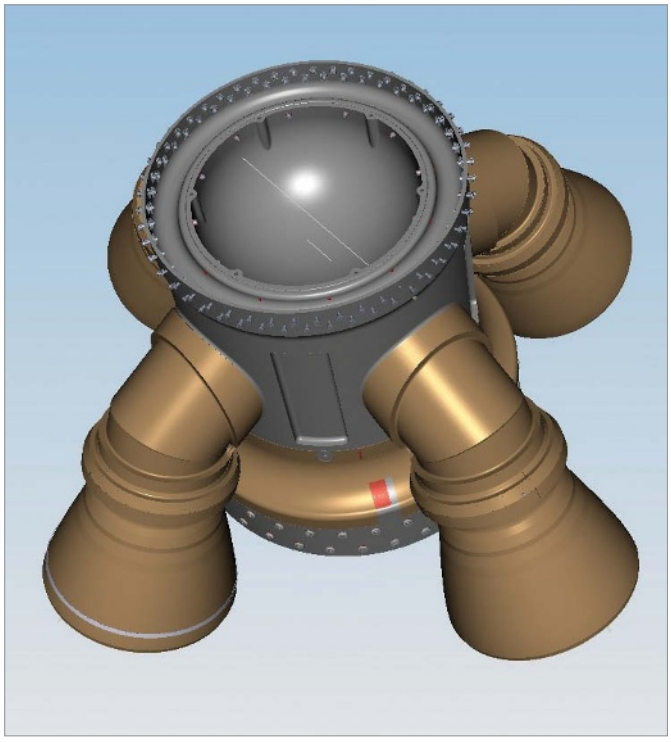
"The CCM ... represented an opportunity for the NASA family to get up the curve on experience with composites," said CCM Project Manager Mike Kirsch. "Our analytical models predicted the response very well and now we're much better informed."

HyperSizer is a structural sizing and design optimization tool that works in a feedback loop with FEA to automatically search for solutions that minimize weight and maximize manufacturability, and is particularly applicable to complex composite materials, and large structures.

"I've been working with composites for 25 years and the CCM is the most complicated structure I've ever dealt with," said Jim Jeans, chief architect for NASA on the project.

Load testing of the CCM involved blanketing the vehicle with 280 linear strain gauges and 80 acoustic sensors that listened for fiber breaks in the layups. The structure successfully withstood tests of loads applied to the structure to simulate launch abort and parachute deployment, and an internal pressure test.

— Lynn Manning



ATK used Siemens NX digita product development software to create the first stage of the Ares I Launch Vehicle for NASA as well as the vehicle's Launch Abort System. This image shows the Launch Abort Manifold, located on the tower on top of the Ares rocket, which reverses and directs thrust into four nozzles on the Abort system. This very fast rocket motor exerts about a 10G force on the astronauts who refer to it as the "eyeballs out, eyeballs in" configuration.

controlling with accounting systems."

Christensen adds that it has become critically important for companies to improve on the bidding process, manage accounting, and keep costs in line. And, as collaboration continues to play an increasingly important role in large aerospace

projects where many different companies are involved in the overall design, Teamcenter facilitates that collaboration. It enables the team to have a single source of data with which to collaborate with stakeholders.

PLM Provides One Point of Access

General Dynamics Robotic Systems (GDRS) is a world leader in tactical autonomous robotics and command and control systems. And it is also a firm believer in PLM. Despite having an arsenal of high-tech computer tools at its disposal, Laura Cook, Windchill administrator at GDRS, believes that PLM technology is what helps the company maintain a competitive advantage.

The company uses Pro/ENGINEER software to design its products and PTC's Windchill to help maintain data security and facilitate collaboration within the company. Though it is currently being used for one specific project, the company plans to roll Windchill out across the enterprise over the next year and a half.

"A good PLM system keeps your engineers from having to reinvent the wheel every time they need to do something," says Cook. "It enables them to work together collaboratively without overwriting each other's work. We're storing all our data from start to finish in our PLM system so we're not jumping back and forth from one system to another."

All employees at GDRS access what they need in the Windchill system. Managers can pull numbers for budgets, engineers can find parts and models, checkers can access drawings, the shop floor can obtain manufacturing data, and personnel ordering parts can access parts lists—all within the Windchill system. "Everyone goes into that one data system and gets what they need surrounding the product," says Cook. "Nothing is sent via e-mail to anyone inside the company; they just get a link back into the system."

Remaining competitive means finding and using the right tools, and Cook believes that PLM technology plays a leading role in keeping GDRS competitive. "We do believe that PLM helps us maintain a competitive advantage, which is why going forward we're rolling this out for the whole company. Without these tools, we would not be competitive at all." ■

Barb Schmitz *is a freelance technical writer with expertise in visualization, simulation, and other design engineering topics. She has more than 10 years of experience as an editor with technical trade magazines. Send feedback about this article to DE-Editors@deskeng.com.*

FOR MORE INFO:

- > Adept Airmotive Ltd.
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- > ATK Space Systems
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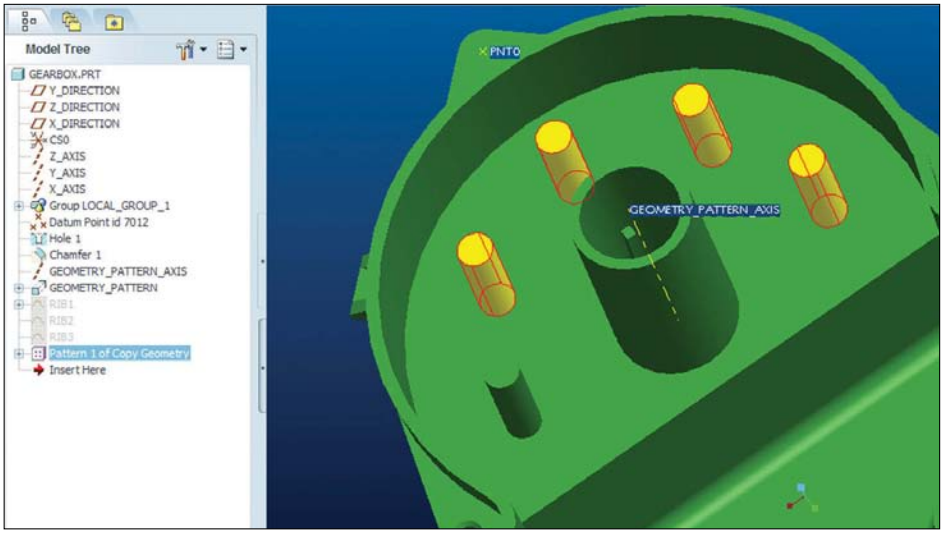
Pro/E Wildfire 5.0: A Dynamic Upgrade

> PTC's classic parametric modeling package returns with push-pull editing.

BY KENNETH WONG



Using an axis as center, you can pattern a feature along an arc segment.

Pro/ENGINEER Wildfire 5.0, the latest version of PTC's flagship MCAD package, hits the market nearly two years after PTC acquired CoCreate, a direct-modeling software company. Though Pro/E remains a parametric modeler, the software makes parametric editing easier and faster by adopting push-pull modeling methods commonly found in direct modelers. Sophisticated patterning, mirroring, tab-creation, and rib-creation tools speed up modeling tasks for shelled plastic and sheet metal. Also returning in this release is the digital manikin, first introduced in November 2008 as part of release 4.0. The 3D human figure is designed to give you a way to study and visualize your machines and assemblies in proportion to an average person's physique.

For Newcomers

If you're unfamiliar with Pro/E, here are a few tips that might speed up your initiation process. Pro/E makes use of the middle-mouse wheel (MMW) quite extensively. Whereas using the MMW for zooming in and out may be intuitive for most, other uses might not be quite so apparent. For instance, to pan the model, you hold the Shift key and the MMW simultaneously, then drag the model around. Similarly, to rotate a model, you keep the MMW pressed down as you drag the mouse around. In addition, you may also use the MMW in the Sketcher (2D sketching mode) to complete an operation, say, finishing a circle

or a rectangle, or to cancel out something in mid-operation, like an erroneous line segment.

If you're performing a parametric operation, like rounding an edge, you can turn to the text prompts and suggestions that appear right below the main menus. It's also the same place where you'll be prompted to enter numeric values and edge selections, such as the number of times you want to repeat a feature or the edge along which you want to pattern a feature. If you're unable to decipher the purpose of a menu button, hover your mouse over it briefly. A text explanation will appear.

I tend to set my display screen's background color to a much darker shade than the default (the soothing shade of blue is easy on the eye but I find that it sometimes obscures lines and edges). I prefer a sharp contrast that makes it easy for me to spot the irregular lines and edges. If you feel similarly, to customize your system color scheme, go to View > Display Settings > System Colors, then change the color scheme in the dialog box to suit yourself.

Pushing Pixels

This release marks the debut of Dynamic Edit, which lets you make parametric edits by pushing, pulling, and dragging on surfaces and edges. (If you're a SolidWorks user, you'll recognize its similarity to SolidWorks Instant 3D.) In this mode, you

see the results of your edits in real time, because geometry regeneration is instantaneous. That means you can adjust the depth of an extrusion, the radius of a rounded edge, or the diameter of a hole by directly interacting with the feature. In fact, you can grab an entire feature, such as an extruded profile, then move it along a surface to a new location.

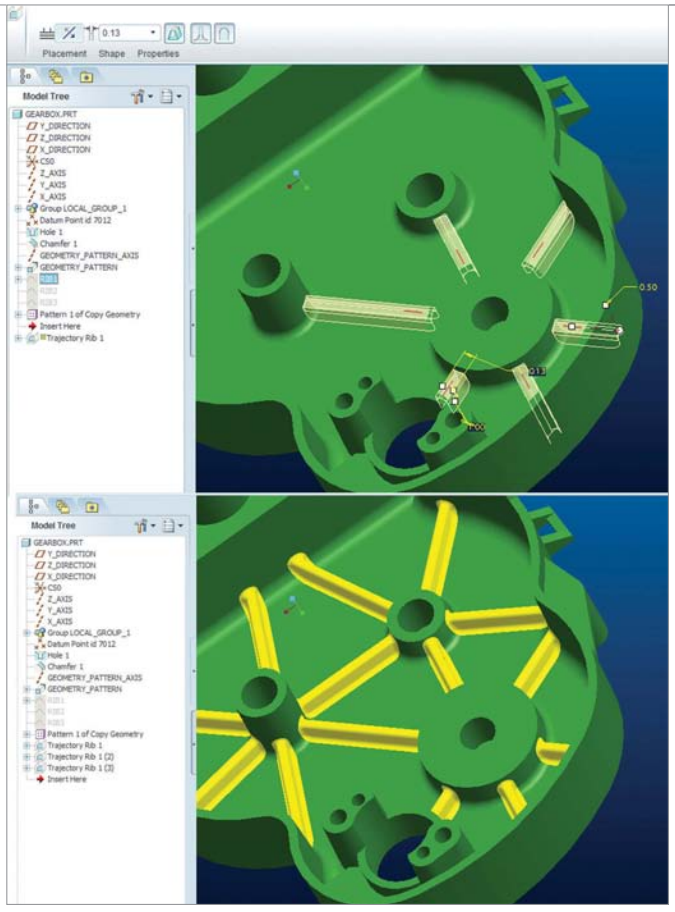
To activate this, you can select a parametric feature from the model tree, then right-click, and select Dynamic Edit. This gives you little drag handles you can use to control and adjust the feature. You can still click on the numeric value that appears right alongside the drag handle, and then enter a new value to adjust the feature. But if you're in conceptual design phase, you may find that the drag handles give you more freedom to explore shape possibilities and push aesthetic boundaries.

Bear in mind, however, that Pro/E still remains a parametric modeler—that is, a program that models 3D geometry according to the history of your parametric steps. Though Dynamic Edit lets you interactively edit your model the way you might do it in direct modelers like CoCreate, Autodesk Inventor Fusion, or SpaceClaim, you're essentially making parametric edits, not direct edits. That becomes evident if you inspect the model tree in Pro/E. You'll find that the tree is made up of a hierarchy of parametric features, not a series of solids and surfaces (which would be the case with models created in direct modelers).

Complex Patterning

Aside from simple patterning operations (like repeating an extruded feature along a straight line, spaced apart by a certain distance), you can also perform certain complex patterning operations. For example, you may select a feature, then pattern it along an imaginary arc segment, using a predefined axis as center. Using the patterning command, you can also duplicate a feature onto a surface, using a datum point to anchor the new feature with precision.

In plastic parts and shell parts with many internal structures, the Trajectory Ribs command can come in handy. Essentially, it lets you automatically create ribs that extend into various directions, terminating when they come in contact with nearby solids and surfaces. Once you have created a rib cluster, you can duplicate the same structure at another location by copying and pasting it. To do



Trajectory ribs can be copied and pasted into new locations.

this, you select the trajectory ribs as a group, go to Edit > Copy, then Edit > Paste, and select the target rib base in the model tree.

The Manikin (Nicknamed Bob)

This release marks the return of the digital manikin, which I took the liberty of renaming Bob. (Bob has a female counterpart, so you may also call yours Jane.) You can drop Bob into an assembly environment by going to Insert > Manikin (just make sure you have a flat surface for him to stand on). For those who routinely work with heavy machinery and plant assemblies, Bob offers an easy way to study clearances, ergonomics, and line of sight. Because Bob comes with various factory-oriented poses (for example, kneeling, pushing, bending down, or with arms stretched), you can check to see if certain dials and levers are too high or too low for him to reach.

Depending on the region your design is destined for, you might need to adjust Bob's parameters to correspond to the physique of the average local worker. To do that, you right-click, then choose Edit Parameters. For more advanced design and analysis capabilities, you can upgrade to the Pro/E Manikin Extension license to operate it fully.

Installation

The license activation process, in my view, is more complex than it should be, perhaps to discourage

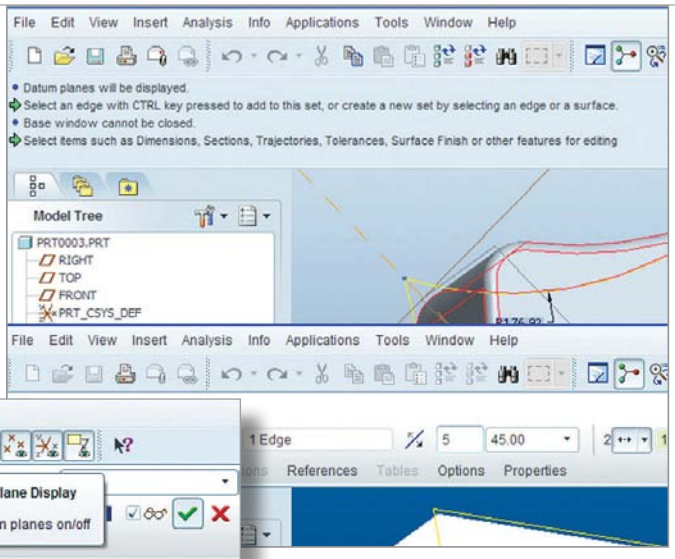
unauthorized use. The license keys came as two .txt attachments in an e-mail: one for node-locked license (which, I discovered, means to install the software on a single machine, identified via CPU ID); another for license borrowing. The instruction reads:

Save the attachment as a .txt file on the license server.

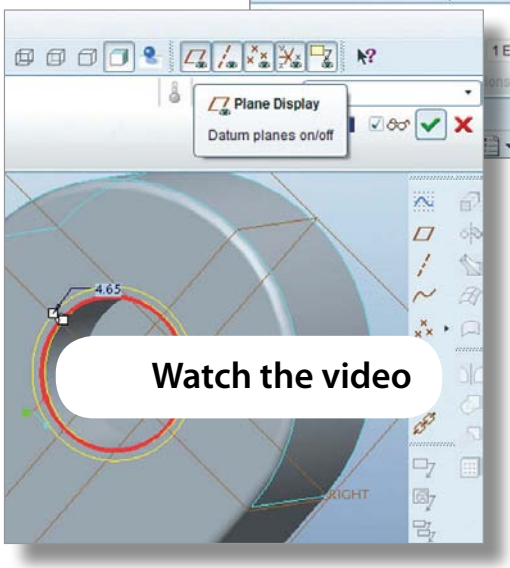
Import this license file into PTC.Setup (using ptcsetup.bat).

The strings __HOSTNAME__ and __PTCD_PATH in the SERVER and DAEMON lines are automatically replaced with the hostname of the license server and the path to the ptc_d executable located in the FLEXLM directory, respectively. For example: SERVER spock PTC_HOSTID = 11-22-33-44-55-66 7788 DAEMON ptc_d d:\ptc\flexlm\i486_nt\obj\ptc_d.

Unable to make heads or tails of this, I resorted to contacting Tech Support, which proved incredibly helpful and responsive. I managed to install the software by granting the technician permission to take control of my desktop. Essentially, he finished it on my behalf.



For guidance on how to complete certain parametric operations, you can turn to the text prompts that appear below the main menu items. You'll also be prompted to enter certain numeric values or select certain edges to complete an operation.



You can hover your mouse over a menu button to see text explanation about what it does.

A Dynamic Return

Aside from the hiccup in license activation, I find Pro/E Wildfire 5.0 to be highly interactive and responsive. Rightly or wrongly, people associate push-pull modeling with ease of use; therefore, the addition of Dynamic Edit makes PTC's parametric heavyweight less intimidating, especially for newcomers encountering it for the first time. With the digital manikin, Pro/E reminds us of a critical consideration that's often overlooked in design: the human factor. ■

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

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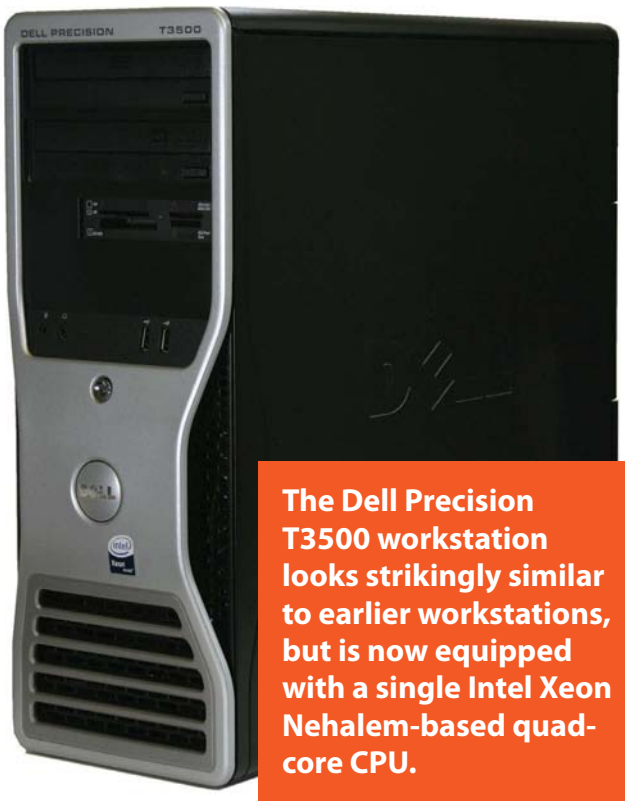
BY DAVE COHN



The Dell Precision T3500 workstation looks strikingly similar to earlier workstations, but is now equipped with a single Intel Xeon Nehalem-based quad-core CPU.

It's been nearly three years since we last reviewed a Dell Precision workstation, and needless to say, a lot has changed in that time. This time around, the Dell Precision T3500 that we received is powered by one of the latest Xeon processors, based on Intel's Nehalem microarchitecture. The single-socket T3500 joins the Dell T5500 and T7500 in the latest refresh of the company's Precision workstation lineup.

In spite of the passing of time, however, our evaluation unit bore a distinct resemblance to the much older Dell Precision 490 (see DE December 2006). The Precision T3500 comes housed in a similar gray and black case measuring 6.8 in. x 18.4 in. x 17.6 in. (WxDxH) and weighing in at 36 pounds. Although configured as a tower, the T3500 can also be reoriented as a desktop system.

The front panel provides two 5.25-inch drive bays that came filled with a pair of optical drives: a 16X DVD-ROM and a 16X DVD+/-RW drive. Below these, a smaller 3.5-inch flex bay contained a 19-in-1 media card reader. Down from there, a sloping panel contained microphone and headphone jacks and two USB ports, with cleverly concealed hard drive and network activity LEDs as well as

Dell T3500 Workstation Benchmark

		Dell Precision T3500 workstation (one 2.27GHz Intel Xeon E5520 quad core CPU NVIDIA Quadro FX 3800,4GB RAM		**Lenovo S20** workstation (one 2.93GHz Intel Xeon W3540 quad core CPU, NVIDIA Quadro FX 4800, 4GB RAM)		**HP Z800** workstation (two 3.2GHz Intel Xeon X5580 quad core CPUs, NVIDIA Quadro FX 4800, 12GB RAM)		**HP xw8600** workstation (two 3.4GHz Intel Xeon X5492 quad core CPUs, NVIDIA Quadro FX 4800, 4GB RAM)		**Lenovo Thinkstation S10** workstation (2.66GHz Intel Core 2 Q6700 quad core CPU, NVIDIA Quadro FX 4600, 2 GB RAM)	**Alienware Area-51 ALX Crossfire** workstation (Intel Core 2 Extreme 9650 quad core 3.0GHz CPU over-clocked to 4.0 GHz, two ATI Radeon HD 3870, 4GB RAM
Price as tested		$2,544		$3,885		$10,604		$9,307		$2,589	$6,163
Date tested		7/30/09		7/29/09		4/24/09		12/22/08		6/30/08	3/24/08
Operating System		Windows XP	Windows Vista	Windows XP	Windows Vista	Windows XP 64	Windows Vista 64	Windows XP	Windows Vista	Windows XP	Windows Vista
SPECviewperf	higher										
3dsmax-04		39.91	42.75	48.43	52.59	50.55	51.51	52.24	**54.61**	37.88	19.61
catia-02		51.85	53.33	60.40	60.61	62.10	61.66	**63.17**	62.48	48.25	**17.06**
ensight-03		47.26	47.84	51.74	**55.33**	53.99	53.62	54.44	50.82	43.33	**24.88**
maya-02		220.79	199.04	232.92	207.87	213.80	209.74	**234.50**	193.15	191.10	**32.16**
proe-04		55.67	55.54	61.56	**64.49**	63.59	61.48	52.73	57.15	48.86	**13.04**
SW-01		123.28	120.57	136.81	**139.54**	135.24	128.08	109.91	119.29	90.90	**28.64**
tcvis-01		28.71	28.07	29.17	**38.76**	28.93	28.29	29.84	27.58	24.46	**6.26**
ugnx-01		33.40	32.27	33.41	33.19	33.34	32.38	**34.17**	31.14	27.04	**12.75**
SPECapc SolidWorks	lower										
Score	seconds	178.39	n/a	**140.42**	n/a	145.17	n/a	164.71	n/a	188.01	n/a
Graphics	seconds	62.99	n/a	47.33	n/a	**41.31**	n/a	54.18	n/a	60.13	n/a
CPU	seconds	36.68	n/a	**31.01**	n/a	32.68	n/a	44.36	n/a	41.48	n/a
I/O	seconds	83.35	n/a	**65.86**	n/a	71.94	n/a	69.96	n/a	90.18	n/a
SPECapc SolidWorks	higher										
Score	ratio	4.66	n/a	5.91	n/a	**6.38**	n/a	4.84	n/a	4.56	n/a
Graphics	ratio	2.92	n/a	3.92	n/a	**4.85**	n/a	3.55	n/a	3.15	n/a
CPU	ratio	8.80	n/a	**10.41**	n/a	9.87	n/a	7.27	n/a	7.72	n/a
I/O	ratio	3.80	n/a	**4.81**	n/a	4.40	n/a	4.52	n/a	3.51	n/a
Autodesk Render Test	lower										
Time	seconds	118.20	125.00	99.00	117.60	59.00	**52.00**	64.40	67.60	**153.20**	95.20

Numbers in **blue** indicate best recorded results. Numbers in **orange** indicate worst recorded results. Results are shown separately for portable and desktop workstations.

four numbered diagnostic lights that help identify any problems during startup. The backlit power button is center just above the Dell medallion.

The rear panel houses a 9-pin serial port, a 25-pin parallel port, six USB ports, an RJ45 connector for the integrated Broadcom 5761 Gigabit Ethernet LAN, PS/2 mouse and keyboard connectors, audio-in and out, and an eSATA connector. Our evaluation did not include FireWire, which is available as an option.

Like earlier Dell workstations we've reviewed, the Precision T3500 case opens on the right. Inside we found a similar unique hard-drive mounting system to the one we first encountered on the Precision 490. Up to two hard drives can be mounted on a special cage that hinges at the bottom of the case, and when latched in place, covers half of the motherboard, including the CPU, with its large passive heat sink. Two large cooling fans mounted in the front panel blow air over the CPU and memory sockets. For our purposes, Dell included a single 7200rpm 160GB Seagate Barracuda SATA drive, although larger and faster SATA and SAS drives are also available. The system supports RAID 0, 1, 5, and 10.

With the drive cage pivoted out of the way, we had easy access to both the processor and the six DIMM sockets, four of which were filled with 1GB 1333MHz DDR3 ECC memory modules. The Precision T3500 can accommodate up to 24GB of memory using 4GB DIMMs. While Dell offers

While Dell offers Intel W3500 and W5500 series CPU options that range all the way up to 3.2GHz, our evaluation unit came with the much more sedate 2.27GHz Quad Core Intel Xeon W5520 processor.

Intel W3500 and W5500 series CPU options that range all the way up to 3.2GHz, our evaluation unit came with the much more sedate 2.27GHz Quad Core Intel Xeon W5520 processor.

The Dell motherboard, based on the Intel X58 chipset, provides a total of six expansion slots: two PCI Express 2.0 x16 slots, two PCIe x4 slots, and two PCI card slots, as well as an internal USB connector. Our evaluation unit came with a single NVIDIA Quadro FX 3800 graphics accelerator installed in one of the PCIe x16 slots. This new high-end board contains 192 CUDA parallel processor cores and 1GB of GDDR3 memory and provides two DisplayPort connections as well as a single DVI port that supports Dual Link DVI. While the single-slot solution requires an auxiliary power connection, it leaves the other five expansion slots completely accessible. Dell offers the NVIDIA Quadro FX 4800 and ATI FirePro V8700 as more expensive options, or users can choose less expensive boards from both NVIDIA and ATI.

Power comes from a 525-watt power supply,

although Dell offers an 85PLUS power supply as part of an extra-cost option that brings the system into Energy Star 5.0 compliance. In spite of four fans—two in the front panel, one in the power supply, and one on the graphics board—the system is virtually silent after startup.

Midrange performance Dell included two identical hard drives, so we could perform benchmark tests under both Windows XP and Windows Vista, and all of the results were very respectable. The Dell Precision T3500 easily outperformed older systems, although it lagged somewhat behind the most recent workstations we've looked at from HP and Lenovo, owing to Dell's decision to send us a somewhat slower CPU and graphics accelerator. Still, the T3500 performed quite well on the SPEC viewperf tests.

With eight threads, the Dell Precision T3500 took exactly twice as long to complete the rendering as the faster HP workstation, which benefited from the equivalent of 16 simultaneous processes.

On the SPECapc SolidWorks benchmark, which is more of a real-world test, the results were considerably slower, specifically because of the slower CPU. The same proved true for the AutoCAD rendering test—although here, thanks to hyper-threading, the results were still quite respectable. With eight threads, the Dell Precision T3500 took exactly twice as long to complete the rendering as the faster HP workstation, which benefited from the equivalent of 16 simultaneous processes.

Dell

Dell Precision T3500

- **Price:** $2,544 as tested ($999 base price)
- **Size:** 6.8 in. x 18.4 in. x 17.6 in. (WxDxH) tower
- **Weight:** 36 pounds
- **CPU:** Intel Xeon (Quad Core) W5520 2.27GHz
- **Memory:** 4GB DDR3 SDRAM at 1333MHz
- **Graphics:** NVIDIA Quadro FX 3800
- **Hard Disk:** Seagate Barracuda 160GB SATA 7,200 rpm drive
- **Floppy:** none
- **Optical:** 1 16X DVD-ROM; 1 16X DVD+/-RW
- **Audio:** onboard integrated High-Def audio (mic, headphone, line-in, and line-out)
- **Network:** integrated Broadcom 5761 Gigabit Ethernet LAN
- **Modem:** none
- **Other:** One 9-pin serial, one 25-pin parallel, eight USB 2.0 plus one internal USB, 19-in-1 media card reader
- **Keyboard:** Dell Multimedia Pro cordless
- **Pointing device:** wireless mouse

Once we factored in the price, however, we are quite ready to excuse the slightly more modest performance. Prices for the Dell Precision T3500 start at $999, with our evaluation unit pricing out at just $2,544 (after applying a $150 discount currently available on the Dell website).

Like its competitors, Dell currently offers 32- or 64-bit versions of Windows Vista as well as downgrades to Windows XP, and qualified buyers can

upgrade to Windows 7 for free once it becomes available. The T3500 is backed by a three-year basic warranty with next business day on-site service. Longer service contracts, direct end-user support with 4-hour 24/7 onsite response, accidental damage protection, data recovery protection, and a prepaid recycling service are all available as extra-cost options at the time of purchase. You can even pay Dell to plant a tree to offset the environmental impact of your new computer.

Dell rounded out our evaluation unit with a cordless Multimedia Pro 105-key keyboard and mouse, although we would have been quite happy with a standard corded keyboard and mouse. Serious CAD users will probably want to configure their system with a faster CPU and bigger hard drive, and may consider splurging for an ultra high-end graphics card, but even when you add those options, the Dell Precision T3500 is still a very affordable midrange CAD workstation that packs an awesome amount of power. ■

*Contributing Editor **David Cohn** is DE's MCAD and workstation expert. A computer consultant and technical writer based in Bellingham, WA, he has been benchmarking PCs since 1984. He's the former editor-in-chief of Engineering Automation Report and CADCAMNet, and the author of more than a dozen books. Please send comments about this article to DE-Editors@deskeng.com or to david@dscohn.com.*

Design-Expert Enables Z Corp Printer Design

> Design of experiments solution from Sta-Ease helps Z Corporation develop its unique 3D color printers.

BY MICHAEL VOGEL

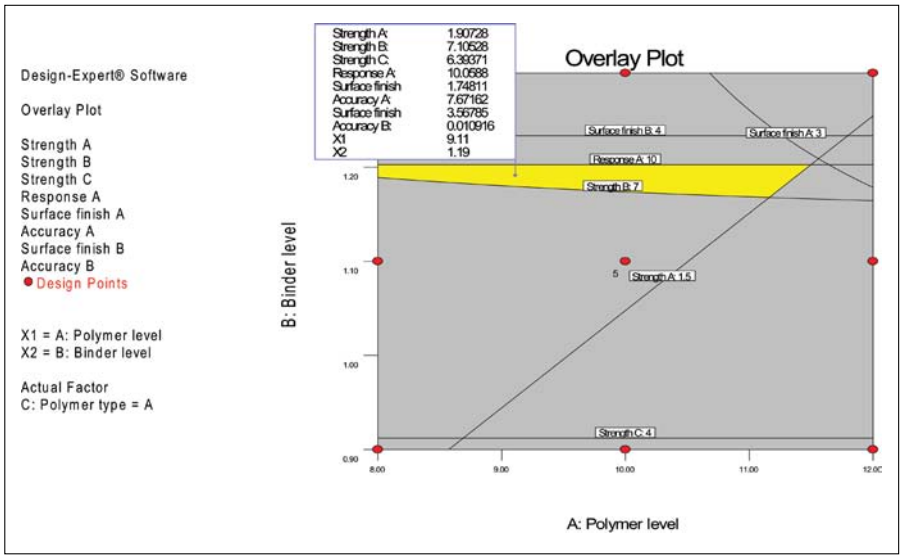


Figure 1: This is a graphical representation of the Design-Expert optimization solution.

Z Corporation overcame many technical and managerial challenges while developing its 3D color printers. Creating such products required a laborious series of spaghetti-like experiments chasing parameters thought to hold the potential for performance improvements. In one case researchers spent an entire year searching for a breakthrough that would achieve critical design specifications.

To accelerate their product development process, Z Corporation provided its engineers with the knowledge and software to do statistical design of experiments (DOE) with the help of Design-Expert software from Stat-Ease. The company developed a procedure by which every factor with a reasonable chance of affecting product performance is systematically and simultaneously evaluated via these controlled experiments.

"The DOE process identifies the significant variables," says Joe Titlow, Z Corporation's director of product management. "These vital few factors are then further investigated through more detailed experiments. This process makes it possible to overcome development obstacles and move much more quickly to an optimized product design."

Z Corporation's 3D printers create physical models from computer-aided design (CAD) data by using an inkjet printhead to deposit a liquid binder that solidifies layers of powder. Full 24-bit color capabilities use colored binder materials (cyan, magenta, and yellow, like a 2D printer) to produce millions of distinct colors. A part can be printed at the rate of

one vertical inch per hour. Because Z Corporation printers use standard inkjet printing technology, they are reliable and affordable. Finished parts cost $0.10 per cubic centimeter in materials.

Difficult Product Development Process

Development of printers based on this technology requires a profound knowledge of the complex interaction of the powder that forms the structure of the model. Other factors are the ink that causes the powder to solidify, the hardware that deposits the ink and powder, and the software that controls the process. Each of these systems must come together to deliver the strength, surface finish, and accuracy needed to meet design specifications.

In the past, the company transitioned slowly from research to product development. Researchers explored new chemicals, changed one factor and measured one response, then changed another factor and measured another response. This one-factor-at-a-time approach wasted a considerable amount of time on factors that were later determined to be insignificant. Researchers also often missed important multifactor interactions.

"DOE offered a logical solution to this problem," Titlow says. "One of our researchers learned from his DOE instructor that Design-Expert software from Stat-Ease offers a very powerful optimization

tool called response surface methods (RSM). RSM models are crucial in developing the products at the heart of most of our projects. We found Design-Expert to be easy to use."

Getting a Stalled Project Going

To fine-tune a powder formulation, a Z Corporation researcher used Design-Expert to create a three-level factorial RSM experimental design.

The researcher selected the following factors (with ranges shown in parentheses):

> Polymer level (8% to 12%)

> Binder level (0.90 to 1.30) [editor's note: actual units of measure are confidential]

> Polymer type (Grade A, B, or C)

ANALYSIS OF VARIANT RESULTS FOR STRENGTH A (REDUCED) MODEL

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F
Model	5.58	2	2.79	77.29	< 0.0001 significant
A-Polymer Level	2.81	1	2.81	77.93	< 0.0001
B-binder Level	2.51	1	2.51	69.46	< 0.0001
Residual	1.30	36	0.036	n/a	n/a
Lack of Fit	1.01	23	0.044	1.99	0.0996 not significant
Pure Error	0.29	13	0.022	n/a	n/a
Cor Total	6.88	38	n/a	n/a	n/a

Note that the last factor is categorical (discrete types), whereas the other two variables are numeric (continuously adjustable). Design-Expert can handle combinations like these without problems.

The responses were as follows (while units of measure are confidential, actual ranges are shown):

> Strength A (0.60 to 2.40)

> Strength B (3.20 to 10.04)

> Strength C (3.10 to 8.63)

> Response A (8.00 to 12.00)

> Surface Finish A (ranked 1 to 5)

> Surface Finish B (ranked 1 to 10)

> Accuracy A (-2.60 to 12.00)

> Accuracy B (6.693E-003 to 9.941E-003).

The software generated a design with 46 runs including 5 replicates. This met the experimental budget. (In cases where there is limited time or material, Design-Expert offers a computer-generated statistically optimal fraction with less than half the number of runs as this full factorial.) Many of the responses suffered from missing measurements,

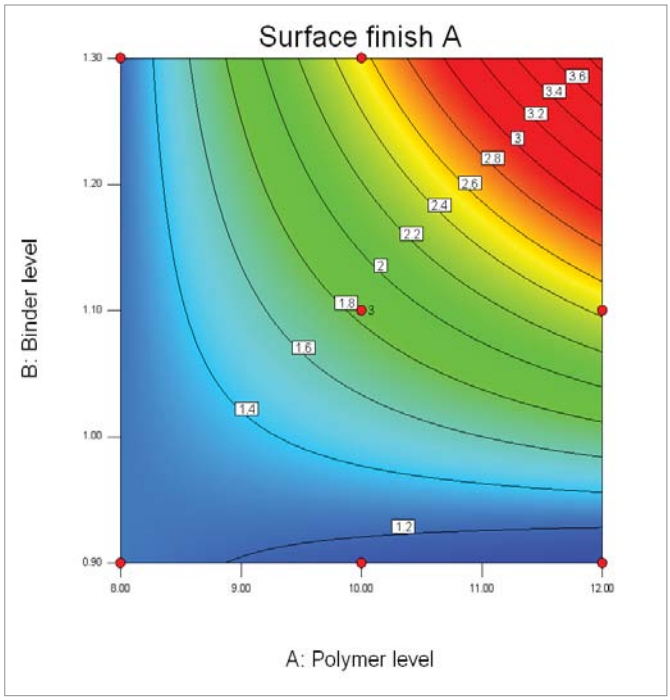


Figure 2: Curvature in Surface Finish A model shows strong interaction between factors A and B.

but the software experienced no difficulty in generating results from these reduced data sets. The majority of the responses were linear, but significant (and important) multifactor interactions were discovered for several of the critical responses (see Figure 2). The researcher viewed the ANOVA (Analysis of Variance) for each response (see Table above). Effects with less than a 90 percent degree of confidence were considered insignificant and deleted from the predictive models.

Optimizing the Product

Next, the researcher developed a desirability function by establishing criteria for each response (maximize, minimize, or hit a target and prioritize them by importance). Often the subsequent numerical optimization by Design-Expert provides a number of different solutions. However, in this case, the criteria led to only one possible solution. Figure 1 shows the small window of success. Technicians mixed the recommended powder recipe and made a batch in the lab. The results correlated remarkably with the predicted values from Design-Expert. Technicians repeated the experiments on a production scale and got the same results. This single RSM experiment resolved an issue that had stopped the project.

"This first success with DOE provided the momentum we needed for a full-blown implementation of the technology," Titlow says. "Now we perform DOE on every new product-development project at the earliest stages. We enumerate every factor that theory tells us might be playing a role. Then we use factorial DOE to screen them, and RSM to provide the optimum settings. Factorial DOE/RSM reduces our time to market while creating products that perform at a higher level. In particular, the print quality of our products has gone up rapidly, allowing us to deliver more value to our customers." ■

Michael Vogel *is VP for Research and Development at Z Corporation. Before joining Z Corporation, Mike worked at Lockheed Martin where he was involved in the design and manufacture of advanced aircraft, spacecraft, and marine systems. He has a B.S. in both Aerospace Engineering and Life Sciences from MIT. Send comments about this article to DE-Editors@deskeng.com*

FOR MORE INFO:

> Stat-Ease, Inc.

> Z-Corporation

FASTApps

> FOR COMPLETE APPLICATION STORIES CLICK HERE

AVEVA NET Enables Woodside Energy Gain Better Control Over Data

> Woodside Energy Ltd., a leading Australian oil & gas developer, was experiencing difficulty in managing and accessing the large amounts of data and drawings required for its facilities. Much of the company's plant information was maintained by third parties, leading to additional challenges in accessing and sharing engineering information.

Woodside accepted tenders from technology vendors to provide a solution to improve the management and delivery of its engineering data. Upon completion of the selection process, Woodside determined that AVEVA NET project lifecycle management software was the best fit for its needs.

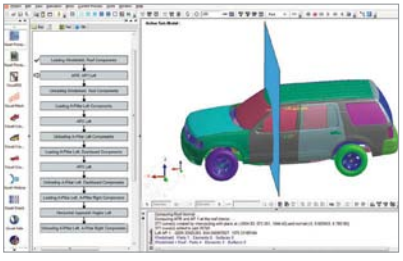
To maximize the potential benefits and ensure that AVEVA NET would provide extensive and accurate information, significant data cleansing, validation, and conversion was undertaken during the implementation at existing sites.

The AVEVA NET implementation has provided a significant return on investment, yielding a 26% IRR over the past 5 years. It is forecast that the IRR over a 10-year period will exceed 84%. The implementation's breakeven point was 3.4 years after commencement, and was achieved in mid 2007.

> More info

The ESI Visual-Process Streamlines IAC's Automotive Simulation, Reporting Process

> International Automotive Components (IAC) is a leading global supplier of instrument and door panels, headliners, cockpits, and fascias. As part of its operations, IAC receives CAD files of surfaces for interior components from automotive OEMs to design parts and meet federal crash test requirements.



In the past, IAC analysts had to perform lengthy manual processes that tied up highly skilled analysts for a considerable amount of time, causing bottlenecks in the delivery schedule.

After evaluating several possible solutions, IAC's engineers decided that ESI offered a flexible solution that enabled them to develop a script that automatically determines impact zones, selects impact points, and calculates impact angles early in the product development cycle.

The script is based on ESI's VisualDSS, which is designed to build and manage simulation models for multiple domains, automate processes and workflows, manage simulation content and data, and support automated reporting.

> More info

FASTApps

T-Rex is Fast, Accurate Boundary Layer Meshing from Pointwise

> Propulsive Wing LLC is developing a new, patented aerodynamic platform that integrates an embedded, distributed cross-flow fan propulsion system within a thick wing. It is a daunting task for any grid generator to capture small details in the fan region embedded

within the trailing edge of a large wing body while creating boundary layer cells. Because the aircraft's performance is tightly coupled to the fan's performance, accurately determining performance parameters—such as lift and drag as well as thrust and power—is crucial to the design.

T-Rex technology from Pointwise, Inc., maker of CFD meshing software Gridgen and Pointwise, was used to create a high-quality boundary layer mesh for this configuration with 25 layers of cells in the boundary layer and 5 million total cells. The entire grid was built in less than a day.

> More info

Bigger isn't always better – but faster is.

Adams Golf® gains insight using analysis and design tools from Siemens PLM Software to develop the new Speedline™ FAST 10 driver.

Adams Golf, Inc. leads the industry in hybrid driver, wood and iron set innovation. Since the 1990's, the golf club has undergone significant transformation and acceleration. In order to compete against companies with larger marketing budgets, Adams Golf must focus on using technology effectively, to innovate and to bring new products to market faster.

In recent years, drivers had grown ever larger. But, driving distances were actually decreasing. Adams found that the reduction in club head speed measured during player tests, correlated strongly with the resulting increase in aerodynamic drag for extreme dimension club heads. Adams decided to use NX Flow in their process for analyzing driver head designs. "We were already using the (NX) design software ... so it fit very well," says Scott Burnett, Director of Product Development for Adams Golf.

The result?

A driver with a larger face area, but reduced airflow resistance – creating increased club head speed. Using integrated design and analysis tools from Siemens PLM Software, Adams Golf was able to bring the new Speedline FAST 10 to market in record-setting time to gain an innovation advantage.

SIEMENS

Get the whole story and register to win a Speedline FAST 10 driver at **www.siemens.com/plm/adams.**

ADVERTORIAL

Desktop High-Performance Engineering Analysis is Here!

> Putting HP Z Workstations and ANSYS HPC performance at your fingertips.

BY PETER VARHOL

Simulation and Analysis, the cornerstone for assuring that MCAD designs meet customer requirements demands heavy computational lifting. Tasks like Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD) and other simulations have typically relied on server-class performance to get the job done. In many cases this meant getting access to outside server resources.

"HP Z800 Workstations are an ideal powerhouse to take advantage of ANSYS HPC."
Dipankar Choudhury, ANSYS vice president of product strategy

For many types of simulations, that is now a thing of the past. The new generation of HP Z workstations, specifically designed to unleash the power of Intel's latest Xeon processor technology, has significantly extended the range of what types of simulations can be run on the desktop. In the past the workstations were relegated to pre- and post-processing phases of any simulation and analysis job. No more.

High-performance HP Z800 workstations powered by two Intel Xeon 5500 processors, 8 computational cores and 16 threads give you the power to test more "what ifs." With a memory capacity of up to 192GB these expert digital workbenches are proving extremely capable at analysis-driven design. The HP Z800 together with high-fidelity simulation capabilities of ANSYS® HPC redefines the price and performance of the engineering desktop. This is why HP refers to the HP Z800 the "solver-ready" workstation.

Processors and Memory Combine for Computational Excellence

It is well known that FEA and CFD are processor core-hungry and memory-hungry applications. These computational tasks can take advantage of all the processing power thrown at them. And the HP Z800 throws a big punch: dual Intel Xeon 5500 64-bit multi-core processors clocking up to 3.3 GHz support up to an amazing 192GB of main memory, all but unheard of in a workstation of the past. The HP Z800 workstation delivers all this computational power backed up by a large number of ANSYS tested, certified and supported graphics adapters, as well as support for industry standard 64-bit operating systems from Microsoft and Red Hat.

Along with this eye-popping computational and visual rendering performance, the HP Z800 has been engineered from the bottom up to minimize power consumption, with highly efficient power supplies and default energy saving modes that can result in less than one watt of power consumption when in an idle state.

The HP Z800 is truly the premier "solver-ready" workstation solution for your design engineering and high-performance simulation requirements.

To complement this workstation punch, the ANSYS HPC delivers high-fidelity engineering analysis and simulation software to take full advantage of all of the processing power of the HP Z800. This combination of HP Z800 workstation and ANSYS HPC, enables engineers to solve problems that until recently were out of reach of the desktop.

The HP Z800 is truly the premier "solver-ready" workstation solution for your design engineering and high-performance simulation requirements.

For more information on how you can benefit from this HP & ANSYS Solution please email z800@ansys.com

For more information on HP Workstations for the CAE market please go to www.hp.com/go/solver. ■

DE MARKETPLACE

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KNOWLEDGE TO SUCCEED
NOW AND TOMORROW

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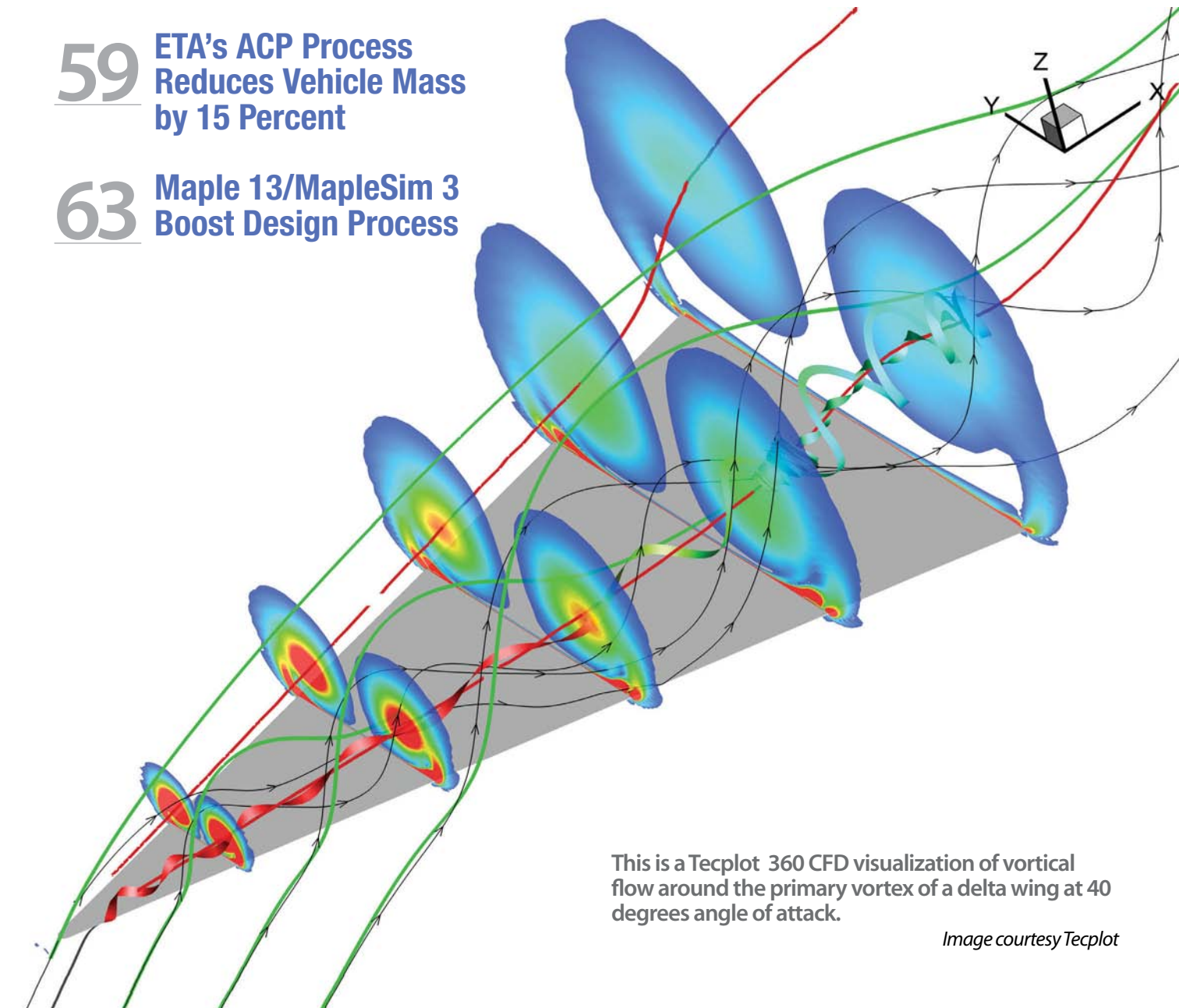


This is a Tecplot 360 CFD visualization of vortical flow around the primary vortex of a delta wing at 40 degrees angle of attack.

Image courtesy Tecplot

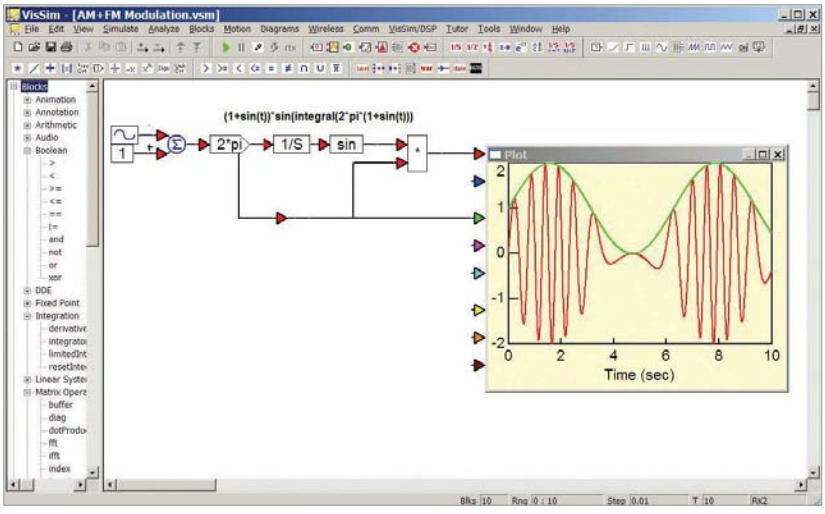
By Pamela J. Waterman

Managing Intense Numerical Analysis

> Slice-it dice-it tools from NI, OriginLab, Tecplot, Visual Solutions, and Wolfram come with enough options to let you have it your way.

Solid-state drives (SSDs) have been a fringe technology ever since they were first displaced by spinning platter drives, back at the dawn of history. But that's changing: in the past two years, tremendous development has taken place in modern SSDs.

Agrad student I once knew went around with glazed eyes saying, "Numbers! Numbers!" when he was scrambling to interpret reams of new raw data. (Late nights and caffeine were a factor, I'm sure.) If your New Year's resolution is to get a better handle on data management, from fitting curves to communicating results and creating batch-processing scripts, you've come to the right place.



Tecplot 360 CFD visualization software calculates total vorticity magnitude and the trajectory of particles with mass, extracts vortex cores, and generates an image showing the vortical flow around the primary vortex of a delta wing at 40 degrees angle of attack. Image courtesy Tecplot

As mentioned in a recent article (November 2009 DE), numerical software users typically fall into two categories: engineers who gather experimental data and need to process it into a more usable form, and engineers who are solving formula-based problems and need automated assistance with hand calculations. But these camps sometimes cross-pollinate and use the same tools. Here's a look at several good options and their latest additions that just might solve your own problems with numbers.

On the Math Side

Wolfram Research delivered Version 7 of its comprehensive Mathematica package last year. This newest Wolfram development continues, as the company puts it, "a consistent focus on integrating features into [the software's] core functionality rather than adding them as disjointed add-ons." For example, in addition to its ordinary differential equation/partial differential equation functions, the software now handles differentiated algebraic equations.

Mathematica's range of capabilities helps users automatically select appropriate algorithms, track numerical precision, visualize data with interactive 3D models, and handle symbolic (e.g., XML or audio) as well as numeric data input and output. New features include intense statistical analyses, flow-line visualization (helpful for fluid and magnetic analyses), improved image processing for cases where data is only available in photographic formats, a major revamping of the graphical charting choices, and formatting options such as placing equations at an arbitrary angle.

From an operational point of view, Mathematica 7 is a high-level programming environment that supports flexible built-in distributed computing. If you've written code to run on two processors, you don't have to rewrite it when more processors become available (four-processor computing comes standard). A stand-alone Workbench package serves as an integrated development environment for the company's other products.

Some people compare Mathematica to PTC's Mathcad. To help you evaluate its capabilities, Wolfram's website offers a unique page with extensive comparisons to other software packages (wolfram.com/products/mathematica/analysis/). Organized by tasks such as Calculator Software or Simulation Systems, it's a good place to start when prioritizing your needs.

Graphing & Visualization

Origin 8.1 software from OriginLab is another powerful package with an almost 20-year history. Version 8.0, released several years ago, introduced a complete rework of how data, graphs, and analysis results were created, explored, and organized. Now, in version 8.1, improved tasks address curve fitting, signal processing, and image processing. The software's specialty continues to be the production of publication-quality graphics now including sparklines (small embedded high-resolution data-graphics now coming into standard use). Users can import up to 90 million data points and compare thousands of data runs, discovering underlying patterns far too subtle for hand-done comparisons.

New Origin 8.1 features include expanded customized graphing and menu options, shortcuts for accessing Windows files in the Project Explorer user interface, expanded input/export functions, an x,y data-merge function, and new productivity functions for batch processing, file sharing, and file transfer. The company's OriginPro 8.1 adds extended analysis tools in the areas of peak fitting, surface fitting, statistics, signal processing, and image processing.

Connectivity to LabVIEW products from National Instruments is a time-saving capability of Origin 8. For example, according to user James Gardner, chief engineer at Environmental Instruments, "With

Eliminate the Bookshelf

Do you have well-worn folders, binders, and technical handbooks filling your shelves (not to mention charts taped to the side of your filing cabinets), aimed at keeping pertinent data at your fingertips? Do you update them yearly? Weekly? Daily? Knovel.com has done that difficult job for you, offering online searchable access to more than 2,000 reference titles, textbooks, and reports. Like a Google for engineers, this one-stop technical source streamlines the process of finding trusted content for increased productivity and accuracy.

Not only that, Knovel brings much of this information to life with interactive functions. You can search tables, pull out one or more data items, and export the information to an Excel spreadsheet. Live graphs mean that you can pick a point, move the cursor over it, and read off exact values. And for math that you can really use, Knovel has pulled 4,000 math examples and turned them into official Mathcad worksheets!

Check out Knovel's website to browse its list of engineers' handbooks, materials property databases, standards, online searches, and libraries of math and best practices. The company offers online subscription plans for 23 unique subject areas (including a trial program) and recently introduced the My Knovel customizable search-content account. *—PJW*

> FOR MORE INFO: **See Kenneth Wong's DE Blog on Knovel's Mathcad worksheets and search function.**

Origin's Analysis Templates it is now very simple to create a reusable application that acquires data from third-party instruments, and then passes the data for analysis and report generation to Origin. One can also get curve-fit results back into LabVIEW to display in LabVIEW's charts and graphs on the fly. What's best is that this is all accomplished in a native LabVIEW environment."

To help users get up to speed, the OriginLab website now offers dozens of multimedia tutorials on very specific tasks ranging from nonlinear curve fitting to customizing data points in a graph.

Calculation to Visualization

Where does data analysis end and visualization begin? As the lines blur between analyzing data and presenting it, users are finding that using more than one package can help them extract the most out of both their experimental and simulation results.

Tecplot's family of products is designed to get useful information out of large amounts of complex data, and does so with visualization options in both 2D and 3D formats. The original Tecplot package focused on managing results from computational fluid dynamics (CFD) analyses, but has since split into two products. The full-function Tecplot 360 supports the CFD simulation market, while the more generalized Tecplot Focus targets any application that doesn't need, for example,

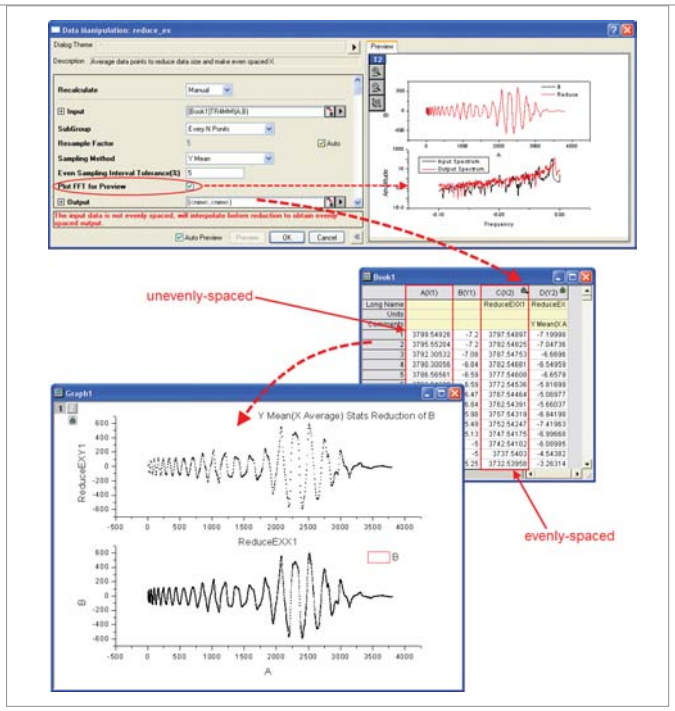
vortex extraction capabilities. A third product, Tecplot SDK, is a tool for developers to create an embedded visualization function.

The power of Tecplot 360 lies in helping users examine terabytes of data and quickly grasp the physics behind a visual 3D field representation. It displays answers to such questions as where is turbulence occurring? And is the flow attached everywhere on an aircraft wing? Tecplot President Mike Peery points out that, generally, users then want to extract numerical information, such as, How does my lift vary with angle of attack? Ultimately, he says, you want an x,y plot of some integrated quantity, perhaps versus time: "It's not all about the glory of 3D exploration, it's also about getting down to quantitative results."

Users can also do feature extractions such as finding all the vortices, or showing only those surfaces where the values exceed certain limits. This capability allows specialists to explore the full 3D data field yet share relevant results with non-experts as needed.

Significantly, Tecplot's Peery has seen a strong move toward automation for these tasks. He says, "In the past, you would simulate, postprocess, create plots, and do it all again. Now [designers] run a thousand cases overnight, and don't have the time to view all the plots and identify trends." All steps can instead be fully automated with scripts and APIs, a capability not always found in the post-processing functions of CFD analysis packages. "Scripting is the only way to make sense of it all."

Bridging the realms of mathematics and modeling is the VisSim software family from Visual Solutions. The company describes its products as a



This is a simple AM and FM modulation diagram displayed with a VisSim plot.
Image courtesy Visual Solutions

very extensive graphical block diagram language containing hundreds of mathematical functions. Need a signal generator? Got it. Summing block? Ditto. Boolean function? Pull it down, drag it over, and "wire it" into your system with a click.

Users say that VisSim offers an easy way to create fast and accurate solutions for linear, nonlinear, continuous/discrete time and other complex, dynamic systems. Its libraries include preconstructed components such as HVAC units, gas turbines, counters, timers, logic functions, and more. Version 7 added interactive 3D plotting and 3D animation; Version 8—scheduled for release in the first quarter of 2010—features such additions as interactive knobs and gauges, named structure wires with data types, nested blocks, and block editing.

John David Hienzmann, lead engineer for motor drive development at Segway, says that when his group developed the wheel-motor drives for the Segway Human Transporter, "VisSim was a great

tool for simulating control algorithm behavior, tuning loop gains, and verifying that what we built was behaving as expected."

VisSim offers direct integration with MatLab, Mathcad, and MapleSim to make it easy to access scripts. More than a dozen add-on modules extend the main product to include additional mathematical functions and compile code in several languages.

Another tool in the spectrum between numerical analysis and visualization software is National Instruments' (NI) LabVIEW 2009. This series of products serves as a graphical programming environment for the development of measurement, test, and control systems, with or without writing lines of code. For example, you can connect a line between a dataset and a triangle symbol (representing integration) and see the integrated results without writing any command lines.

LabVIEW's built-in analysis functions include FFTs, curve fitting, frequency analysis (with transients), pattern matching, and edge detection. The base package also offers a single environment for combining graphical and customized textual code via its MathScript Module.

Recent performance improvements come with LabVIEW 2009's support for 64-bit operating systems plus a parallel FOR loop function that automatically splits iterations across multiple cores. In addition, the Service Pack 1 release of the LabVIEW MathScript RT Module addresses users' needs to deliver full determinism in situations where jitter in real-time hardware applications is unacceptable.

NI offers many add-on modules and toolkits for specific tasks such as image and signal processing and report generation. In fact, users can download fully functional trial versions of more than 25 LabVIEW applications. You can also access tutorials, sample code, webcasts, videos, and publications at NI's extensive searchable developer zone (zone.ni.com/dzhp/app/main). Organized by technology, industry, or application area, this resource helps users quickly learn from others' relevant work.

As always, ask questions to figure out what the software can and can't do. The software might create 30 types of 2D or 3D graphs, but can you click on a point and extract or interpolate it? Are you comfortable with the GUI: is it easy to navigate with menus and icons, or does it require entering more code than you'd like? Does it give you the flexibility you need to create complex equations with both numeric and symbolic variables?

A great way to start is simply by viewing the software's online tutorials and webinars, read what others are saying in forums and reviews, then run your own data through a free trial package. It's time to tame the numbers. ■

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FOR MORE INFO:

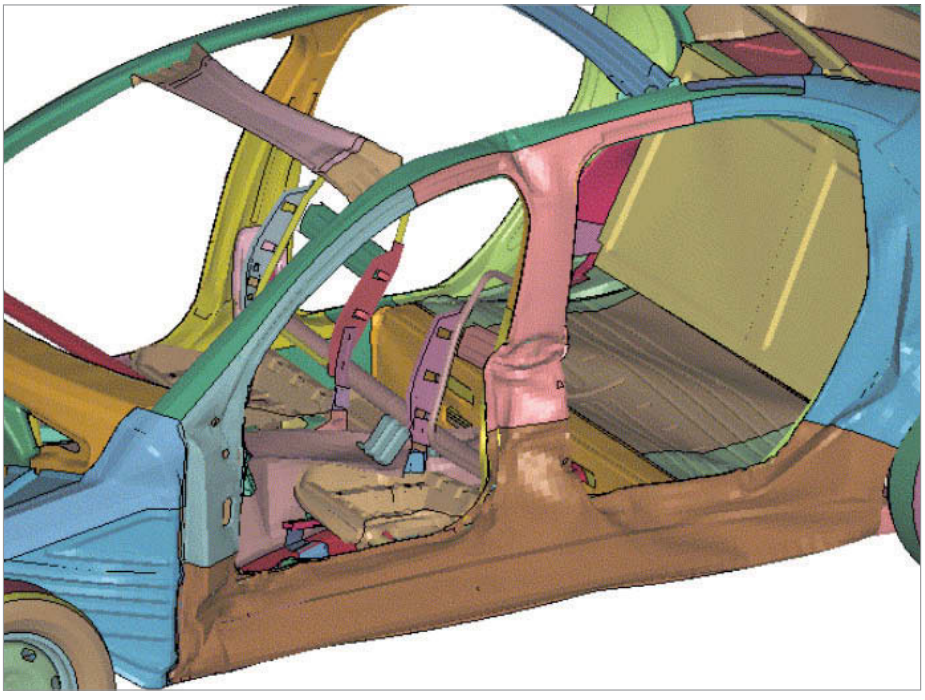
- > Knovel
- > National Instruments
- > OriginLab
- > Tecplot
- > Visual Solutions
- > Wolfram Research

By Jonathan Gourlay

ETA's ACP Process Reduces Vehicle Mass by 15 Percent

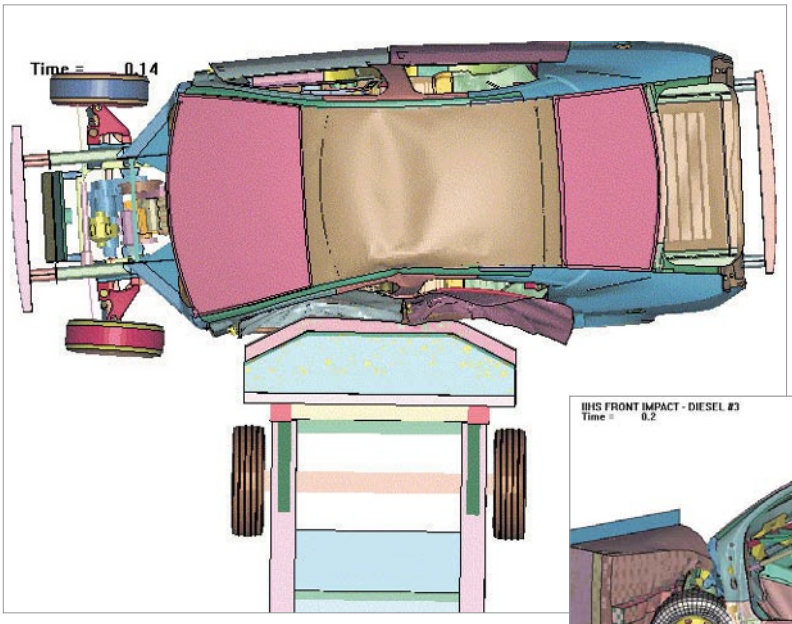
> Savings lead to reduced components, smaller powertrain, improved quality, and capability to cut product development costs by 35-40 percent.

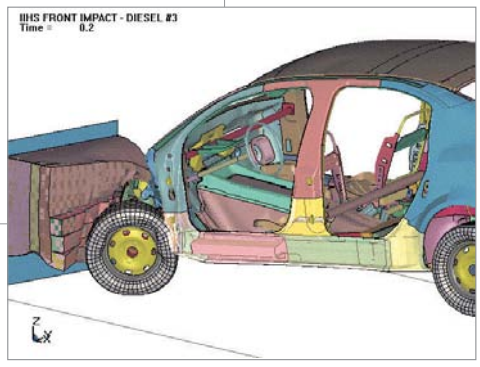
It's no secret in the automotive industry that reducing weight and mass in vehicles saves big money in both materials for the manufacturer and gas for the consumer. But such reductions can compromise structural integrity and so have come in modest increments and led to complex redesign. Add to that the increasingly stringent environmental and safety regulations that will be taking effect through 2016 coupled with unclear prospects with regard to fuel costs, and it's easy to see why an industry group wants to change the game.



Simulations reveal that a new product development process has helped reduce the mass of vehicle passenger compartments while maintaining design robustness and improving efficiency.

With an eye toward coupling efficiency with crashworthiness, the Auto/Steel Partnership—





Engineering Technology Associates (above) accepted the challenge of reducing an automobile's mass while improving crashworthiness, stiffness, and quality at the same time. It also saves on fuel.

The Future Generation Passenger Compartment project (right) used high-strength steel.

comprised of six steel companies (Ak Steel, US Steel, Mittal, Defasco, Nucor, and Severstal) that joined with GM, Ford, and Chrysler—wanted to develop a lightweight passenger compartment using advanced high-strength steel. In 2004, the partnership approached Engineering Technology Associates, Inc. (ETA) to solve the problem.

ETA had a track record of successful CAE analyses for various automotive OEMs over the course of 26 years, so ETA VP of Engineering and Consulting Akbar Farahani, Ph.D. and his team had the street cred to take on the challenge of reducing automobile mass while improving crashworthiness, stiffness, and quality at the same time.

Accelerated Concept to Product

Using the ULSAB-AVC (Ultra-light Steel Auto Body Advanced Vehicle Concepts) model donated by the Auto/Steel Partnership (A/SP) for Phase 1 of the project, ETA started on the Future Generation Passenger Compartment (FGPC) project. It provided Farahani and ETA's advanced engineering group with the opportunity to develop the idea that many design concepts could be evaluated under multiple load conditions simultaneously. Further, no design would be initiated until a concept met all of the design and manufacturing targets set at the beginning of the project. The idea was dubbed the Accelerated Concept to Product (ACP) process.

"The methodology is a multidisciplinary and holistic design solution," says Farahani. "The nucleus of the idea came [during] a project for GM about seven years ago, but software was not mature enough then to accomplish ACP."

In the conventional development process, a product is designed, analyzed, tested, and then redesigned. Using the ACP process, CAE, design, and manufacturing are all synchronized.

To reach the goal of reducing the vehicle's mass by 25 percent, the ETA team brought all the tools at its disposal to bear. That includes multiple CAE tools—modeling tools, application specific tools, solver technology, and optimization solutions—as

well as one of the most important tools used in the ACP process, ETA's own advanced modeling suite eta/VPG. VPG provides the pre/post, safety, structure, fatigue, drop test, ALE-FSI, and material handling analyses. Another ETA-authored solution, eta/DYNAFORM, is used for formability analysis, die face engineering, die structure analysis, and manufacturing process simulations. The team also uses Nastran, LS-DYNA from Livermore Software Technology Corp., HEEDS from Red Cedar Technology, and SFE CONCEPT from SFE GmbH.

Once an optimized concept is identified, further design, analysis, and optimization takes place using loading, manufacturing, material, and cost constraints. Finally, CAD data is generated for an ideal production-ready design.

With funding from A/SP members as well as the U.S. Department of Energy, two A/SP engineers and five from ETA started work. The vehicle package was adapted for both conventional diesel and hydrogen fuel cell powertrains and in 2007, the team realized a mass reduction of 30 percent when compared with a typical passenger compartment of the same vehicle class. The team beat the goal by five percent while maintaining the required structural parameters for stiffness and durability, and improved the vehicle's crashworthiness. The final optimized design was proven by a series of studies demonstrating the design's ability to accommodate variations in vehicle curb weight and impact barrier height.

Phase 2 Enabled by HPC, Other Gains

Because of that success story, the development continued. This time, Farahani had further advances in sophisticated advanced CAD/CAE (modeling and analytical) software, newer advanced high-strength steel, and gains in high-performance computing (HPC) at his disposal.

"Our challenge was to, first, make the process faster, quicker, and better," says Farahani, "and to further reduce the mass while keeping safety and performance intact." Engineers were aided in this second phase of the FGPC project by a 64-CPU HPC cluster using hardware from HP and SGI to crunch numbers.

A U.S. OEM was selected to donate a 2008 model year luxury vehicle and a target of reducing its mass by 20 percent became the next goal.

"Every six months or so, we made an improvement," says Farahani. Along the way, he added, automation was added to the process as a result of newly developed tools. "Recently, we felt it was the right time to announce the process and how it could impact product development."

The FGPC Phase 2 achieved a mass reduction of 15 percent to 20 percent via the ACP process. "It's a significant reduction in product mass and cost," says Farahani.

Fuel Efficiency Gained

While lighter weight clearly results in better fuel efficiency, actual gains will vary depending on tires, transmission, and the powertrain. But according to figures attributed to a study by MIT's Laboratory for Energy and the Environment, a mass reduction of 10 percent results in fuel-consumption savings between 4.5 to 8 percent.[1] Another study found that when the same mass

reduction occurs in a conventional vehicle with no change in powertrain, fuel savings range between 1.9 and 3.2 percent, but when the powertrain is resized, the savings improve to between 6 and 8 percent.[2] Yet that can be improved upon when one considers the ability to incorporate smaller, more fuel-efficient engines.

According to ETA, the program also proved that advanced joining technology (laser-weld or adhesive bonding) could further reduce the mass of a passenger compartment.

Using ACP to drive the project proved that at the same time CAE and CAD designs change, maximum mass reduction is possible while design robustness and efficiency can be significantly improved. It also showed that system or subsystem components can be reduced to improve manufacturing efficiency. Taken together, the reductions in parts and mass translate to reductions in product development costs that range between 35 and 40 percent. Finally, though the FGPC project focused on a steel product, the ACP process is applicable to numerous structural materials.

Hardware Makes it Happen

"If I were to have presented this five years ago, people would have laughed at me…," says Farahani, explaining there were four "wings" to the process. "Software is getting smarter and better, new tools are becoming available, there are advanced materials, and then hardware. Hardware is absolutely the base ingredient of this process."

In December 2009, ETA was chosen as the winner of the 2nd Annual SAE (Society of Automotive Engineers) Detroit Section/MITEF Vehicle Innovation Competition for the ACP process. Farahani says that ETA is currently working on refining a new product, trying to make it "more automated, cleaner, and faster."

In the meantime, the ACP process is being offered as an engineering service, and just might become the tool needed to optimize the high-efficiency car of the future. ■

Jonathan Gourlay *is the senior content manager at Desktop Engineering and for deskeng.com. Send comments to DE-Editors@deskeng.com.*

1. Cheah, L. et al. (2007). Factor of Two: Halving the Fuel Consumption of New US Automobiles by 2035. MIT LFEE 2007-04.

2. Forschungsgesellschaft Kraftfahrwesen mbH Aachen (fka). Determination of Weight Elasticity of Fuel Economy for Conventional ICE Vehicles,Hybrid Vehicles and Fuel Cell Vehicles. www.worldautosteel.org/uploaded/FkaReportWeightElasticityStudy-062107FINAL.pdf

FOR MORE INFO:

- > Chrysler
- > ETA
- > Ford
- > GM
- > HP
- > Livermore Software Technology
- > Red Cedar Technology
- > SFE GmbH
- > ULSAB-AVC

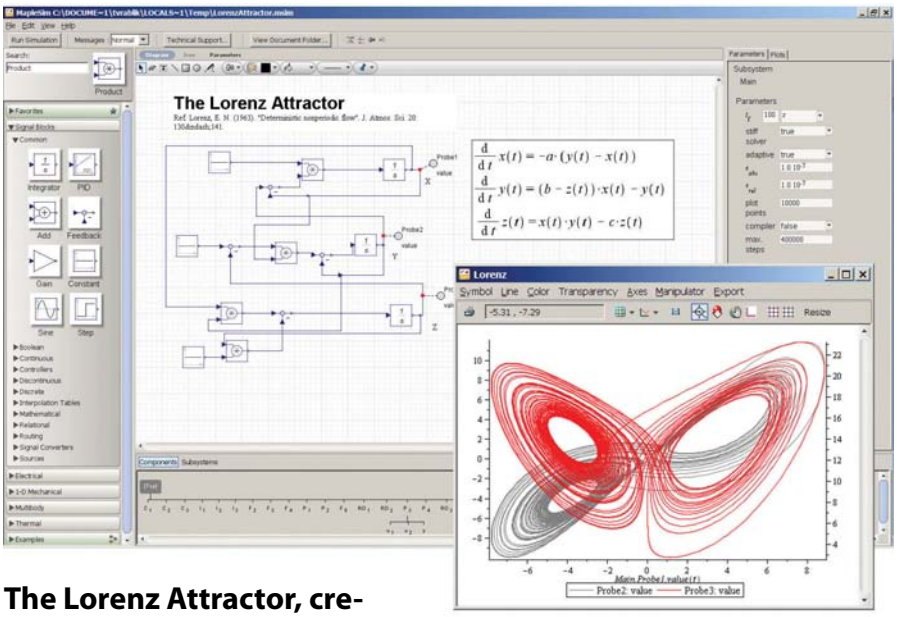
The online version of this story includes AVIs of the simulations and links to the reference studies. For more information on this topic, please visit deskeng.com.

By Peter Varhol

Maple 13, MapleSim 3 Boost Design Process

> Maplesoft builds on its legendary symbolic math engine to deliver comprehensive engineering simulations.

If a lot of your engineering work involves solving sets of equations involving calculus, differential equations, Laplace transforms, Fast Fourier transforms, and the like, you probably use one of the symbolic mathematics engines available on the market. One of the first of these, Maple, came out of the University of Waterloo in Canada. Today, in its 13th major release, Maple remains a standard for working with symbolic, as opposed to numeric, equations.



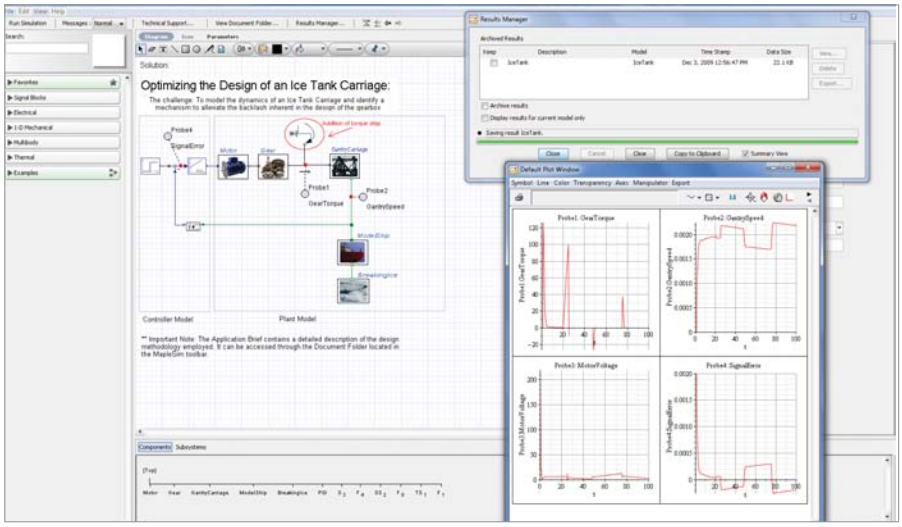
The Lorenz Attractor, created with MapleSim's signal blocks, is used for modeling chaotic systems such as climate or weather prediction.

Further, Maple 13 works with an intriguing modeling and simulation tool, MapleSim 3. MapleSim provides a drag-and-drop block-diagram modeling environment that enables engineers to build a simulation manually or using equations from Maple. It includes templates for control analysis, creating custom components from mathematical equations, generating data sets, equation generation and manipulation, optimization, Monte-Carlo Simulation, and sensitivity analysis.

I installed Maple 13 and the new MapleSim 3 on an HP mid-range Z600 workstation with dual 64-bit Intel cores running at 2.8GHz with 12GB of memory. This fast system ran both Maple and MapleSim well, with even complex calculations completed and displayed within a second or two.

Maple 13: Analytical Foundation

To call Maple 13 a symbolic math engine only describes part of the story. You can do symbolic calculations; that is, calculations with variables rather than numeric values. But you can also create complex 2D and 3D graphs of those equations, modify the graphs by changing the equations, and animate the graphs. Further, you can create custom "fly-throughs" of these animations, giving you a continuous view as you traverse the graph from one end to the other.



MapleSim enables engineers to create a mechanical design based on calculations from Maple, then execute the design to simulate how it might work once manufactured.

If you want to create formal documentation of your analysis, Maple provides tools that enable you to clean up your calculations and results, and render them in a format for others to read. You can document designs, the analyses that went in to optimizing those designs, and have unambiguous records of them so they can be modified or enhanced in the future.

Maple includes a large set of pre-defined functions and components, as well as the ability to complete many standard equations. It also provides graphical controls to build rudimentary user interfaces on analyses so others can run them, even using different input values. You can also animate the analysis by creating the equations and entering starting values for the variables.

MapleSim 3 Adds Modeling

MapleSim 3 works with the Maple symbolic math engine to take the results of analyses and create a functional and working model from the equations. Further, you can simulate the operation of these models, both examining the model visually and producing data that can then be evaluated separately.

You can create abstract or realistic models. The block diagrams used by MapleSim can create abstract linear, nonlinear, discrete-time, or continuous-time models. By wiring together components, you can create a flow of data that simulates the passing of information and control from one component to the next. These components can use standard engineering or mathematical functions, or be based on symbolic equations.

More realistic models can be created using drawings or images of the system or subsystem being modeled with the mathematical functions within the diagram. The model can be purely functional or it can be as realistic in appearance as you want to make it. By connecting each of the subsystems or

components with lines on the worksheet, you can indicate the flow of data between the components.

You can then execute these models in a simulation, showing how they might function. Further, you can also collect data to evaluate them. These models are functional representations of the system or product being designed. Each component in a model provides a number of parameters that you can set as initial values, as well as how those values might change over time or in response to changes in other parameters.

To run the simulation, you can set up specific input parameters, use real-life data from measurements, or apply MapleSim's random number generator. If you are doing sensitivity testing of your model, you may want to apply all three and see how it behaves under different circumstances.

You can also build visual representations of your designs. You can generate 2D and 3D plots, and import CAD models to make the simulations more lifelike. Components within models can even be shown in motion during the simulation run, if of course the system being modeled has moving parts. This enables engineers to observe motion to make sure it conforms to what is expected under the range of execution of the simulation.

Roundtrip to Maple

Once you have created a model in MapleSim and run the necessary set of simulations, you can go back to Maple for analysis and documentation. For example, you can run a simulation and take the results to Maple to see how well the results fit the equations that helped create it. By using Maple's documentation tools, you can make sure that your model includes the documentation necessary to justify the design as well as ensure that engineers in the future understand and can make modifications to it.

A real strength of MapleSim is multibody dynamics and simulation. These are mechanical systems with frames that are connected to other bodies via beams or other flexible structures. Automobiles and other vehicles are typical examples; in fact, Maplesoft tells me that the automotive industry is the largest user of the product. The beams, joints, and other components respond to forces that are defined by equations and input values.

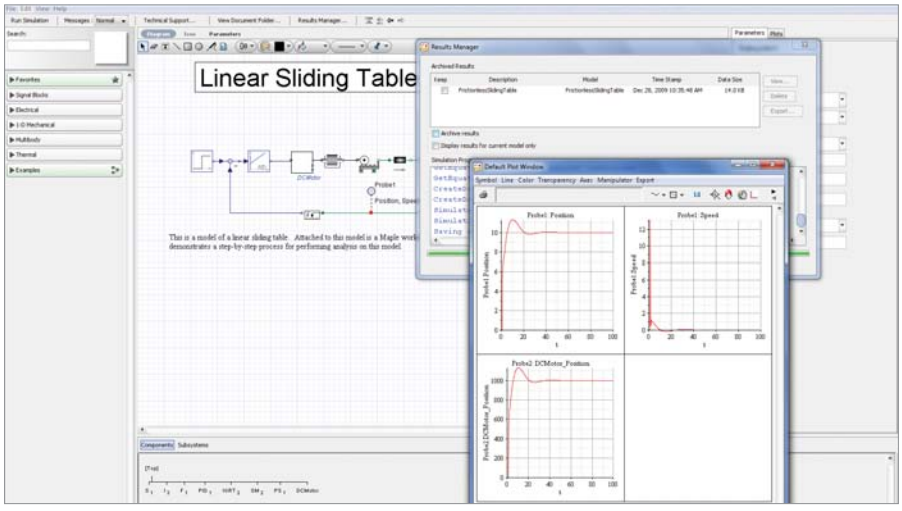
You can use your components, as well as those provided by MapleSim, to create custom libraries of subsystems that you commonly use. This lets you simply pick and choose from your own library to create modifications and enhancements to existing designs. You can also use one or more of the templates to quick-start any analysis.

Last, MapleSim can generate C code for its models, making it possible to more easily move from model to implementation if the implementation has a software component. This is especially appropriate for real-time systems design, because the tight performance requirements of such systems can be modeled successfully, and the resulting code reflects that model. From a software standpoint, at least, engineers could go directly from simulation to implementation.

MapleSim 3 Adds Ease of Use

The additional features in the new MapleSim 3 add to the ease of use of the simulation environment. MapleSim 3 incorporates a project manager

that enables an engineer to keep track of the progress and various pieces of a simulation project. In addition, it provides a way to nest models, so that complex models can be more easily developed and viewed. Nesting also makes navigating through the model easier and more straightforward. The help system was also improved, including the use of "tool tips," short instructions on the use of a feature displayed when you hover over its icon.



MapleSim can be used to model movement, such as the friction generated by sliding along a linear surface.

One of the most powerful features of MapleSim is its ability to run a simulation as a part of a "hardware in the loop" prototype. In this configuration, you can have a device generate inputs to a simulation similar to what it might receive as a real product, and collect data on how the simulation performs. For design engineers this can save the time and expense of building a system prototype to do the same kind of analysis.

Maple 13 and MapleSim 3 form a powerful combination of analysis, modeling, and simulation tools that can aid engineers with front-end work leading to optimal designs. The only caveat is that it is a complex software suite. MapleSoft does a good job of enabling scientists and engineers to be productive very quickly, but it still comes with a learning curve. You can use it for years and continue to discover new capabilities. However, thanks to a broad array of examples, tutorials, pre-defined equations, and other features, technical professionals should be able to make use of it immediately and expand their skill sets as they use it. You do not need experience in formal mathematical analyses to find its value.

Virtually all design engineers can benefit from this environment, but it is especially appropriate for those of you who have a mathematical bent and use formal equations in your initial analysis and design work. Maple and MapleSim can take you from concept exploration almost to the production line in a significantly shorter period of time than any manual method. And that alone makes these products worth their weight in gold.

*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.*

FOR MORE INFO:

> Maplesoft

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

ZWSOFT Announces Fastest ZWCAD Ever: 2010

>**ZWCAD Software Co., Ltd.**, a supplier of CAD platforms, announced the release of ZWCAD 2010, along with its second annual design contest, ZWCAD Design Contest 2010.

Now available in 14 languages and compatible with Windows 7, ZWCAD 2010 assures users of faster speed through memory optimization, new features (In-Place MTEXT Editor and Splinedit), and enhanced application programming interfaces.

Stratasys Expands its 3D Printer Product Line

> **Stratasys** has expanded the Dimension uPrint product line with the uPrint Plus, an enhanced version with new features, while keeping the price under $20,000.

Like the Dimension uPrint personal 3D printer (dimensionprinting.com), the uPrint Plus has a small footprint for desktop use. It measures 25 x 26 in. The uPrint Plus can print in eight colors of Stratasys' ABSplus material. The uPrint Plus material colors include red, blue, olive, black, dark gray, nectarine, fluorescent yellow, and ivory. The printer has a build envelope of 8 x 8 x 6 in., which is 33 percent more volume than the uPrint and allows for larger models. The new printer offers two resolution settings—0.010 in. and 0.013 in.—to give users additional print options.

SpaceClaim 2009+ Engineering Software Released

Precise multi-touch 3D modeler enhances model preparation for simulation.

> **SpaceClaim** has announced the fifth release of the company's engineering software, SpaceClaim 2009+. This new version of SpaceClaim supports Windows 7 and Multi-Touch for 3D direct modeling. Other new 2009+ capabilities are aimed at driving ease of use in preparing models for simulation.

SpaceClaim 2009+, says the company, puts modeling tools in the hands of engineers and CAE analysts. With SpaceClaim, engineers are said to be able to perform simulation, collaborate, and converge before specifying the design concept to the CAD team for detailing and design-for-manufacture. Additionally, SpaceClaim provides CAE engineers with a solution to easily prepare, edit, and optimize CAD data, according to the company.

2009 was a remarkable year for SpaceClaim, according to Chris Randles, SpaceClaim President and CEO. "Our rapid growth this year demonstrates that we are solving real, complex, and costly engineering challenges, such as accelerating the development of concept models, or speeding model preparation for upfront or downstream analysis and simulation," added Randles in a press statement. "On average, our customers report a halving of the time taken to prepare models for CAE, enabling them to be more productive and accelerating overall time-to-market."

SpaceClaim 2009+ received the most visitors in the month of January.

InspectionXpert Brings Inspection Capabilities to Pro/ENGINEER

> **Extensible CAD Technologies** has released InspectionXpert for Pro/ENGINEER, an inspection report automation and ballooning solution that works within the Pro/ENGINEER interface. It allows users to automatically generate inspection report forms and ballooned inspection drawings.

InspectionXpert for Pro/ENGINEER comes standard with tools to eliminate manual tasks associated with in-process inspection in industries such as medical devices, aerospace, oil and gas, and automotive.

The software allows users to generate ballooned inspection drawings from dimension characteristics in Pro/ENGINEER models and drawings. It comes standard with AS9102 and PPAP inspection report formats.

SYCODE CATIA V4 and V5 File Export Plug-ins for AutoCAD and SolidWorks

> **SYCODE** has released CATIA V4 and V5 file export plug-ins for AutoCAD and SolidWorks. These plug-ins give AutoCAD and SolidWorks the ability to export 3D solid data in AutoCAD and SolidWorks to CATIA V4 and V5 files without the need of a CATIA license.

The AutoCAD plug-ins have been tested to work with AutoCAD 2000 through to 2010, 32-bit as well as 64-bit versions. The SolidWorks add-ins have been tested to work with the 32-bit as well as the 64-bit versions of SolidWorks 2001 through to 2010.

Fishbowl Solutions' Bulk Loading for PDMLink Supports Flat File Docs

> **Fishbowl Solutions** has announced support for flat file documents, such as PDF, Microsoft Word, Excel or PowerPoint, with its linkLoader for Windchill PDMLink solution.

PTC offers a Windchill Data Loader that is used during a Windchill PDMLink implementation for tasks such as loading users, groups, attributes, and more. It can also be used as a bulk loading tool for documents.

Fishbowl's linkLoader for Documents has a user interface designed to simplify the mapping of files associated to documents during the bulk load process. linkLoader for Documents can run from any computer on the network, allowing system administrators to share the loading responsibility with business owners who understand the migration objectives.

In addition to documents, linkLoader also supports PTC Pro/ENGINEER, SolidWorks, AutoCAD, and Autodesk Inventor data.

Simpoe to Integrate Datakit's CrossCad Ware into Simpoe-Mold

>**Simpoe**, a plastic injection simulation software developer, will integrate Datakit's CrossCad Ware technology in its flagship product, Simpoe-Mold.

Simpoe's software can be used to determine the manufacturability of a part before production, saving the costs of mold prototypes. The software can also be used as a marketing tool, enabling interactive demonstration when the performance of a product has to be shown to a customer.

To keep Simpoe-Mold's ease of use, Datakit's CrossCad Ware technology was chosen to be integrated. This way, the conversion is transparent to the end-user. Native CATIA V5 files can be processed directly by Simpoe-Mold.

Siemens Launches Tecnomatix 9.1 Digital Manufacturing Software

>**Siemens PLM Software** has released Tecnomatix 9.1, which includes new planning workflows and several new and enhanced capabilities. Its improved integration with Teamcenter means that many Tecnomatix capabilities can be launched and/or controlled using the Teamcenter environment.

Tecnomatix 9.1 highlights include:

• Automotive body-in-white (BIW) planning on Teamcenter with drag-and-drop capability from a list to assign weld points to parts.

• Simulate directly from Teamcenter to assign weld points to operations and relevant robots within a 3D environment based on the open JT format. Find the correct weld guns and optimize the positions of the relevant robots.

• Define measurement features, as required, from dimensions to pressure, voltage, torque, speed, to virtually any other shop floor measurement.

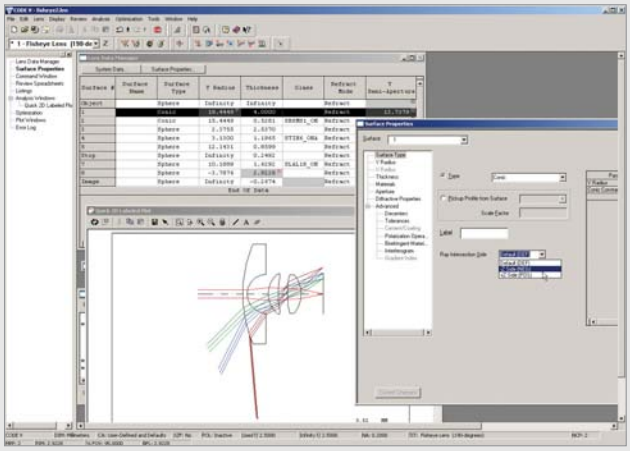
OMEGA Releases New Thermal Flow Switches

>The **OMEGA Engineering** FSW-420/30 series of thermal flow switches has no moving parts. They are designed to monitor relative flow rate for applications where the actual flow rate is not important.

This CE-compliant product features automatic scaling and set-point with pushbutton re-scaling. They are well-suited to industries involving flow and temperature control or alarm, and applications involving automation and process cooling.

Prices for the FSW-420/30 series start at $295.

Optical Research Associates' CODE V 10.2 Delivers Designed to Enhance Ease of Use



>CODE V 10.2, the newest release of the optical design software from **Optical Research Associates** (ORA), delivers a number of enhancements designed to simplify its use and provide greater flexibility.

CODE V 10.2 introduces improved ray tracing algorithms that the company says increase robustness when designing optical systems with extreme aspheres, hyper-hemispherical fields of view (fisheye lenses), and highly tilted components. Custom macro writing has also been simplified in CODE V 10.2 to allow users to specify an external program as the default text editor.

Roland and MecSoft Demonstrate Design-to-Model Workflow

> **Roland DGA Corporation** and **MecSoft**, the developer of VisualMILL for SolidWorks and other CAM software solutions, demonstrated a new, seamless subtractive rapid prototyping (SRP) workflow at SolidWorks World (solidworks.com) in Anaheim, CA.

MecSoft showcased its new 64-bit version of VisualMILL for SolidWorks, which it says enables designers to machine larger, more complex parts that were previously cumbersome or impossible to handle due to the memory limitations of 32-bit systems. Throughout the show, MecSoft produced prototypes and parts on Roland's MDX-40A 3D milling machine, which features the company's SRP technology. ■

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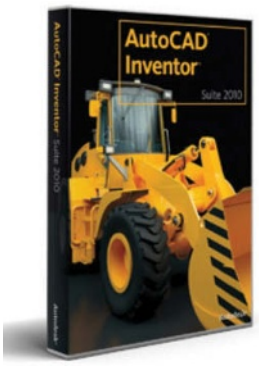

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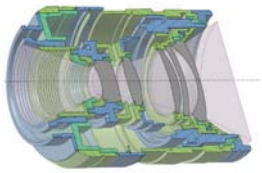

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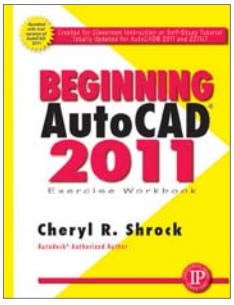

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The Growing Need for Multiple CAD Access in ERP

VINAY WAGLE
CCE

In order to enable customers to sustain the rapid pace of product development, enterprise resource planning (ERP) software providers must link to the 3D CAD data—the model's product master—seamlessly, and in real time.

Most ERP companies use "connector" software that runs as a plug-in to CAD systems, extracting product information from a CAD database and providing it to the ERP system via message-based (ERP API) or file-based (XML) mechanisms. This requires the process to be initiated from the CAD side rather than from the ERP end, thus running the risk of the ERP system being out of sync with the CAD data as the "connector" process is manual and static in nature.

ERP companies are also at the mercy of the CAD software companies who provide access to CAD APIs for development of the connector software. And as CAD companies evolve into product lifecycle management (PLM) technology providers, they will become increasingly averse to licensing their APIs to the ERP providers. The considerable overlap between PLM and ERP functions in the engineering environment makes competitors of the two.

> Seamless connectivity between CAD and ERP is crucial for success.

Finally, the proliferation of CAD technology providers, each with a unique database and corresponding API, means that ERP companies are forced to develop multiple CAD connectors, using expensive royalty-based APIs, to remain competitive.

For these reasons, ERP companies must develop solutions that are independent of CAD APIs to enable access to CAD data from multiple systems. Such a solution would consist of a single API (C++) or dynamic

web-services that can be quickly integrated into any ERP system to provide access to data from multiple CAD systems without requiring any licenses. And it would be essential that popular formats like CATIA, NX, SolidWorks, Solid Edge, Pro/ENGINEER, and Inventor are supported.

CCE's Oceans SDK does this. The CAD-independent technology allows easy integration of 3D CAD data assets in enterprise applications, providing a single, non-royalty based solution to provide dynamic access to product data from all major CAD systems. This ability permitting dynamic access to CAD data on a "when needed, where needed" basis throughout the company gives enterprise application vendors a significant competitive advantage.

Based on market needs, ERP vendors would need to decide the depth of integration they want to achieve with CAD. Simpler integrations might mean the ERP system manages only critical data such as part name, number, and description while the CAD data access tool provides a real-time connection to other CAD data.

In deeper integrations, ERP systems could leverage the complete functionality of the CAD data access tool to actively manage the CAD data, leading to reliable synchronization between engineering and manufacturing data management (reminiscent of PLM systems).

A globally competitive marketplace that demands manufacturing companies deal with complex products, shrinking development times, and lean resources also points up the need for a synchronized workflow from design and engineering through manufacturing and delivery. Real-time visibility is critical to making time-sensitive decisions on procurement from the extended supply chain. Seamless connectivity between the design tool (CAD) and the resource-management tool (ERP) is thus crucial for an enterprise's long-term success, especially with regard to small to mid-size businesses in the supply chain. Tools that help reduce complexity and cost when interfacing with multiple CAD formats from customers help win new business and grow profitably. ■

Seamless connectivity between the design tool (CAD) and the resource-management tool (ERP) is thus crucial for an enterprise's long-term success, especially with regard to small to mid-size businesses in the supply chain.

Vinay Wagle *is VP of sales and marketing at CCE (cadcam-e.com). He founded Compunix in 1989, which was merged with Cimsoftek to create CCE in 2000. Send feedback about this commentary to DE-Editors@deskeng.com.*

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