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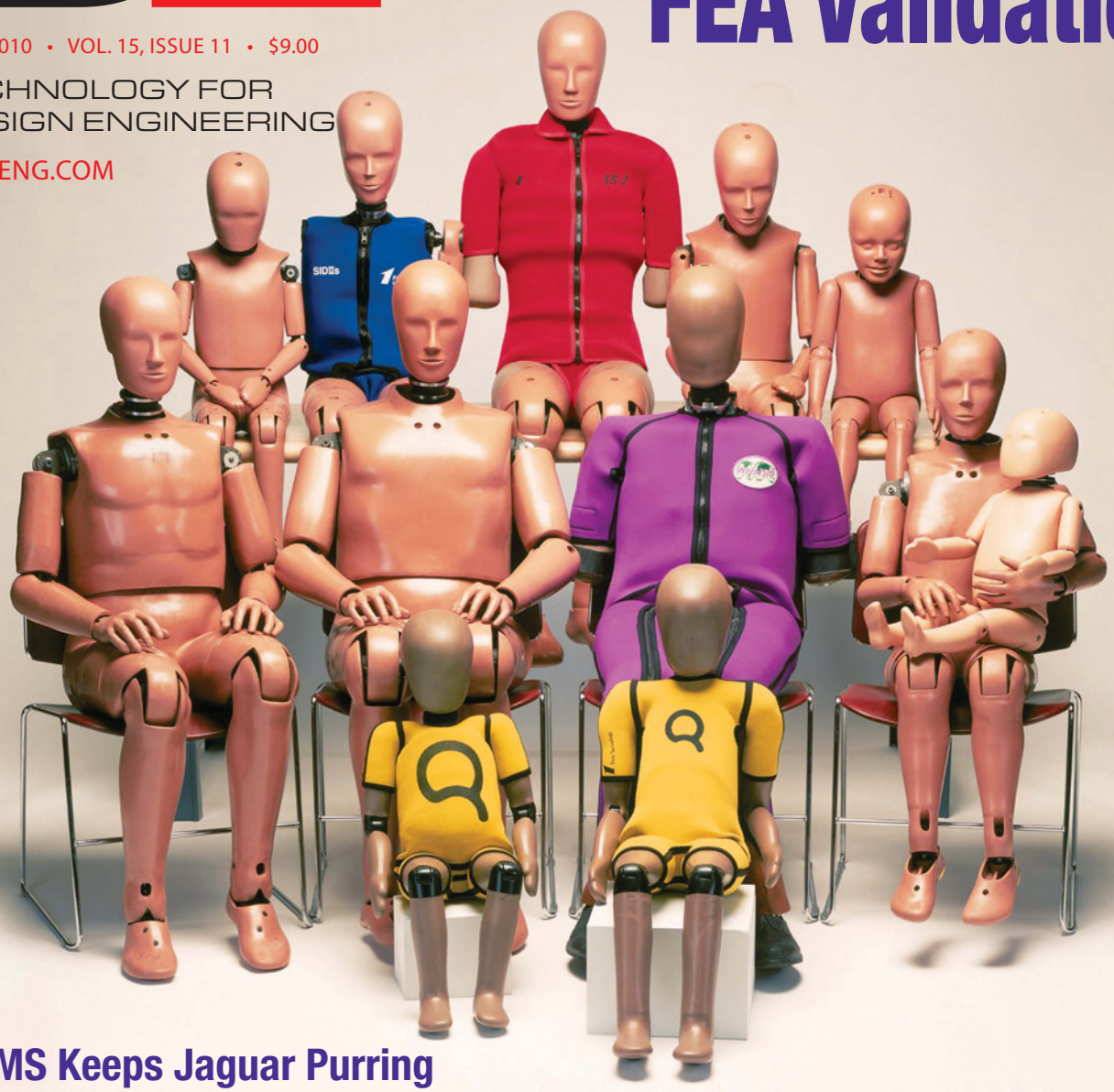

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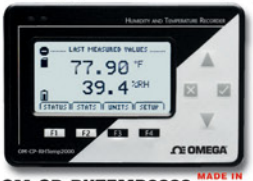

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Are You Ready for the Petrabyte Revolution?

STEVE ROBBINS
steverobbins@deskeng.com

Sometimes it seems like I spend all day on the phone. This makes sense because DE is a nexus for companies that develop engineering products and services and the engineers who want to learn about new ideas and products that will help them in their jobs.

Through all this information and noise, every once in a while something clicks and an aha moment—an epiphany, really—occurs.

I was recently on a call set up by ANSYS, listening to Professor Piero Dellino of the University of Bari, Italy, explain how he had used ANSYS FLUENT to simulate volcanic eruptions and the particle clouds they create. Through experimentation he has defined what volcanic ash is, how it moves, and the particle size and concentration of an ash eruption. He said that most volcanic material is glass and some of it, which can remain suspended in the atmosphere for a long time, is very fine and shaped irregularly. ANSYS software can simulate the gas and particulate matter from an eruption as well as the distribution of the ash cloud using discrete phase modeling, resulting—as you might have guessed—in a very large data set.

> We could change the way we model ideas and the way the world behaves.

On to the next call: Microsoft's Bill Hilf, general manager of Platform Strategy, briefed members of our editorial staff on Microsoft's Technical Computing initiative. I had just reviewed, "Modeling the World," on Microsoft's website.

Microsoft is leading this initiative to empower engineers and scientists with the tools to create large-scale computer models that can create simulations of complex systems. Changes in computer technologies will drive this revolution. Our conversation focused around technical computing on the cloud, simplifying parallel development, and the tools and applications that will be enabled from these changes. Engineers in the near future could work together to build common platforms that

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would scale to the resources needed, including very large-scale multicore clusters that are not available today. The power to tackle the biggest problems, analyzing data without preconceived models, and finding patterns that create the solutions would become available to researchers from companies or academia, large or small. As Bill explained Microsoft's vision of this initiative, the proverbial light bulb went off.

Scientists and engineers are creating massive amounts of data, some intentionally, and some through experiments, tests, and sensors. Data is being recorded from almost every aircraft in service today, from satellites, environmental monitors, from sources we don't even think about. Machines are creating data just for other machines. If scientists, engineers, or even financial analysts have access to very large amounts of data and the computer power to let statistical algorithms find patterns, we could change the way we model our ideas and the way the world behaves.

I wondered if Professor Dellino could improve the chances for predictive behavior of volcanic ash clouds if he incorporated real time-weather data. If the data from his model of eruption particle behavior was public, it isn't a stretch that aerospace engineers around the world could use it to design aircraft engines to withstand the effects of the glass particles in volcanic ash or predict what concentrations of ash are safe for the engine to fly through.

Can engineers and scientists make data public in today's world, with competitive pressures and intellectual property concerns? How does the technical community address the issues of sharing data? Would your client or company allow test results or analysis data to be made public? Are you ready for the petrabyte revolution? Let me know what you think. ■

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

EDITORIAL

Steve Robbins — Executive Editor
Jonathan Gourlay — Senior Content Manager
Anthony J. Lockwood — Editor at Large
Margaret S. Gurney — Copy Editor

CONTRIBUTING EDITORS

Mark Clarkson • David S. Cohn • Al Dean
Mike Hudspeth • Tom Kevan • Susan Smith
Peter Varhol • Pamela J. Waterman • Kenneth Wong

PUBLISHER

Brian Vaillancourt (x263)

ADVERTISING SALES

603-563-1631 • Fax 603-563-8192
Brian Vaillancourt — Publisher (x263)
Jeanne DuVal — Account Manager (x274)

ART DEPARTMENT

Darlene Sweeney — Art & Production Director (x257)

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Steve Robbins — Chief Executive Officer
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ADVERTISING, BUSINESS, AND EDITORIAL OFFICES

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603-563-1631 • Fax 603-563-8192
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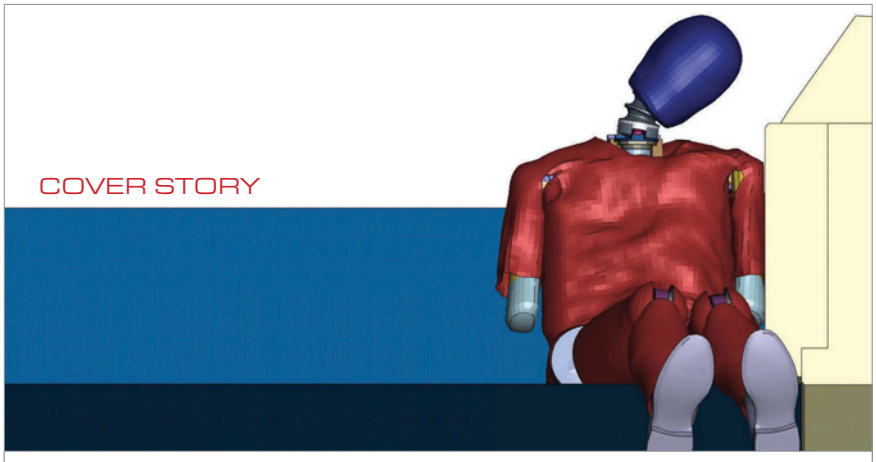
"Home computers are being called upon to perform many new functions, including the consumption of homework formerly eaten by the dog."

> Doug Larson



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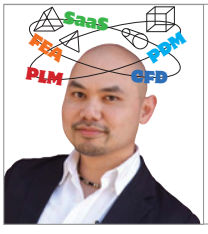

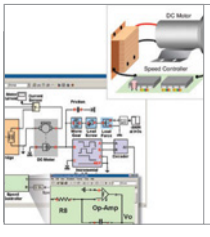

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ON THE COVER >

A typical crash-test dummy family used to assess the effects of automobile collisions on different genders and ages. SIMULIA uses SLM and Isight software to qualify the results of these tests across different versions of Abaqus FEA models. Read the article by Lynn Manning beginning on page32.

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A Current View to Foretell the Future

> CIMdata examines the latest China syndrome, Heppelmann's bullish outlook for PTC, projects Centaur, Cumulus, and Krypton, and Sustainability Express.

KENNETH WONG
kennethwongsf@earthlink.net

Pick up anything—anything lying around you. There's a pretty good chance the label reads "Made in China." From the workstation on your table to the sunglasses perched on your nose, most products manufactured today must pass through the Dragon's heartland at some stage in their lifecycles.

Recently, CIMdata, which publishes annual reports on the product lifecycle management (PLM) market, turned its gaze towards the Great Wall of China. What the analysts discovered was a market that managed to grow despite a bruised global economy. In its China PLM Report, published in April, CIMdata noted, "The global economy was in a major recession during 2009. However, with the heavy investment in infrastructure and the growing needs of its domestic market, the GDP (gross domestic productivity) of the People's Republic of China still grew 8.7%."

In this report, CIMdata analysts tallied up revenues from sales of mechanical computer-aided design (MCAD), simulation and analysis, collaborative product definition management (cPDm), numerical control (NC), computer-aided manufacturing (CAM), and digital manufacturing.

"In China, PLM has been widely applied in large discrete manufacturers, particularly aerospace and defense, automotive, and high-tech companies," the report stated. "[While] still small, PLM investments within China are growing rapidly. Growth was sustained in spite of the global economic downturn in 2009. In 2009, the China PLM market grew 6.2%. The growth rate of the China PLM market is forecasted to be 12% in 2010." By contrast, global PLM market is expected to grow only by a single digit in percentage, according to CIMdata.

Ken Amann, CIMdata's research director, explains the secret behind China's resilience. "The real driver for China's growth," he noted, "is in fact its government, which continued to spend money and develop programs around infrastructure and energy. For instance, they're bringing online

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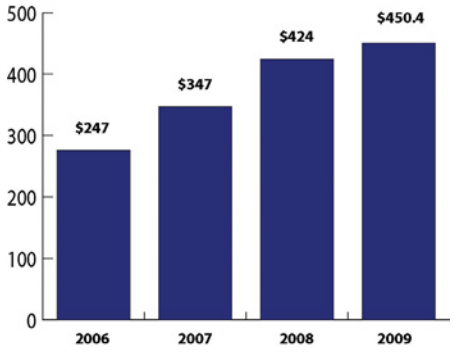
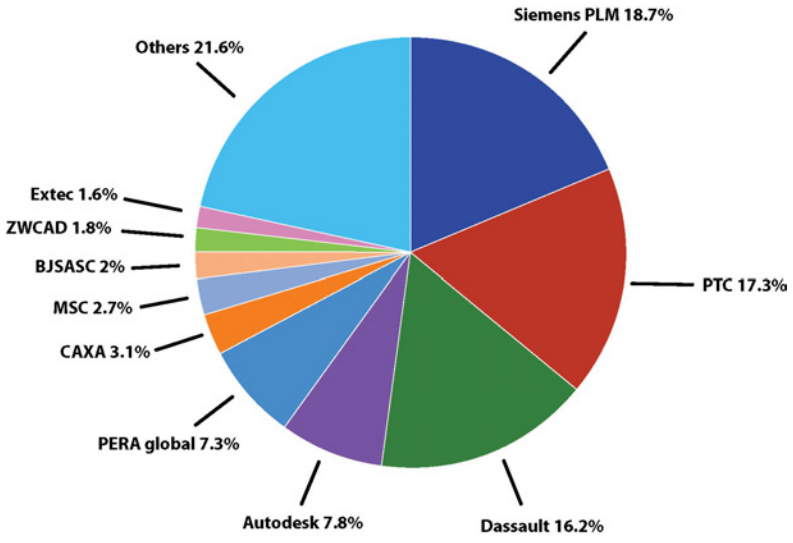


▲ **Growth of China's mainstream PLM market, 2006 through 2009 (measured in U.S. $ millions). Graph created from data in CIMdata's China PLM report, April 2010.**



▲ **Who's grabbing market shares in China? Here's the breakdown, according to CIMdata's China PLM report.**

five nuclear plants a year, from now through the next decade … they're investing in shipbuilding, continue to put money in aerospace and defense …"

According to CIMdata, combined market shares of PTC, Dassaual , and Siemens PLM Software account for nearly 52% of China's PLM market. "All three have been active in China's PLM market for several years," noted Amann. "Depending on the industry, one or the other of those three is generally the leader of the market, but no one is a leader in every area inside China."

But these international PLM merchants can't rest easy, as a new rival may be emerging from the East. "China-based PLM companies are going to be competitive in that market," observed Amann. "They understand the culture better. They'll develop the product and solutions to fit the culture and the country."

Click here to listen to the recorded interview "PLM Behind the Great Wall of China".

Anticipating Double-Digit Growth at PTC

Jim Heppelmann will be ordering new business cards. His current one reads Chief Operating Officer, PTC. Come October, he'll need one that reads Chief Executive Officer. That's when he'll officially succeed the company's current CEO Dick Harrison, who will become PTC's executive chairman.

Growing up on his parents' dairy farm, Heppelmann tinkered with equipment that had a tendency to break down and observed their mechanical lifecycle. Perhaps that was a preview of what he would later do at PTC: develop engineering software and product lifecycle management (PLM) technologies. Just as he prepares to take the helm, latest figures from industry watcher CIMdata foretells a lackluster period for PLM, a decline of 12% in 2009. Nevertheless, Heppelmann is convinced he can shepherd PTC into bullish, double-digit growth.

In 2008, after PTC acquired CoCreate (a direct modeling company), Heppelmann told reporters, "Are we going to merge Pro/E and CoCreate . . . ? No . . . That's like merging a race car and a SUV. What you end up with is an ugly, slow, funky looking hybrid that doesn't work well on the road, off the road, and won't win races." Yet, the most recent release of PTC's premiere CAD program Pro/ENGINEER shows push-pull modeling methods commonly associated with direct modelers like CoCreate. So has the time come for Heppelmann to eat his own words and celebrate the birth of hybrid CAD?

On the eve of his promotion, he revisited the topic. "If you want a schematic, a napkin drawing, 2D is best," he said. "If you want a quick concept without a lot of formality, and you want the software to be as simple as possible, then I think you're talking about a direct modeling approach. On the other hand, if you want to build a very sophisticated product design, and you want to use design automation techniques, parametric modeling is the best. These [methods] all have strength in their pure configurations.

"But we're starting to see at the boundaries some pretty interesting blends.... In the old days, I really had to understand the design intent that's baked into the model before I dare change it. Now I really have the option to do a flexible move, if you will—a quick little direct edit.... I don't think you're going to see the pure forms of these technologies morphing into a single technology. It would be interesting to have a product that lets you work in different modes, and allow some users to work in hybrid mode."

Despite a decline reported in mainstream PLM revenues (according to CIMdata's PLM Report for 2009), Heppelmann is anticipating double-digit growth for PTC. "I plan to see PTC's PLM revenue grow in the 20% plus rate," he said. "We're growing two to three times faster than the industry. That's the trend that dates all the way back to 2004. So we don't really see ourselves losing momentum; we see ourselves gaining momentum in 2010. We're very bullish."

Click here to listen to the recorded interview.

Autodesk Unleashes a Trio of Tools

The cloud-computing land grab has already begun. In May, Autodesk galloped into unclaimed prairies with three new technology previews: Project Centaur, Project Cumulus, and Project Krypton. Centaur is currently in limited beta (by invitation only). It's a plug-in for Inventor users to perform design optimization in the cloud. This feature allows you to pick a design, specify materials, specify constraints (for example, holes A and B are connected to the rest of the assembly via pin joints), specify load conditions, specify variable parameters, then run an optimization session.

In return, you receive a number of proposed design iterations, with slight variations in safety factors, weight gains or weight losses, and percentages of weight changes. Usually, the most optimal design (identified by the software based on your specs) is presented at the top of the list, but you can view all iterations and pick the one you feel is the best.

An optimal design is usually one that meets your target safety factor, but with less material than you started off with. So you can conceivably use this approach to identify places where you can shave off materials without compromising strength, durability, or integrity. In the way it works, it closely resembles SolidWorks' design optimization, with

one big difference—in Autodesk's Project Centaur, number-crunching takes place in the cloud.

Similarly, you can use Cumulus to perform computing intensive meshing and solving operations in Moldflow Insight. You will set up your mold simulation scenarios on your local machine, but once you're ready to solve, you'll be tapping into Cumulus's web-hosted computing horsepower.

Like Cumulus, Krypton also draws on Autodesk Moldflow's material database and technology. Once installed in Autodesk Inventor, Krypton appears as three buttons, or indicators for the manufacturability, cost estimate, and environmental impact of your design. The feedback is instantaneous. As you design, it keeps track of the changes in your volume, thickness, and features.

If you add features with undercuts, for example, Krypton warns you that you'll increase the manufacturing cost. When you choose one material over another, Krypton lets you know you may be increasing costs and environmental impact. It won't give you unit cost or provide quotes, but it distinguishes materials as low-, very low-, and high-cost groups. It also alerts you of materials that have high or low recyclable rates.

Krypton is currently available for Autodesk Inventor 2010 and 2011, Inventor LT 2010 and 2011, and SolidWorks 2010. If you're a SolidWorks user, you may be familiar with SolidWorks Sustainability Xpress, the environmental impact analysis function that comes free of charge with the software. (The full version, SolidWorks Sustainability, requires license purchase.)

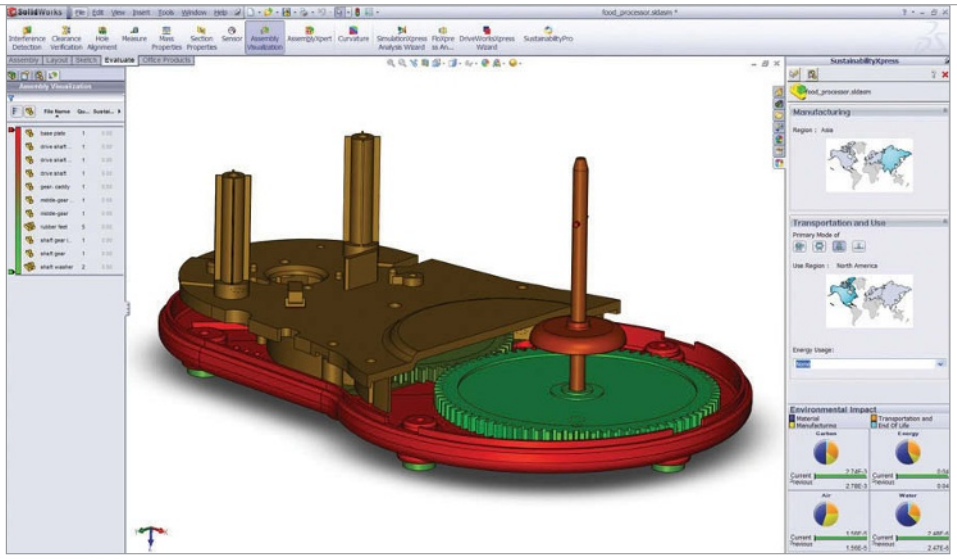
"We're certainly not positioning [Krypton] as the equivalent of the sustainability tools from SolidWorks," said Bob Willaims, an Autodesk product marketing manager. "While Krypton does include a component that indicates environmental impact, this is not meant to be our sustainability offering. It's a design guide for plastic parts."

A Look at SolidWorks Sustainability

To date, SolidWorks remains one of the few CAD companies offering a sustainable design development tool, built right into the modeling environment. If you're on the latest release of SolidWorks (2010), you can use Sustainability Xpress, the app under the Evaluation tab, to calculate your design's environmental impact. But the free Xpress version works only on parts. To work on assemblies, you need SolidWorks Sustainability, the full license that costs roughly $3,000.

With Sustainability Xpress, you can use your material specifications, manufacturing methods (injection molding, machining, etc.), raw material locations, and deployment destinations (where the end products will be used) to tally up your parts' environmental impact in four areas: carbon emission, energy use, air pollution, and water pollution. In the full version, in addition to the parameters listed above, you can also specify transportation mode (air, train, truck, and so on) and lifetime energy use (say, the anticipated energy used by a washing machine's average lifespan).

The advantage of the full version is the ability to visualize how each individual part contributes to the entire assembly's environmental impact. The color-coded visualization makes it easy to identify parts that cause the greatest harm, prompting you to switch material, production method, or something else to bring down the carbon count, energy use, and pollution levels. Furthermore, the ability to perform stress analysis and environmental assessment in the same window goes along way



SolidWorks Sustainability lets you visualize the environmental impact of your assembly components in color, making it easier to single out the biggest contributors.
Image courtesy SolidWorks Sustainability portal

to ensure that you don't inadvertently compromise your design's structural integrity while you're exploring ways reduce its carbon footprint.

The two quickest ways to reduce your design's impact are (1) reducing your design's overall mass and (2) switching to less harmful materials. For the latter, you can use SolidWorks Sustainability's Find Similar tool to single out alternative materials with comparable tensile strength, yield strength, and heat conductivity.

The results can be exported as a PDF report, a good way to present your findings or justify your engineering change orders to those who might not have SolidWorks. If you'd like to learn more about the results, you may visit SolidWorks' Sustainability portal, which has a free carbon footprint calculator. The browser-based app lets you compare your design's impact (measured in kg of CO2) to the effects of driving an average U.S., European, or hybrid car for a number of miles, adding more weight to your understanding of the assessment.

Life Cycle Assessment, or LCA, is an emerging science, still in its infancy. Currently, several prominent LCA methodologies compete for legitimacy and recognition. This is reflected in SolidWorks Sustainability FAQ, which states, "The values in SolidWorks Sustainability are useful to within +/- 20% and should be used as an estimate. The more accurate way of using the product is to track the relative changes from one version of a design to the next."

Both Sustainability and Sustainability Xpress are designed as a comparison tool—that is, to set up one scenario as your baseline, then compare it against other iterations. This method lets you pick the best materials, production methods, and acquisition regions to make your product greener.

Click here for a video demonstration. ■

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

FOR MORE INFO:

> Autodesk, Inc.
> CIMdata
> PTC
> SolidWorks

CIMdata President Ed Miller Dies

Ed Miller, president of CIMdata and a longtime advocate and visionary in the product lifecycle management (PLM) industry, died June 6, after a short illness. He was 61.

Miller was born on April 21, 1949 in Linton, Indiana. He attended Purdue University and graduated in 1971 with a bachelor's degree in electrical engineering. He was a member of Eta Kappa Nu and Tau Beta Pi engineering honoraries. He received a master's degree in engineering from The University of Michigan in 1973. Miller worked for the Burroughs Corporation and later joined Manufacturing Data Systems, Inc. (MDSI).

Miller joined CIMdata in 1985 and became a champion of the development and use of PLM. Starting with the inception of product data management (PDM), Miller worked with industrial companies around the world to help them learn the benefits that PDM, and later PLM, could deliver to their businesses. He helped them understand how to define their needs, select technologies and solutions, and implement those solutions effectively. He also worked with PLM suppliers to help them recognize industry's needs.

As CIMdata president, Miller focused on building the company's global brand, growing the company from a North American PDM management consulting and research firm to a globally recognized leader in the PLM market. Miller is credited with being instrumental in attracting and retaining some of the industry's best and brightest PLM professionals.

Miller authored numerous industry articles and was a frequent keynote speaker at PLM solution supplier and industrial events around the world. It is said his vision will continue to shape the industry for years to come.

Miller is survived by his wife Karen, his daughter Jana, his son Ryan, and his sister Barbara Reed. He will be sorely missed by his family as well as countless colleagues and friends around the world.

Notes and messages will be forwarded to Miller's family by CIMdata. Such notes can be sent to info@CIMdata.com.

FOR MORE INFO: > CIMdata

Padova Technologies Teams up with Bright Computing

Padova Technologies has partnered with Bright Computing to offer Bright Cluster Manager, a software product that is designed to make HPC Linux clusters of any size easy to use, manage and scale. Bright Cluster Manager is a Linux-based cluster management software solution designed to address the complexity of running clusters. Its graphical user interface offers access to management and monitoring functionality for cluster administrators. Its HPC user environment provides a range of HPC software development tools for the cluster users.

FOR MORE INFO:

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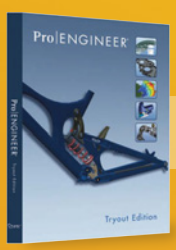
Jeffrey Nibbelink, Engineering Group Manager, Link Manufacturing, Ltd.

[I am Productive] Link® designs and builds suspension systems for the world's leading truck manufacturers. Pro/ENGINEER® helps us keep these relationships in the fast lane. We're an extension of our customers' engineering departments, sharing CAD files in real time for immediate feedback on our models.

[I am Proactive] Customer requirements often change throughout the design and development stages of a project. Pro/ENGINEER facilitates a fluid process, enabling our team to instantly modify suspensions for ever-evolving application needs.

[I am Progressive] Pro/ENGINEER keeps us miles ahead of the competition. We can visualize and design a new suspension before it's built. So our engineers can analyze and test the unit before it's installed. This dramatically reduces the development design cycle and keeps Link on the road to success.

PTC®



[Be a Pro/ENGINEER] Download a free 30-day, interactive trial at **PTC.com/go/tryout**

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Knovel Partners with ASM International to Enhance Engineering References

Knovel, a Web-based application integrating technical information with analytical and search tools, today announced a partnership with ASM International, The Materials Information Society. ASM publishes information on selection, properties, processing, and performance of materials ranging from metals and alloys through plastics and ceramics in handbook, dataset, and atlas forms. Knovel partners with more than 70 international professional societies and publishers to ensure engineers have access to technical content across 23 engineering subject areas. ASM's published content will be combined with Knovel's data search capabilities and interactive analysis tools. The combination of expanded materials information alongside best practice information on processing, design, and development, will enable engineers using Knovel to access more of the data they need and incorporate it into their work. "Partnering with Knovel means that ASM's leading knowledge base of materials data will reach even more engineers," says Stan Theobald, managing director of ASM International. "By combining our content with the interactive, personalized and optimized data search features provided by Knovel, engineers will be able to make better choices when selecting materials for their products and projects." "Our customers turn to Knovel for trusted materials information to reduce design time and make better choices," says Delores Meglio, vice president, publisher relations for Knovel. "It was clear to us that ASM was the ideal partner to help us expand our materials information offering. We're thrilled to be able to offer our customers Knovel's data search and analysis tools in conjunction with ASM's data rich content."

FOR MORE INFO:

> Knovel

Materialise Moving U.S. Headquarters to "Factory of the Future"

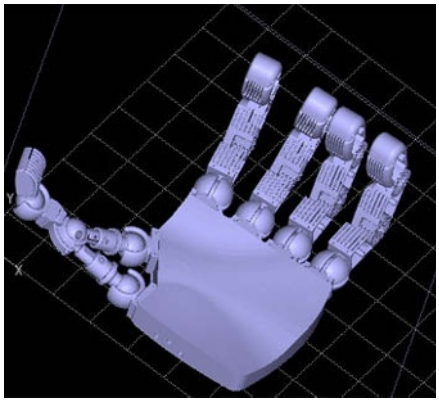
Materialise will begin medical production in Plymouth, MI, to meet the increasing needs of the orthopaedic industry. Materialise is celebrating 20 years of product development through its software and hardware infrastructure via additive manufacturing. At the new site, it will establish an additive manufacturing facility that will produce customized surgical guides. The Michigan Economic Development Corporation approved a tax credit for more than half of a million dollars over seven years to encourage Materialise to establish its facility in Michigan. The project is expected to create more than 200 new jobs, including 80 within Materialise.

FOR MORE INFO:

> Materialise

Winners Announced in Dimension 3D Printing Extreme Redesign Contest

Dimension 3D Printing, a brand of Stratasys, has announced the winners in its sixth annual "Extreme Redesign" challenge. Extreme Redesign: The Ultimate 3D Printing Challenge, is a global design and 3D printing contest and scholarship for high school and college students. The three category winners and Green Bonus winner were selected from an international pool of entries by a panel of experts from within the design and engineering fields. Designs fall into one of three categories: High School, University, and Art and Architecture. The three first place category winners will receive $2,500. The remaining finalists will each receive $1,000 scholarships. In addition to the student scholarships, each instructor of a first-place winning student will receive a laptop computer for use in the classroom. This year's contest also featured a new "Green Bonus." This award recognizes one student whose design best displays innovation in areas such as energy efficiency and environmental sustainability. The Green Bonus winner will receive a $250 gift card. Winners and categories follow:



Robo-Prosthetic Development Platform by Dale Herzog, Quinsigamond Community College, Worcester, MA.

> **High School:** Maxwell Krist, Eckstein Middle School, Seattle. The goal of his design, "Electricity Usage Meter," is to create a monitoring device that displays the amount of electricity a household electrical appliance uses. The device is solar powered and has two functions. The first function displays the amount of electricity an appliance uses in kilowatt-hours, while the second function records how many kilowatts the appliance has used over a 24-hour period.

> **University:** Dale Herzog, Quinsigamond Community College, Worcester, MA. The goal of his design, "Robo-Prosthetic Development Platform," is to create an adaptable platform to aid in the development of prosthetic systems for the human hand. The 3D assembly snaps together forming smoothly sliding joints capable of handling every day objects. The hand is capable of using custom circuit boards and sensors integrated directly into each of the individual phalanges as well as the swapping of entire finger assemblies through standard mounting points.

> **Art and Architecture:** Trevor Clarke, Fullerton College, Fullerton, CA. The goal of his design, "Roy," is to create an improved, human-like, character for use in stop-motion film. Traditional stop-motion films have used characters made from clay or other moldable materials. Roy is made of ABS plastic and can be quickly articulated to mimic the motions of a human being.

> **The Green Bonus** went to Benjamin McCombs and Jonathan Hoekstra, Caledonia High School, Caledonia, MI.

FOR MORE INFO:

> Dimensional Printing

LMS North America and CPS to Offer Certification

LMS and the Center for Professional Studies (CPS), a Michigan licensed technical training institution, have partnered to offer a simulation/test engineering certification program. According to the companies, no certification for this specific group is being offered by academia, industry, or professional organizations. Through their partnership, LMS and CPS are providing training in software tools and methodologies, along with hands-on application in a real world settings. "We are very excited about working with LMS in this area," says Daryl Patrishkoff, chief executive officer of CPS. "Certification in simulation/test engineering will offer our students a huge advantage in the market place ... [and] will give these engineers the proficiency in a variety of virtual simulation and testing tools." CPS also offers technical professionals certification in design engineering, program management, and Lean Six Sigma.

FOR MORE INFO:

> LMS

WorkNC Dental Developer, Sescoi, Recognized by French Government

Sescoi's WorkNC Dental CAD CAM for the machining of dental implants has received the endorsement of French government body, OSEO Innovation, which is dedicated to the promotion and support of innovative small- and medium-sized companies in France. Following a review of Sescoi's automatic 5-axis dental implant machining developments, OSEO classified Sescoi as an "innovative company." WorkNC DENTAL automatically applies the right tool path strategies for different material stock such as titanium, zirconia, chrome cobalt, and any other dental prosthesis material. According to the company, the recognition from OSEO reflects Sescoi's ability to develop innovative solutions to specific customer applications, and its commitment to providing affordable mass customization and personalization solutions to the medical and manufacturing communities.

FOR MORE INFO:

> Sescoi

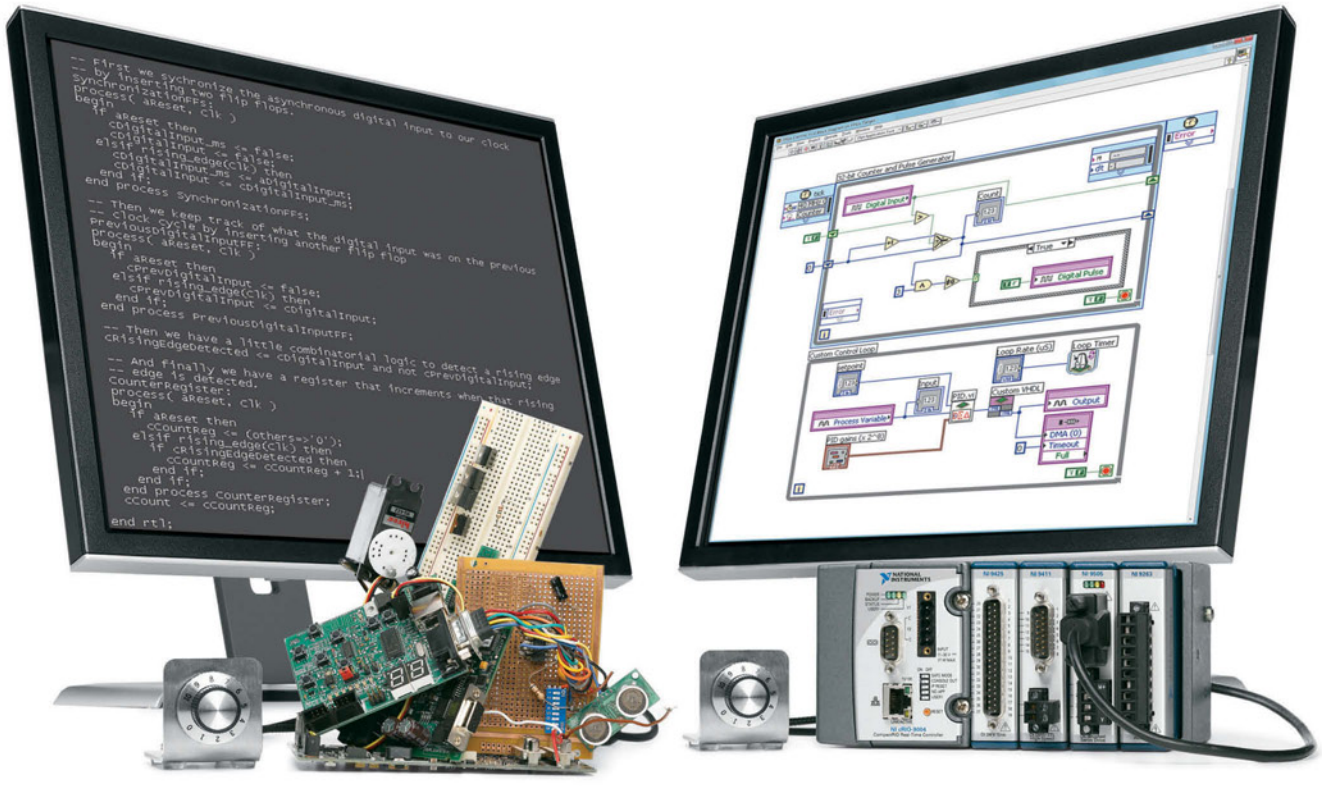
PGI Compilers Now Available on Cray

The Portland Group has announced an agreement under which Cray Inc. will resell PGI optimizing Fortran, C, and C++ compilers and development tools with the Cray CX1 line of deskside supercomputers and the Cray CX1000 line of rack mount supercomputers. The PGI compilers and tools are used to create and run high-performance computing applications for complex modeling and simulations. PGI compilers and tools support the latest 64-bit processors from AMD and Intel as well as CUDA-enabled GPU accelerators from NVIDIA running under both Linux and Microsoft Windows.

FOR MORE INFO:

> The Portland Group

Embedded Prototyping. Simplified.



Traditional Prototyping Tools

Graphical System Design Tools

Get to market faster and reduce development costs with graphical system design, an approach that combines open, graphical software and off-the-shelf hardware to help you quickly iterate on designs and easily implement them on an NI embedded platform. The NI CompactRIO system offers an ideal embedded prototyping platform with a built-in microcontroller, RTOS, programmable FPGA, integrated signal conditioning, and modular I/O, as well as tight integration with intuitive NI LabVIEW software.

>> Learn how to simplify embedded design at **ni.com/embedded** **888 279 9833**

NATIONAL INSTRUMENTS

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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.

Printer-Scanner-Copier Does Color or Black & White

> The wide-format ColorWave 300 offers a single footprint and multiple functions.

In this day and age of the paperless office, we still spend a tremendous amount of time executing arborcide so that we can print and copy stuff. And many outfits spend an enormous amount of time waiting for either A) some service bureau to scan or print their oversized engineering documents or B) for the service dudes to show up and move their Sherman tank-sized printer, scanner, or copier around the office to turn one more cubicle into a bunkhouse. Océ North America has a solution for both of these office headaches.

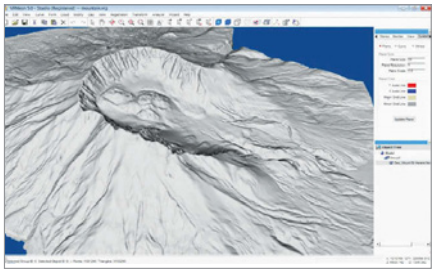
The new Océ ColorWave 300 offers big-unit black-and-white and color printing, scanning, and copying in a single 78 x 36 x 68-in. footprint. It includes everything as well as an optional top delivery tray, the ColorWave 300 can be tucked under a flight of stairs or in some formerly useless corner near the storage closet. Since it uses inkjet technology, it is easy to maintain and it doesn't need special venting.

READ MY COMPLETE REVIEW:

>Océ

Point Cloud Processor Updated

> VRMesh 5.0 lets you import point cloud data in excess of one billion points.



Importing, cleaning up, and simplifying large masses of point cloud data can tax anyone's patience. With the introduction of VRMesh 5.0 point cloud and mesh processing software from VirtualGrid, you can give yourself a tax break on that job.

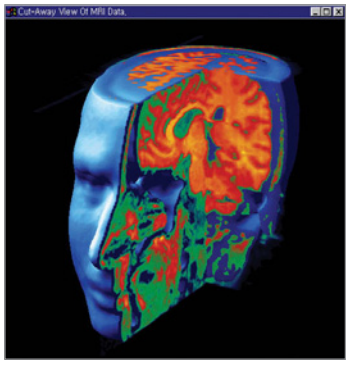
VRMesh 5.0 has the tools and power to clean and simplify large (meaning more than a billion points) point clouds, generate high-quality triangulated meshes, and recreate NURBS surfaces for further manipulation in your CAE and CAE applications. It has advanced point-cloud processing techniques such as denoise and decimation that reduce the size of point clouds efficiently but without sacrificing accuracy. Other new features in VRMesh 5.0 include the ability to export NURBS surfaces in IGES format and a new capability for restoring sharp edges along wireframe curves.

READ MY COMPLETE REVIEW:

>VRMesh 5.0

Visual Numerics Enhances PV-WAVE Visual Data Analysis Software

> PV-WAVE 9.5 includes expanded OpenMP parallelization support as well as Windows Vista and Windows 7 support.

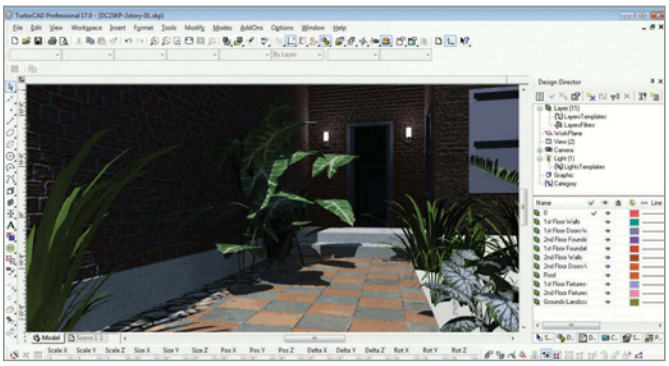


Visual Numerics, which was acquired a year ago by Rogue Software, a maker of software development tools, components and frameworks, has been a leading developer of technical solutions for numerical analysis and visual data analysis for users in such disciplines as aerodynamics, CFD, Earth science, and test engineering in industries as diverse as oil and gas exploration and medical analysis for years now. Visual Numerics makes tools for developing and deploying signal and image processing, simulation, data mining, and any huge numerical analysis job you can think of. That's why its important news when the company announced a new version of PV-WAVE. 9.5 to be precise.

PV-WAVE is a family of products that enable you to import, manipulate, analyze, and visualize complex data sets. Included in the family is time series analysis and Java-based collaboration applications.

READ MY COMPLETE REVIEW:

>PV-WAVE 9.5



IMSI/Design Increases Performance of TurboCAD Pro

> TurboCAD Pro 17 boosts speed and takes advantage of GPU based graphics cards.

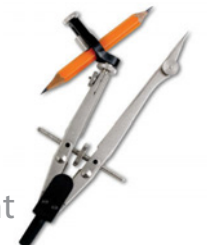
It's been a while since I sat down with Bob Mayer, the COO of IMSI/Design—the company that makes TurboCAD. Bob is one of the smartest guys you'll meet, and he's one of those people who just know what it is that CAD users will want as opposed to what he wants them to need. The insights that Bob gets are why TurboCAD has been a steady, well-regarded general-purpose CAD system for years. Only I intensely the phrase "general purpose."

Just out in version 17, TurboCAD is, indeed, general purpose if you need design, drafting, detailing, and modeling but are loathe to cobble together two or three applications that cost at least as much as TurboCAD itself yet offer mostly a lot of expense, bells, and whistles that you will never use. Only, this general-purpose system has most of the functionalities too, and it's extensible to a Platinum edition that has pretty much as robust as anything you'd ever want. So, it's general purpose in that it can pretty much what you need to do and grow with you as your needs expand.

READ MY COMPLETE REVIEW:

>TurboCADPro 17

It's a Mistake to Deny CAD to Future Engineers



Last month, Steve Robbins, DE's executive editor asked if engineering students should still be taught pen-and-paper drafting before being taught computer-aided design. DE's readers responded. Below are excerpts:

"Get those students some computers and 3D software! I don't have any advantage over somebody that never used pencil and paper. The sooner a student gets to learning CAD software the better."
— *Miguel S.*

"There are indeed several elements of discipline, orderliness, logic, and process that are imparted by the experience of manual drafting. Many of these can also be disseminated through training in electronic drafting (2D CAD) as well. In that regard, I would jettison the mechanical process but definitely hold onto the electronic process.
I would also like to make a seemingly contrarian statement regarding the reliance upon computers in design.... But computers don't enable you to create faster, they only enable you to erase faster. Creation or innovation in design doesn't come from the computer, it comes from the brain."
— *Michael M.*

"For my day job I'm a mechanical designer, but for the last 10+ years I have been instructing mechanical design. I allow my students to use their tool of choice. This could be board drafting, 2D electronic or SolidWorks or Inventor. By limiting the students' knowledge of various tools you will handicap them in today's job market."
— *Michael H.*

"At my first job with IBM, I helped work on a 2D parametric geometry and finite element engine. In 1971 I was optimizing part geometry graphically online. I was also running FE analysis online—they let me use a whole 360/65—interactively.
Why the hell would anybody use pencil and paper 40 years later? I still see advice on using 2D Autocad and cringe. Parametric modelers are the ONLY way to go."
— *Chris P.*

"I do not disagree engineering students should have access to the latest tools, but I fail to see these tools providing the base training required to make an all round good engineer. The 'old draugthing' skills MUST be taught. If CAD tools can be used to do this, all the better. If they cannot, then there is no alternative but to use older methods."
— *Paul W.*

"I suspect that, because CAD programs are written to replace the mechanical pencil, compass, straightedge, and French curve, a foundation in the use of those tools to produce engineering drawings could be of considerable value ... If nothing else, it might help the budding engineer understand why the programs work the way they do."
— *Edward A.*

"I think it would be a disservice to engineering students to not teach them drafting starting on the drafting board and learning for several weeks how to put lines on a piece of paper with a pencil, as it still is sometimes the easiest way to quickly get an idea across. Without learning the basics, it makes it harder to make an educated judgment as to whether or not the computer/calculator/CAD program is giving you a good answer."
— *George D.*

"There is as much purpose in teaching hand-drawing as there is in teaching how to use a slide-rule. And the earlier the exposure to 3D CAD the better."
— *James I.*

"I see NO benefit for students learning this today. What would they use it for and what would they learn? You might as well teach them how to use a slide rule. This would be an utter waste of their learning time, which would be much better utilized learning how to use 3D CAD!"
— *Brian L.*

"What a wicked thing to do to a young, ... engineering student, designer, or drafter … make 'em hand draw something. There's no way that I would ever go back to board drafting."
— *Randy M.*

"I'd have to say absolutely not. With all the emphasis there is these days on 3D prototyping, product life cycle management, etc., a graduating engineer is severely handicapped if they don't have this experience.
— *Michael S.*

"I'm currently in a position that still considers 2D CAD as an engineer's skill and not as a technician. 3D CAD is already mostly a technician's job in automotive (where I am currently) and is in large part how aerospace has been for some time (where I used to work). Maybe that is the point of view that the administrators are taking. So, the question is, is CAD relevant to an engineer's ability to innovate and/or iterate through a design quicker than having a technician do it?"
— *David T.*

"(I) learned to use CAD first and then took an entry-level class that taught the use of drafting paper and pencil. I believe this was very helpful.... The 'old drafting board and pencil' really teaches some fundamental areas that the CAD system does automatically, and a person may not catch a mistake when not given the opportunity to see it this way."
— *Sheldon M.*

Letters have been edited for style and space.
Submit your own letter to de-editors@deskeng.com.

FOR THE COMPLETE LETTERS:
>Deskeng.com

The Firmware-Hardware Connection

> The relationship between firmware and hardware is being redefined, making it impossible for the mechanical engineer and firmware developer to operate in a vacuum.

BY TOM KEVAN

Firmware development is becoming one of the dominant factors in design timelines. The software's complexity has increased to the point where it often eclipses that of hardware, primarily because it is taking over much of the work previously done by hardware.

Design engineers often see firmware as the riskiest aspect of development, but this has in no way diminished its use. The software brings such dynamism and flexibility to the design process and the devices and machines it empowers that it has become a defining technology. The flexibility alone opens multiple design paths to advanced functionality.

The relationship between firmware and hardware is being redefined, making it impossible for the mechanical engineer and firmware developer to operate in a vacuum.

The Connection

The fact is, this technological shift has created an inescapable link between software and hardware that did not exist before. The bond between the two, however, requires engineers to work differently.

For example, most designs today involve some sort of programmable device. Mechanical engineers must be aware of what's involved in programming these devices to effectively design hardware.

"In many cases, if I am designing hardware, I have to ask myself how it will work with software," says David Palchak, a product engineer at MindTribe, an engineering firm specializing in the development of innovative technology products. "What will the software have to do, and is that a reasonable demand? And if it is a particularly complex interaction, it is easier for me to design

PRODUCT OFFERINGS

Texas Instruments' Scalable Sitara ARM9 MPU

Texas Instruments' four new Sitara ARM9 microprocessors (MPUs) integrate a variety of connectivity options to provide developers of embedded industrial, medical, and consumer devices with flexible architectures to support multiple industry-specific peripherals and interfaces. The AM1808, AM1806, AM1707, and AM1705 MPUs include serial ATA (SATA) and universal parallel port (uPP) interfaces, as well as TI's Programmable Real-Time Unit (PRU), which offers configurable I/O control, enabling extended peripheral capabilities and custom interfaces. The hardware and software scalability of the AM1x devices are coupled with a suite of software and development tools that enable designers to reduce their product's time to market.

Features ande benefits:

> 375 and 450 MHz ARM9 options
> PRU interface offers user configurability
> Ability to implement and tune standard, custom, and "lite" versions of common and proprietary serial interfaces, such as UART and CAN
> PRU offloads the ARM9 to improve application processing capacity, reduce overall power consumption, eliminate latency, and improve real-time responsiveness

Analog Devices' ADXRS450 Digital iMEMS Gyroscope

The ADXRS450' angular rate (rotational)sensor features an advanced, differential quad-sensor design that enables it to operate accurately under intense shock and vibration conditions. The MEMS gyroscope's low-power operation makes it effective for applications such as robotics, industrial instrumentation, avionics, and stabilization for high-speed trains.

The sensor has sensitivity to linear acceleration specified at only 0.03°/sec/g, acceleration rectification of 0.003°/sec/g2, a noise-rate density specification of 0.020°/sec/√Hz, and power consumption of 6 mA under typical conditions. Other features include internal temperature compensation over an extended industrial temperature range and an optional ceramic vertical-mount package that enables three-axis sensing on a single PCB without daughterboards.

Features ande benefits:

> SMT-compatible vertical-mount package reduces costs because all axes are sensed on the same PCB board.
> High-vibration rejection over a wide frequency range allows for stable readings in harsh environments.
> Internal temperature compensation enables greater stability over extended industrial temperature range.
> The 2,000-g powered shock survivability delivers greater reliability.
> The –40°C to 105°C operating range is suitable for most industrial and other harsh environments.

– More Sensor Offerings on page 29

the hardware, write the firmware drivers, and then pass it off to someone who writes higher-level applications. This way, I am transferring the knowledge of what the hardware does and how the overall system is supposed to work."

To ensure clear communication of design concepts, there must be good interplay between the hardware and firmware sides of a project. Frequently, the best way to achieve that is for the mechanical designer to understand firmware and to be able to take over some critical software roles if necessary. It's also important for the firmware engineer to understand the hardware and why something needs to be done a particular way. Achieving the desired functionality and performance depends to a large extent on the way the software is written.

A Balancing Act

The benefits of the new relationship between hardware and firmware can have a major impact at the component level, with such devices as sensors. For example, firmware has significantly improved analog circuitry. Engineers have learned to use the software to optimize A/D converters, speeding up their sampling rates and allowing them to be moved up the signal chain, closer to the source. Using extensive averaging techniques, firmware can also extend the range of an A/D converter.

"If you have a 12-bit converter and your samples contain noise, you can average out the noise," says Palchak. "You can increase your reading resolution to 14 or 16 bits just by averaging. But you have to average a lot of samples, and that's not something that was feasible before microcontrollers and firmware took over."

Specifications (25 lb.)	44.5N (10 lb.)	111N
Resolution (mN)	1 mN	10 mN
Safe Overload (of R.O.)	150%	150%
Excitation	Powered by USB	Powered by USB
Accuracy (ppm)	700 ppm	700 ppm
Operating Temperature	–60°F to 200°F	–60°F to 200°F

In some cases, you can use a less expensive or lower performing sensor and then compensate for its shortcomings by doing advanced signal processing in firmware. This allows you to juggle performance and price to meet the requirements of your design.

Firmware can also help with sensor calibration. The software allows designers to select a sensor that has less than optimal performance in a particular area. "Maybe a sensor doesn't have great temperature stability, but you can calibrate that in firmware," says Palchak. "You know how the performance of a sensor is affected when it gets cold. With a calibration curve, you can adjust the sensor's values. So you can take an inexpensive sensor that is affected by temperature and use firmware to compensate for that and get a much better reading."

PRODUCT OFFERINGS

The FUTEK LLB130 Miniature Load Button

The LLB130 is a miniature load button designed for press or inline compression applications. The sensor is made of 17-4 PH stainless steel, with a 0.38 in. OD. These load cells deliver ±0.5% nonlinearity and 0.002 in. nominal deflection. The company also offers options for external matched output. All packages include USB 210, extended software, and system calibration.

This model is suited for a variety of applications, from measuring and controlling equipment to precision mechanics, clamping, tool manufacturing, and apparatus engineering. The miniature load cell can be installed easily, and because of the small dimensions, it is well suited for use in restricted structures for both static and dynamic measurements. ■

Tools of the Trade

There are a number of tools that aid, simplify, or improve firmware development. In general, evaluation kits (EVs) are readily available from most manufacturers. EVs allow you to begin firmware development early in the design cycle.

For example, the Kionix Accelerometer Application and Firmware Development Kit provides a simple environment in which to begin the development of applications and firmware that incorporate Kionix accelerometers. The development kit provides a common interface to Kionix evaluation boards and software that lets you display and record acceleration data. In addition, the kit's graphical register map allows you to see and change the contents of control registers.

There are also families of tools available for microcontrollers from different vendors. "A lot of engineers here at MindTribe like the IAR Embedded Workbench series of compiler and debugging tools," says Palchak.

The IAR Embedded Workbench is an integrated development environment for building and debugging embedded applications, and it includes a C/C++ compiler. The toolkit supports a wide range of ARM devices, hardware debug systems, and RTOSs, and it generates compact and efficient code.

Finally, there is National Instruments' LabView. This leading graphical programming platform enables the development of test, measurement, and control applications.

*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.*

FOR MORE INFO:

- > Analog Devices
- > FUTEK
- > IAR Systems Software
- > Kionix
- > MindTribe
- > National Instruments
- > Texas Instruments

More Than Just a Workstation Today

> Today's engineering workstation enables engineers to bring their ideas to fruition faster than ever before.

BY PETER VARHOL

Thanks to advances in computing performance and software, design engineers today have the opportunity to dramatically change the way that they work. This opportunity is driven by the emergence of the engineering workstation as an intelligent workbench. It combines fast and flexible computing hardware with software innovations from engineering software vendors that provide a platform for radically improving and accelerating the design process.

This workbench enables engineers to do work on their workstation that often had to be done in data centers, or not at all. Computational power, memory, and overall system performance makes it possible to perform design activities more quickly, and with it saves time and money on engineering, and also makes it possible for the engineer to engage in a greater number of projects.

The intelligent workbench brings with it the ability to improve the design in the process. Engineers can iterate through multiple designs and design approaches in order to come up with the best design. They can design, analyze, simulate, adjust, and repeat until the design is optimized.

In other words, this intelligent workbench enables engineers do what they do best.

Behind the Workstation

A wide variety of designs can meet customer or market requirements from a design standpoint. But at some point in the product design and manufacturing process, it's not unusual to realize that while the chosen design is satisfactory, it's not the best. It may not be the least expensive to manufacture, or it may use more materials than necessary.

Today, engineers have the tools to change that dynamic for the better. Engineering-driven orga-

nizations now have access to inexpensive workstations and workgroup clusters based on the new 64-bit Intel® Xeon® processor 5600 series, with six cores and two threads per core. These workstations and work group clusters deliver the compute capacity of high-performance computers that were only available in the data center just a few years ago.

Software is also taking better advantage of the ability of faster hardware to deliver higher performance at lower costs. Software from vendors such as ANSYS, COMSOL, and SolidWorks take advantage of the multiple cores and threads as well as the processing throughput to produce better designs as well as to quickly analyze and simulate those designs. Engineers can do more at their desktops, and do it more quickly.

Smaller design organizations can benefit immediately from the combination of high-performance hardware based on Intel processors and innovative design, analysis and simulation software. These shops are now able to provide engineers with the tools to perform design, analysis, and simulation almost entirely from their desktops. This means that these shops can act more like large design houses by producing higher quality designs more quickly, and with existing expertise and resources.

To take full advantage of the intelligent workbench, engineers can perform multiple operations simultaneously, combining design, analysis, and documentation activities rather than separating them into discrete steps. Engineers can quickly iterate through new ideas, build and analyze models, and refine designs to a point not possible just a few years ago. And they can do this in a time period measured in weeks for most designs, rather than years.

But large engineering shops with established design processes can also use the intelligent workbench as the opportunity to reinvent those processes. Because powerful and inexpensive workstations and modern design and analysis software don't require specialized data centers, large design organizations can examine their workflows and recreate them to save time and eliminate inefficient steps.

Thanks to today's high-performance Intel-based workstations, design engineers are finding a better and faster way to design products. ■

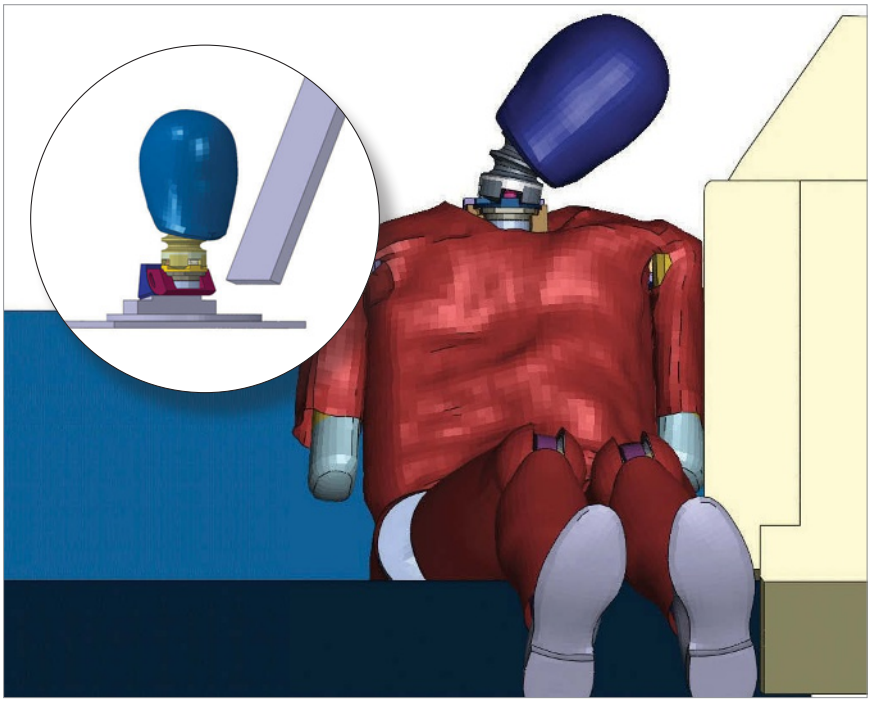
FOR MORE INFO:

> Intel Corp.
> Intel/Workstation
> Intel/HPC
> Intel/Cluster

Crash Course in Data Management Speeds Up Huge Simulation Task

> Simulation Lifecycle Management cuts the qualification process for critical Abaqus finite element analysis crash-test dummy models from weeks to days.

BY LYNN MANNING



Component test (left) and full-body test (right) of crash dummy Abaqus FEA models. SIMULIA uses SLM and Isight software to qualify the results of these tests across different versions of FEA.

The idea for the automotive crash-test dummy first came to life in the 1950s when U.S. Air Force flight surgeon Col. John Stapp found that more of his fighter pilots were dying in car crashes than from accidents in their hi-tech jet aircraft. The Stapp Car Crash Conferences started that decade and continue today as a venue to share information on the latest research and advancements for improving

A major challenge in the ongoing development of physical crash-test dummies is the need to reasonably represent how the human body responds in an automotive accident. The ultimate goal of crash dummy research is to aid in creating design improvements for both vehicles and occupant restraint systems to reduce injuries and save lives.

This ongoing research has led to energy-absorbing crumple zones and other structural innovations that help protect occupants during car crashes. It has also led to the addition of air bags, which, when combined with a properly worn three-point

A crash dummy (FEA virtual model at left, physical model at right) has a complex internal structure and multiple sensors that record up to 35,000 data points in a typical 150-millisecond crash.

seat belt, reduces driver deaths by 61 percent in frontal crashes, according to the National Highway Traffic Safety Administration (NHTSA).

But car manufacturers are now also legally obligated to certify the potential effects of crash events on the humans involved. As a result, crash dummies for front-impacts (Hybrid), side-impacts (SID), and rear-impacts (RID) have been developed, with engineers from around the world contributing to their evolution. Today, physical crash dummies are a valuable part of every automotive OEM's product design, development and testing arsenal.

Smart investment, big price tag

A very valuable part: A single physical crash dummy can cost more than $200,000. Made from a variety of different materials, including custom-molded urethane and vinyl, they are based on true-to-life human dimensions (a typical "dummy family" includes several different sizes ranging from toddler to large adult male). They have ribs, spines, necks, heads, and limbs that respond to impact in realistic ways. And they are loaded with sensors (44 data channels on the current front-impact standard, the Hybrid III) that record up to 35,000 items in a typical 100- to 150-millisecond crash.

Automotive companies and government organizations continue to collaborate on the acceptance of international safety standards (a "WorldSID" project is now underway) and harmonize methods of testing as the market for each country's vehicles becomes increasingly global. But physical test dummies are only a part of the crash and safety certification process. As computer-aided engineering software and computing resources rapidly advance, there is increasing emphasis being placed on developing ever-more-accurate virtual crash dummies.

Simulating the crash simulator

Since a physical crash dummy is a manufactured product like any other, it is no surprise that engineers use realistic simulation with finite element analysis (FEA) software to guide its design, production and performance. Given the power of FEA to cost-effectively reduce real-world testing, in the case of expensive crash dummies, and even more expensive vehicle prototypes, it pays to simulate the simulator: You can crash a virtual car and dummy many times, much faster and at far less cost than a single physical test.

Since the goal of simulating a simulator of the

complex human body is to closely represent reality, the resulting data must correlate well with physical crash test results. So standardization of FEA models is critical: Each virtual dummy must exhibit responses to crash impact loads and accelerations in a precise, repeatable manner that mirrors what happens to its corresponding physical crash dummy.

What's more, the simulation vendor must qualify its software to run smoothly as each new and improved version of a physical crash dummy comes on the market and as each new version of crash simulation software is released. In the case of creating a new virtual crash dummy or updating an existing one, the software qualification process involves evaluating large quantities of FEA data, gathered from multiple simulations of various crash scenarios, run on different versions of simulation software and, in turn, correlated with new physical test data.

Data, data everywhere

In the Providence, RI headquarters of SIMULIA (the Dassault Systèmes' brand for realistic simulation), a team of engineers qualifies and supports a range of virtual crash dummy models developed for their Abaqus FEA software by First Technology Safety Systems (FTSS), a leader in crash dummy innovation for more than 40 years. The SIMULIA group also separately develops and qualifies its own virtual crash dummy models, which are versions of the BioRID (Biofidelic Rear Impact Dummy) and WorldSID (Worldwide Side Impact Dummy).

"We need to make sure that every new version of each dummy model that's released will work accurately and give the same response no matter which version of Abaqus we, or our customers, are using," says Sridhar Sankar, the SIMULIA crash engineering specialists group leader.

A typical FEA dummy model will have about 100,000 elements, 150,000 nodes and 500,000 degrees of freedom. "To ensure, within engineering tolerances, that you get the same results from the virtual dummies as from the physical tests of the real ones, we have to run component, sub-assembly and full-model tests on each one," says Sankar.

A component test is used to evaluate an individual FEA model of a dummy neck being bent, a lumbar spine being shoved sideways, or a head being dropped on a hard surface. A sub-assembly test assesses the stresses on a full rib cage model hit from the side by a pendulum, with the ribs being individually deformed and possibly intruding into the body cavity. And a full-body test incorporates an entire dummy model being hit from the side by a virtual "solid" barrier or subjected to a simulated sled test. Different testing standards (NHTSA, IIHS, etc.) require a variety of tests. "With 30 to 60 of these validation tests per dummy model, we end up with a very large number of outputs to generate and then compare," says Sankar.

SLM brings the power of PLM

Until recently, dummy qualification took the SIMULIA engineers about four weeks for each updated Abaqus virtual dummy model. (A completely new model, such as a WorldSID, would take far longer than that to create.) "These kinds of challenges meant a lot of man-hours for our team," says SIMULIA crash engineering specialist George Scarlat.

Before they could even begin the analysis, Scarlat's

group had to create their databases by manually modifying each of the previous validation test responses to add proper filtering. Next, engineers had to manually launch and run the simulations for the 30-60 tests in the current and previous versions of Abaqus, and then run a postprocessing step to generate the curve plots describing the analysis results. Finally, a second postprocessing step would take the analysis curves, two at a time, and generate statistical comparisons.

"In terms of data you could have 60 tests multiplied by 200 variables multiplied by five different versions of Abaqus," says Scarlat. "This was a lot of manual work. To meet our deadlines, we really needed to improve the efficiency of the entire process."

So the group decided to apply a combination of SIMULIA's own Simulation Lifecycle Management (SLM) tool, and the company's Isight software for simulation automation and design optimization. The results were dramatic: "By using our own tools, which we also provide to our customers for automating and managing their simulation processes, we went from four weeks to four days for the qualification process," says Scarlat.

How'd they do that? SIMULIA SLM leverages Dassault Systèmes' ENOVIA product lifecycle management (PLM) solution with SIMULIA's simulation expertise. Using SLM as both a database and a process controller, the engineers could save and manage their simulation data, reuse simulations, retain performance metrics, protect intellectual property and shorten design cycles. They used Isight software within SLM as an add-on tool for driving automation of the data (Isight also has powerful optimization capabilities, which were not needed in this case).

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Sacraficing Stand-ins to Make Automobiles Safer

Crash dummies' lives are nasty, brutish and short. Before they ever get behind the wheel of a car, their heads, chests and limbs are removed, probed, dropped, and struck. They are reassembled, dabbed with marking paint, and slapped on either side of the head with calibration stickers to help engineers evaluate slow-motion films of crashes. During a test, crash data is recorded in a temporary repository in the dummy's chest, then downloaded to a computer. If any dummy part is damaged or fails, it can be swapped for an identical one, but a dummy can only be crash tested a certain number of times before its functional lifespan comes to an end.

Still, crash dummies have served their purpose well: cars today are much safer than those of half a century ago. To mark the 50th anniversary of the formation of the Insurance Institute for Highway Safety, the IIHS filmed a 40 mph frontal offset crash between a 1959 Chevrolet Bel Air and a 2009 Chevrolet Malibu. Thanks to improved safety standards, the crash dummy in the new car fared dramatically better than the one in the older model.

> View the video.

The crash dummy qualification team used SLM as the underlying driver for running each of the three main dummy qualification tasks (preprocessing, analysis and postprocessing) sequentially. SLM automatically exported all the necessary files from its database for each task (activity). It then automatically imported back into its database any specified result files after the activity was run.

Isight further automates qualification

SLM also leverages the capabilities of Isight, in this case for process automation. The crash group engineers first used Isight to create a workflow that enabled them to simultaneously launch all of the Abaqus analysis tasks on a compute cluster. A second Isight workflow was employed in the final postprocessing task to help determine the correlation between results from different versions of Abaqus software on identical dummy tests. A Python script was used to modify input files, compare results, and generate comparison reports. The team ran each project on a Linux 64-bit compute cluster using an average of 1200 CPUs for a full run-through.

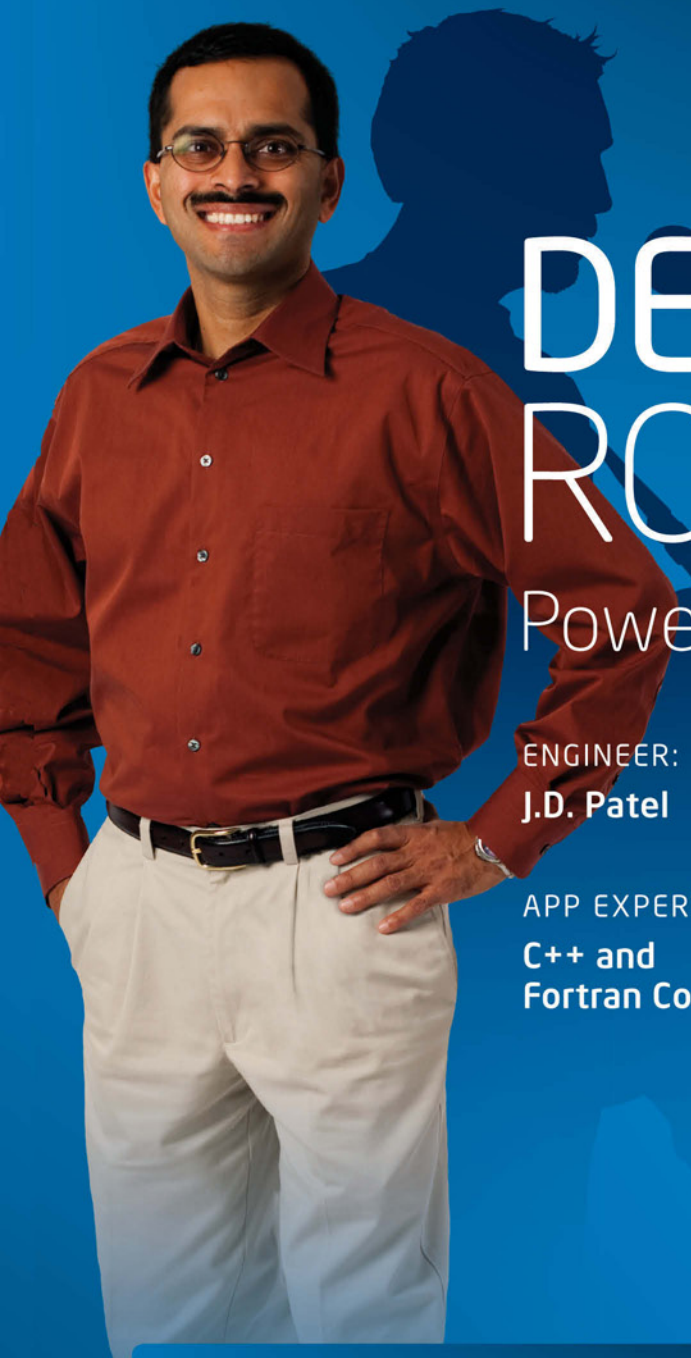
The team qualified five FTSS dummies in the first year of using the new workflow—taking about the same number of man-hours needed to finish only one dummy qualification project before.

The automobile safety engineering world is getting ever closer to the perfect crash dummy. Hybrid IV, also known as THOR, is a dummy currently under development with biomechanical and measurement enhancements that will generate more data than ever. ■

Lynn Manning *is a science and technology writer based in Providence, RI. Send comments about this article to DE-Editors@deskeng.com.*

FOR MORE INFO:

> SIMULIA



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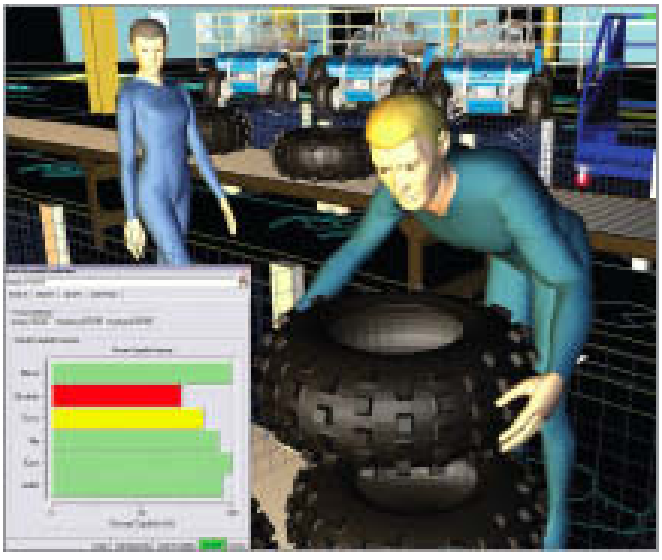
GM Puts Siemens Digital Humans to Work

> Workflow simulation for virtual manufacturing to assess plant/assembly procedures.

BY KENNETH WONG

Bob Tilove, a technical fellow at General Motors' Manufacturing Systems Research Lab, commands a small army of digital humans. Day or night, whenever he wants to find out something about an assembly process or a plant layout, he calls on them to do his bidding. They're part of his workflow and assembly environment simulation arsenal at GM.

As reliable and sophisticated as they are, Tilove feels it's time to up the ante, to improve current technologies to enable more advanced simulation exercises. He gave a presentation on the subject at the Congress on the Future of Engineering Software (COFES) 2010 in Scottsdale, AZ. Here, he shares his thoughts about spawning a new generation of digital humans and simulation tools for manufacturers.



Jack and Jill, digital human models that are part of Siemens PLM Software's Tecnomatix suite, enables automakers like GM to digitally simulate and study the impact of assembly work environments on humans.

Your vision is a little different than Most CAD vendors who promote the idea of "digital prototyping," using a digital replica in conducting studies in a digital environment. Can you explain?

Tilove: Most people, when they speak of "digital prototyping," are thinking about the end product or artifact, and how it will work, and whether or not all of the pieces will fit together, or if it will break when you drop it—things like that....

In my area, virtual manufacturing, I'm thinking not so much of the final product, but of the manufacturing process in the factory or the plant for making it. So it's similar to "digital prototyping," if you think of the thing that you want to prototype as the manufacturing facility, which means all the parts and sub-assemblies, the work in process, how they flow through the system, plus all the tools and equipment and conveyors and controls involved ... a much bigger scale.

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"virtual simulated work environments" focuses on manufacturing operations involving human assembly workers. In automotive, we call that general or final assembly, where people are installing and connecting hoses, cables, wiring harnesses, instrument panels, seats, carpets, and so forth. And of course, with the focus on human operators, we are concerned about their ergonomics and comfort.

At COFES You indicated CAD packages are not well-equipped for certain materials and processes you wish to simulate. Can you outline your challenges?

Tilove: As a researcher, my job is to envision what [simulation] might look like in the future, and try to drag that vision into reality by doing advance R&D projects.… Today's CAD systems handle rigid, solid objects and mechanisms with rigid links very well, but they do not handle those flexible parts I mentioned before like hoses, cables, wire harnesses, foam, or carpets well.

Today's systems handle interference detection quite well in packing and motion planning of rigid objects, but they are not able to simulate what happens when a flexible part comes into contact with another flexible or rigid part. For example, if you imagine a hose fitting onto a connector, the connector is bigger than the hose by design. In today's CAD systems, if you were to run an interference check, it would say, "There's interference." We would then say, "OK, that interference is by design, so it's fine." But when the hose is actually installed, it doesn't interfere with the connector. It deforms, and we need to be able to model and simulate that deformation, including the forces that are involved.... What we need to move to is what some people call "physical modeling," where we're modeling not only the geometry but also the materials and the physics involved.

What are the shortcomings you've noticed in digital human models that come with current PLM systems?

Tilove: We do have digital human models or computer manikins in commercial tools, and we try to use them to assess reach, access, and ergonomics. But the problem is, the digital human models today are not too smart. They're like those wood human models you may have seen that artists use. You can put its hands somewhere, you may reposition its torso … but you can't just tell a digital human to reach into a cluttered environment and install a part. That does not just happen automatically. Either a highly skilled ergonomist has to manually adjust the joints in the digital human to get a realistic posture, or, in some cases, companies use motion capture technology ... capture the posture of the human, and use that to program [the movements of] digital humans. In the future, we need the digital humans to be much more intelligent, to be able to figure out for themselves where to stand, how to grasp, how to reach.... That's a significant R&D challenge.

What are the risks in applying insights drawn from observing digital workers to real assembly line workers?

Tilove: Let me try to clarify. The digital human is a model. It's an approximation—we recognize that.... What we're trying to do is to identify and fix problems before they would otherwise be noticed by the real assembly line worker. … At the end of the

day, our objective is to make the best possible work environment for the real assembly line worker ... we would probably find and continue to fix problems later in the process in the real world . . . but the more we can simulate virtually, the better off we are.

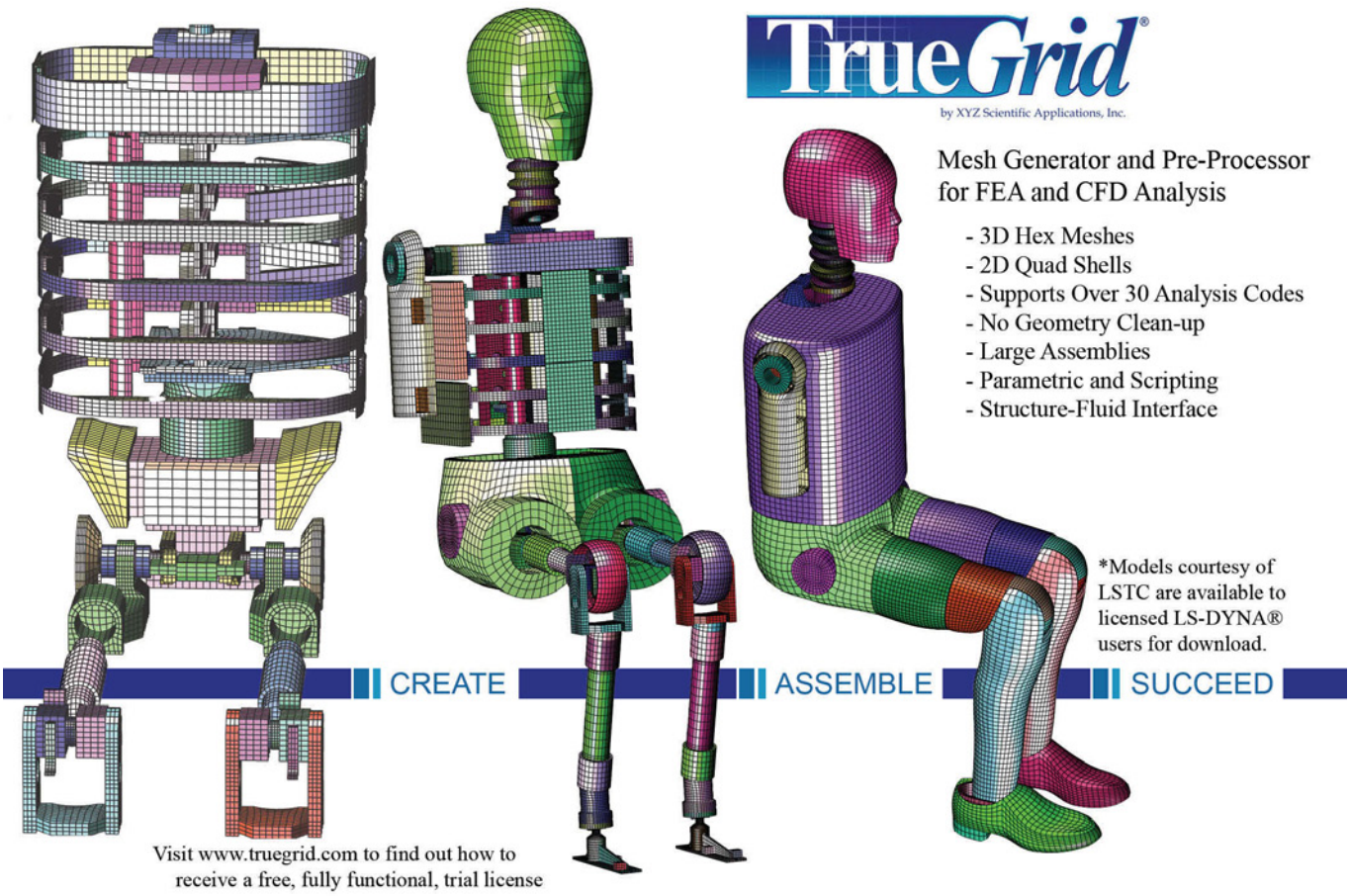
This type of digital human also appears in gaming. Have you explored the idea of collaborating with game companies?

Tilove: What you're asking about are interactive computer games with great graphics and intelligent actors in them. One of the things I would say is that the creators of those games are looking for compelling and exciting experiences, not necessarily things that obey the laws of physics or the biomechanical capabilities of real humans. In a way, that's part of the fun of those games. So far, we have been focusing mostly on getting the physics and human biomechanics right, but when we finally get to virtual simulated work environments, I think they are more likely to be built, from a computer science perspective, like multi-agent, distributed computer games than like today's manufacturing work cell simulations. At least I think that's a good possibility. ■

FOR MORE INFO:

> COFES

> Siemens PLM Software



Jaguar: Style and Quiet Power

> MS helps Jaguar maintain its brand, enabling engineers to combine luxurious silence with a powerful ride and first-class handling.

BY JENNIFER SCHLEGEL

Jaguars are known for power, style, quality, and—most importantly—driving dynamics and comfort. It's a clear brand image Jaguar has maintained for decades by giving its expert engineers leading-edge automotive technology.

A case in point is the chassis and suspension design of the XJ series, Jaguar's flagship full-size sedan. A third-generation XJ was introduced in 2003 with a ground-breaking aluminum body and chassis that minimizes the use of heavier steel parts.

The aluminum design is 60 percent stiffer and 40 percent lighter than comparable all-steel vehicles, translating into improved fuel economy and handling. Furthermore, a Computer Active Technology Suspension (CATS) system constantly monitors and tunes the car's four-wheel independent double-wishbone suspension to match driving conditions, automaticaly adjusting for maneuvering, responsiveness, and comfort.

A redesigned XJ is underway. A key goal of the project is to optimize the design of the chassis to maintain current ride and handling behavior while further reducing interior noise. Historically, traditional prototype testing performed late in development was used to eliminate road noise, but time constraints limited what engineers could accomplish with this trial-and-error method.

Building full vehicle concept models

To ensure an efficient process and successful project outcome, Jaguar opted to work with LMS Engineering Services to perform a systematic multi-attribute optimization of the vehicle chassis. The multi-attribute optimization process required engineers to create full-vehicle concept models to predict different functional performances for road noise as well as ride and handling. To reach the target noise levels and maintain precise handling, engineers optimized and balanced the functional performance quickly and efficiently.

The road noise model was a hybrid representation consisting of test-based and simulation-based building-block sub-models assembled in LMS Virtual.Lab Noise and Vibration using a frequency response function (FRF)-based sub-structuring method. The chassis sub-frame (including all the different suspension connections) and the various suspension links were represented as

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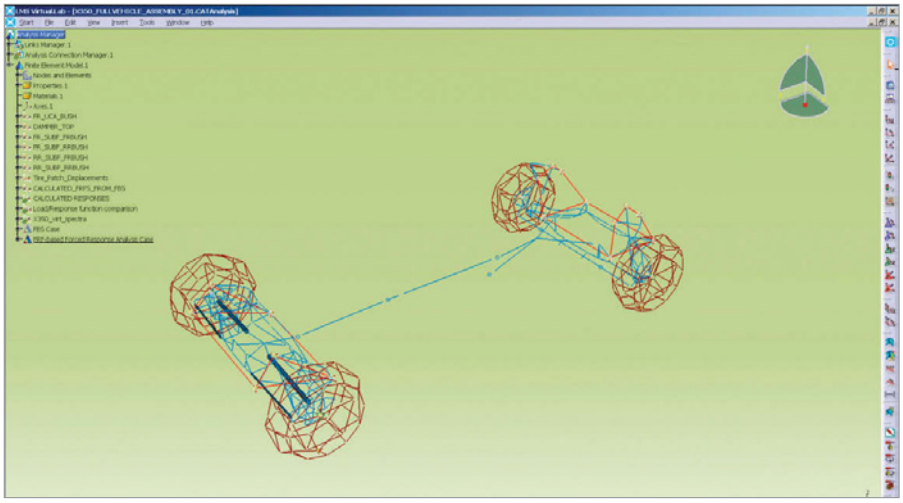
flexible-body finite-element analysis (FEA) models. For computational efficiency, these FEA models were reduced to modal representations. The car body (frame, doors, side panels, etc.) was a test-based representation created from FRF measurements taken by LMS Test Lab. A revolutionary test-based NVH tire model unique to LMS was derived from FRF experimental data, along with three-degree-of-freedom road displacement measurement data.



The hybrid full vehicle road noise model in LMS Virtual.Lab contains test-based representations of the tires, body and road displacements as well as a simulation-based representation of the chassis sub-frame (including all the different suspension connections). *Image courtesy of LMS*

New test-based tire model

In order to respond to the automotive industry's need for accurate representations of road-induced input forces on the vehicle structure (an input that remains the same regardless of suspension or body design configuration), LMS engineers developed a NVH tire model. A physically correct tire representation can achieve accurate predictions of structure-borne road noise in the early vehicle development stages when prototypes are not available for measuring the forces or resulting noise.

Traditional automotive industry methods for handling road noise phenomena involve applying experimental spindle forces or vertical displacements to the tire patch. Each method has limitations with respect to absolute accuracy or input dependency on suspension characteristics. For an accurate design evaluation, an invariant input that can reproduce measured vehicle cabin response is required. This is why LMS decided to develop a new NVH tire model derived from experimental data along with three-degree-of-freedom tire patch input displacements. When coupled with a vehicle model, road noise can be predicted accurately up to 300Hz, enabling virtual testing of suspension and body design changes.

Tire manufacturers typically make modal models available to the vehicle OEMs, but effects such as wheel rim flexibility and cavity acoustic effects are not included. Fully meshed FE models have been created to include these effects, but a high level of accuracy is difficult to achieve.

"For these reasons, an experimentally derived NVH tire model is an attractive approach," explained Joris Van Herbruggen, vehicle development manager at LMS Engineering Services. "When the NVH tire model is coupled with representations for road displacements, sub-frame, body, and chassis in a

full vehicle model, road noise can be accurately predicted for frequencies up to 300 Hz."

Multi-attribute optimization

LMS and Jaguar engineers worked together to create a full-vehicle ride and handling model for predicting handling and steering feel during steady-state cornering, step steer inputs, double lane changes, and other vehicle maneuvers. LMS Virtual.Lab Optimization correctly adjusted these models using a Design of Experiments (DOE) process to determine various "best of" chassis parameters.

According to Van Herbruggen, thousands of different chassis parameter combinations were explored. It let engineers find the "best-possible" optimized road noise using a target curve while keeping handling performance within specified boundaries. The final result was a set of modified chassis design parameters and the study's predicted road noise levels were lower by as much as 2 decibels. ■

Jennifer Schlegel *is senior editor at LMS International. Send comments about this article to DE-Editors@deskeng.com.*

FOR MORE INFO:

> Jaguar

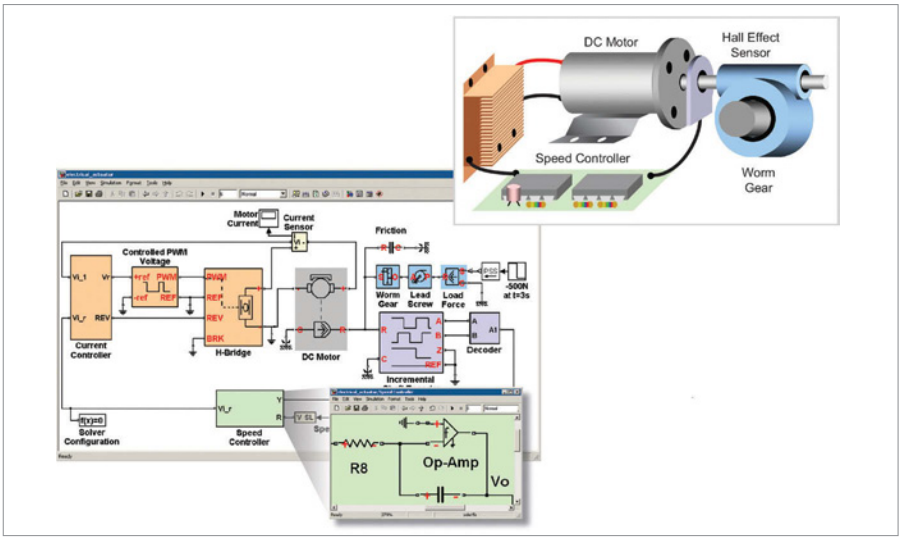
> LMS

A Work in Progress

> At this point, concepts and culture are changing slowly. It's the new crop of enabling tools that is driving and shaping the mechatronics methodology evolution.

BY TOM KEVAN

Mechatronics' evolution has been much like that of the design of a complex machine. The essential concept is present in the early stages of development, but a fuller picture slowly unfolds as layers of detail are added that define new elements. For the machine, this means a better understanding of structure and functionality. In the case of mechatronics, the core concept and "culture" are being fleshed out, and new enabling tools have been added to the designer's arsenal.



The top window depicts an electromechanical system that contains a DC motor, worm gear, Hall effect sensor, speed controller, and a motor servo-amplifier. These components are combined in an associated SimElectronics model (left). The colored blocks in the model correspond to the components in the electromechanical system. *Image courtesy of MathWorks*

The fact is that the methodology is not static. Instead, it is slowly changing, evolving, and reinventing itself to adapt to the changing nature of the machines and devices it creates and the marketplace it serves. Additionally, its core concepts and practices morph as engineers better understand how they can best meet the end user's needs.

Putting the T in Mechatronics

When it was first introduced, mechatronics was generally perceived of as the integration of the mechanical and electrical disciplines. Recently, however, the engineering community has begun to see the methodology as a broader multidisciplinary effort that pulls together mechanical, electrical, software, and control (above), along with problem-specific specialties, such as civil, biomedical, environmental, and chemical engineering.

To implement this multidisciplinary approach, designers must be familiar with the general principles and concerns of a broad range of engineering disciplines. This breadth enables the degree of collaboration called for by mechatronics.

"The modern engineer is what we call a T-shaped

engineer," says Kevin Craig, Robert C. Greenheck Chair in Engineering Design, Marquette University. "He has discipline depth but also multidisciplinary breadth...."

Now design innovators are casting their net even further to include additional areas of expertise. What makes this evolution so radical is that the new disciplines were not previously part of the design process.

Leading proponents of mechatronics now recognize that design problems cannot be solved by science, technology, engineering, and math alone. The problems must be solved through human-centered design, where the engineers understand the end users and their needs and the culture in which the device or machine is going to operate.

"Human-centered design includes people with business, social science, language, culture, and complexity training," says Craig. "And forward-thinking companies are taking this approach. This is where solutions happen, and when innovation occurs."

Only by adding the human element to the equation can the design team determine what is desirable. Once they do that, science, technology, engineering, and math will tell them what is feasible, and business will tell them what is viable and sustainable.

This shift in mechatronics is beginning to make the nontechnical skills just as important as the hard sciences in the design process. The challenge now is to achieve the right balance.

Shifting Culture

Even with the growing awareness of the multidisciplinary approach's value, traditional mindsets still impede broad adoption of mechatronics. The greatest barrier is the silo structure that permeates the design cultures of many companies. The profile of narrowly focused engineers prevents mechatronics from reaching its full potential. Everyone knows what needs to be done. The challenge is making it happen.

The silver bullet that might do in design silos is the growing assertiveness of the major mechatronic practitioners and the influence they have on their suppliers. One example of this is the relationship Procter & Gamble—which makes the machines that make its products—is cultivating with Rockwell Automation, a major supplier of motors and drives.

P&G needed Rockwell to become a mechatronics-enabling supplier and a full design partner. That meant Rockwell would provide insight into how its products could best be incorporated into P&G's designs. In doing so, P&G's needs are met, and Rockwell gains a competitive advantage over other suppliers.

Most machine-building companies are small to mid-size, and they don't have big engineering staffs. As a result, they need the level of advice and integration help that P&G was seeking. So if a supplier can provide that advice, its offerings become more valuable.

If the efficiency enhancements that mechatronics offers aren't enough to make companies change their design culture, then perhaps lucrative ties with major machine makers will. If Walmart can require its suppliers to use RFID tags, then maybe machine makers can nudge their suppliers toward embracing mechatronics.

Ironically, another factor moving companies' design culture toward mechatronics has been the economy. "I think the financial crisis helped a little bit because it gave people more time to step back and look at their development process," says Christian Fritz, Product Manager for Motion Control and Mechatronics at National Instruments. "And the companies that had optimized their processes positioned themselves well for the downturn."

Common Ground

Not all mechatronics concepts are new, but many of the established practices it incorporates must be adapted to accommodate the methodology's multidisciplinary approach. For example, mechatronics is model-based design. But to really implement the methodology, engineers need a common modeling environment, where all the disciplines can interact and see how design requirements can be met with different or complimentary approaches.

"If you look at mechanical, electrical, and software engineering, the abstractions that each discipline uses to encode its ideas are very different," says Gary K. Fedder, Director, Institute for Complex Engineered Systems, Carnegie Mellon University. "In most respects, the abstractions in one discipline don't translate to the other disciplines. The common ground on which all can relate to each other is on the functional level."

Tools for Change

Until recently, engineers were limited to a few tools that provided the functionality required to support mechatronics. "There are two main programs: MathWorks' MATLAB, which is a leading model-based design tool, and National Instruments' LabVIEW, which is predominantly focused on real-time measurement and control design," says Marquette's Craig.

"Better tools that are easier to use will mean more engineers capable of doing Mechatronic analysis early in the development cycle as a means of option analysis,"
— *Stoyan Lokar*

Practitioners of mechatronics, however, can now point to a new generation of tools. "In the past, mechatronics was more about what engineers should do," says Christian Fritz, Product Manager for Motion Control and Mechatronics at National Instruments. "But recently, tools have begun to emerge that enable the engineer to pursue mechatronics. Companies that provide design tools have started to extend their functionality to cover more than just one area. For example, companies that provide mechanical design tools have started to include control and motion simulation capabilities, or they are partnering with others to compliment their design tools with other tools.

"We've seen a number of major industrial suppliers of servo drives and mechanical components, such as gearboxes and timing belts, come out with their own electronic tool sets to calculate critical parameters and help size and select components," says Stoyan Lokar, Associate Director of

Mechanical & Materials Technologies at Procter & Gamble Corporate Engineering.

According to Lokar, Rockwell Automation has made a major update to its Motion Analyzer software, with much more functionality. And Wittenstein-Alpha (gearboxes), Zero-Max (couplings), and Gates (timing belts) have all updated their software and published critical data required for mechatronic analysis.

As you would expect, major design software vendors are also delivering mechatronics tools. "Over the past 12 months, National Instruments released a couple of features that help realize the mechatronic design approach," says Fritz. "For example, we released some features in LabVIEW that allow you to implement real-time algorithms in a real-time embedded system...."

By themselves, mechatronics' concepts and the design culture would probably change at a slow pace. But the introduction of tools designed specifically to support the methodology might speed things up.

"Better tools that are easier to use will mean more engineers capable of doing Mechatronic analysis early in the development cycle as a means of option analysis," says P&G's Lokar. This will require less and less prototyping of parallel paths. Engineering decisions can then be made based on models, then the models can be extended to higher fidelity and finally proven out on hardware that's close to final design." ■

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

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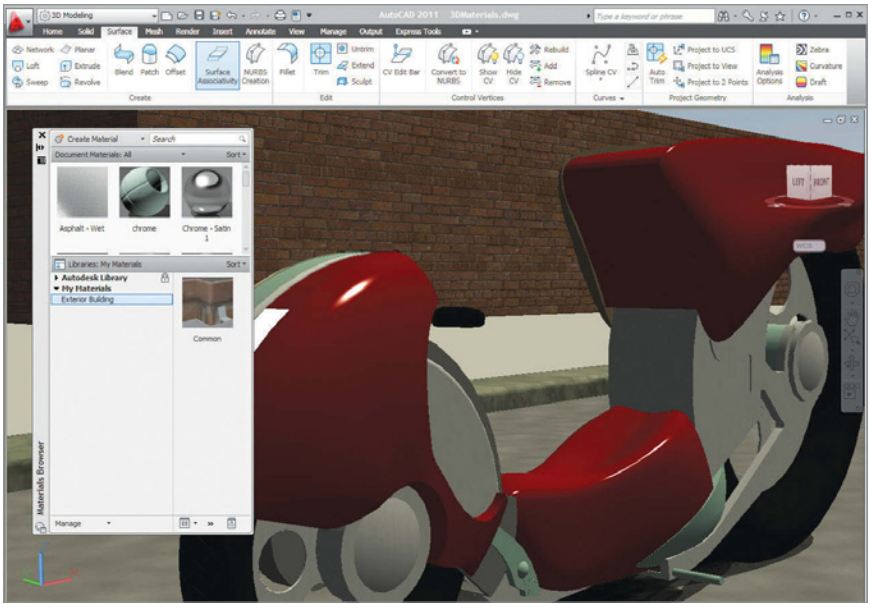
AutoCAD 2011: Even Better than Before

> There's something for everyone in the latest release of AutoCAD.

BY DAVID COHN



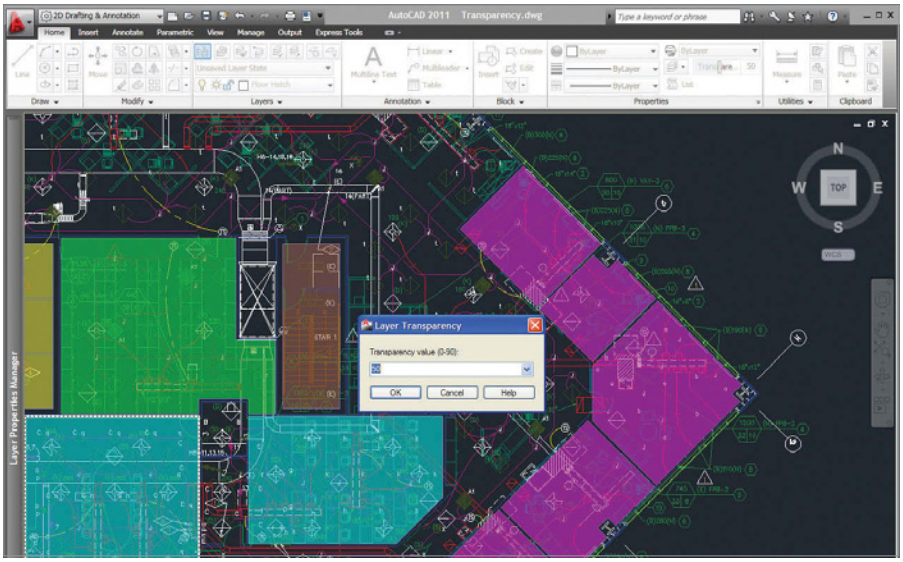
A new material library provides consistent materials across all Autodesk software. The Materials Browser makes it easy to search for materials in the Autodesk library or user-defined libraries.

For its 25th major release of AutoCAD, Autodesk has continued to find ways to make its best-selling CAD program even better and to surprise even the most loyal, long-time users with a host of useful improvements. AutoCAD 2011 offers powerful new functionality for both 2D and 3D users.

Improving the Interface and the Tools

The first thing users will notice upon starting AutoCAD 2011 is a revised drawing window, with a dark gray background when working in model space. The traditional dot grid, which few ever used, has been replaced with horizontal and vertical grid lines similar to engineering graph paper. Red and green lines show the location of the x and y axes of the origin. Above the ribbon bar, which has also been tweaked a bit, the Quick Access toolbar now provides a drop-down for changing workspaces plus both Save and Save As tools. A new Navigation bar provides fast access to tools such as SteeringWheels, the ViewCube, Pan, Zoom, and Orbit, and also integrates support for 3Dconnexion input devices. There are also a number of new visual styles, with the ViewCube now available even when working in 2D. Of course, all of these interface components are completely customizable.

The next welcome change is the inclusion of a bunch of useful object manipulation tools that



A new transparency property lets you apply transparency to objects and layers similar to the way you control color, linetype, and lineweight. Transparency can vary from 0 to 90 percent.

had previously been available only to subscription customers. Isolate Objects and Hide Objects tools control object visibility independent from layer visibility. A Select Similar tool lets you select an object and then automatically select all other objects of the same type and with the same properties, with complete control over which properties to filter. There's a new Selection Cycling button on the status bar that displays a small Selection panel when you select an object that overlaps other objects, so you can easily choose the right one. And a new Add Selected tool enables you to quickly create a new object in your drawing based on the properties of an existing object. For example, you could quickly add a new polyline on the proper layer without having to first change layers and then start the PLINE command.

AutoCAD 2011 also adds a new transparency property, a long-requested feature. You can now apply transparency to objects and layers in the same way you apply colors, linetypes, and lineweights. The default transparency value for layers and objects is 0, but can be set as high as 90 percent. The new transparency setting shows up in all palettes and dialog boxes where you would control other layer or object properties. The actual display of transparency is toggled on and off using a new button on the status bar, much the same as you would toggle the display of lineweight.

Big Changes to Hatches and Gradients

But perhaps the biggest improvement to basic 2D functionality in AutoCAD is the new contextual ribbon tab for creating and modifying hatch patterns and gradient fills. Since the earliest releases of AutoCAD, filling a closed area with a hatch pattern has required users to adjust lots of settings in a dialog box that, while open, covers up much of the drawing. And in order to see the resulting hatch, you had to either click a preview button or click OK to accept the hatch and close the dialog box. Invariably, you'd then need to open the dialog box again to adjust various settings. Now, instead of a dialog box, the hatch creation tools show up in the ribbon and you can see the hatch pattern change immediately within the context of your drawing as you adjust various settings. The

potential time savings is incredible. I was able to create a typical drawing in half the time thanks to this one new feature. You can now choose to create the hatch on a specific layer and hatches can now include a background color in addition to a line color, enabling you to create the effect of layering hatches in a single hatch object. Of course, hatches can also take advantage of the new transparency property.

Once you've created hatches, you can easily modify them, using either the contextual ribbon or a new hatch grip that enables you to change the origin point, hatch angle, and hatch scale on the fly. And finally, a new command lets you send all hatches underneath all other objects in the drawing, and a new setting enables you to mirror hatches while retaining their orientation.

New grip editing capabilities have also been added to polylines and splines. Whereas for years users have had to manipulate polylines using the cumbersome PEDIT command, polylines now display additional grips that let you easily add, remove, or relocate vertices and convert straight polyline segments into arc segments, and vice versa. Similar new spline grip editing capabilities eliminate the need to use the SPLINEDIT command, and you can switch between editing spline fit points or control vertices.

Parametric Improvements All New 3D Tools

While the enhancements to AutoCAD's 2D drafting tools will appeal to all users, the changes to the 3D tools greatly improve accessiblity to the 3D space and the new capabilities begin to rival those found in 3D modeling programs such as Autodesk's own Inventor software.

AutoCAD 2011 now includes two 3D workspaces: a 3D Basics workspace contains a selection of the most basic tools while the 3D Modeling workspace includes the complete array of 3D functionality.

A new button on the status bar provides access to a new set of 3D object snaps separate from the older 2D object snaps so you can snap to a vertex, the midpoint of an edge, the center of a face, and so on. In addition, 3D modeling tools such as Extrude, Loft, Revolve, and Sweep have been enhanced so that you can select an edge or subobject for use as a profile or curve when creating a new surface.

But the biggest 3D news is the incorporation of surface modeling. In addition to solids and mesh objects, AutoCAD 2011 can create procedural and NURBS surfaces. Procedural surfaces can be associative with the curves used to create them, so that if you modify the curves, the surfaces update to reflect those changes. NURBS surfaces are not associative, but have the added advantage of being shaped by manipulating control vertices. You can begin with procedural surfaces to take advantage of associative modeling and then convert them into NURBS surfaces to do additional editing.

Surface creation and editing tools include a Network tool to create a surface through a set of curves, a Patch tool create a "patch" based on a bounding edge that forms a closed loop, and a Blend tool that creates a smooth transition between existing surfaces. There are also tools for offsetting, filleting, trimming, extending, and

AutoCAD LT 2011

AutoCAD LT, AutoCAD's lower-cost 2D drafting sibling, has once again adopted many of the new features of Autodesk's flagship program, making AutoCAD LT even better than before. AutoCAD LT 2011 sports the same appearance as AutoCAD 2011, with the dark gray model space background and grid lines replacing the old-style grid dots. The ribbon and Quick Access toolbar have also been updated to match similar changes in AutoCAD. And AutoCAD LT also includes the new Navigation bar, although since AutoCAD LT is strictly a 2D program, it lacks the ViewCube and does not support 3Dconnexion input devices. But most of the new 2D drafting tools found in AutoCAD 2011, including the object visibility, Select Similar, and Add Selected tools are included in AutoCAD LT 2011 as well.

AutoCAD LT 2011 also includes the new transparency property and takes advantage of the new Hatch Creation and Hatch Editor contextual ribbons. Similarly, AutoCAD LT users can now edit polylines and splines using grips.

While AutoCAD LT doesn't include any of the tools for creating geometric or dimensional constraints, users can take advantage of any constraints that are already present in drawings previously created or edited using AutoCAD. And while AutoCAD LT lacks the ability to create 3D geometry, it can display 3D models created in AutoCAD. Its MSRP is $1,200. — *DC*

sculpting. AutoCAD's new surface modeling tools support up to G2 (curvature) continuity and many editing capabilities take advantage of grips.

Once you've created your 3D models, you can use new analysis tools, such as zebra striping to check the continuity between surfaces, curvature analysis to identify areas of high and low curvature, and draft angle analysis to determine if a model has adequate draft between a part and its mold. You can control the display and behavior of each analysis tool using the new Analysis Options dialog box.

The mesh modeling tools added in AutoCAD 2010 have also been enhanced by the addition of a new Merge Mesh tool for combining two or more adjacent faces into a single face, a Close Hole tool for closing gaps in mesh objects, and a Collapse Face or Edge tool that lets you force vertices of surrounding mesh faces to converge at the center of a selected edge or face.

A Long List of Other Enhancements

AutoCAD 2011 also takes fuller advantage of the unified Mental Ray rendering tools available across all Autodesk products. The new release includes a new materials library that is consistent across all products. When you install multiple Autodesk products, only one copy of that library gets installed. A new Materials Browser makes it easier to find and use materials or even create and add your own, and when you apply materials to

objects in an AutoCAD drawing, they'll migrate seamlessly when you export a drawing for use in other Autodesk products.

AutoCAD 2011 also enables you to attach and display point clouds created from 3D scanning devices. You can attach a point cloud file (an ISD or PCG file) containing up to 2 billion points much the same as you would attach other types of external reference files. Once attached, AutoCAD can display up to 1.5 million points at a time, with the number of visible points controlled by a new Point Cloud Density setting. At present, about all you can do with a point cloud once attached is to create geometry by snapping to points, which is not all that practical at present. But expect to see tools in the future that automate the creation of objects based on point clouds.

Other subtle but welcome changes in AutoCAD 2011 include the ability to save a customized list of annotation scales, complex linetypes that maintain their readability in any orientation, and the ability to ignore missing AutoCAD shape or font files when opening a drawing. And when working with externally referenced files, when you select a reference object in the drawing, the corresponding reference is selected in the External References palette, and when you select a reference in the palette, the corresponding object is highlighted in the drawing.

As a whole, there's something great in this new release of AutoCAD for every user. I'm not sure how they do it year after year, but once again, Autodesk has managed to make AutoCAD 2011 even better. ■

AutoCAD 2011

Price:

> Full system: $3,995

> Annual subscription: $450

> Upgrade from AutoCAD 2010: $595

> Upgrade from AutoCAD 2009: $1,195

> Upgrade from AutoCAD 2008: $1,795

System Requirements:

> Operating System: Windows 7, Windows Vista (SP1 or later), or Windows XP (SP2 or later); 64-bit or 32-bit

> CPU: Intel Pentium 4 or AMD Athlon dual-core 1.6GHz or greater (3.0GHz or greater recommended for Windows 7 or Vista or 3D modeling; AMD64 or Intel EM64T processor for 64-bit version)

> Memory: 2GB RAM

> Video: 1024x768 VGA with true color minimum (for 3D modeling: 1280x1024 with 128MB video RAM or greater, Pixel Shader 3.0 or greater, Microsoft Direct3D-capable workstation-class graphics card)

>Other: Microsoft Internet Explorer 7.0 or later

FOR MORE INFO:

> Autodesk

***David Cohn**, a computer consultant and technical writer based in Bellingham, WA, has been using AutoCAD for more than 25 years and is the author of more than a dozen books on AutoCAD. He's a contributing editor to* DE *and the former Editor-in-Chief of* Engineering Automation Report *and CADCAMnet. You can visit his website at www.dscohn.com.*

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Rhino 5 Drives Modeling Passion

> A solid modeler if you want it to be, but it does a lot more than that and now works on the Mac.

BY MIKE HUDSPETH

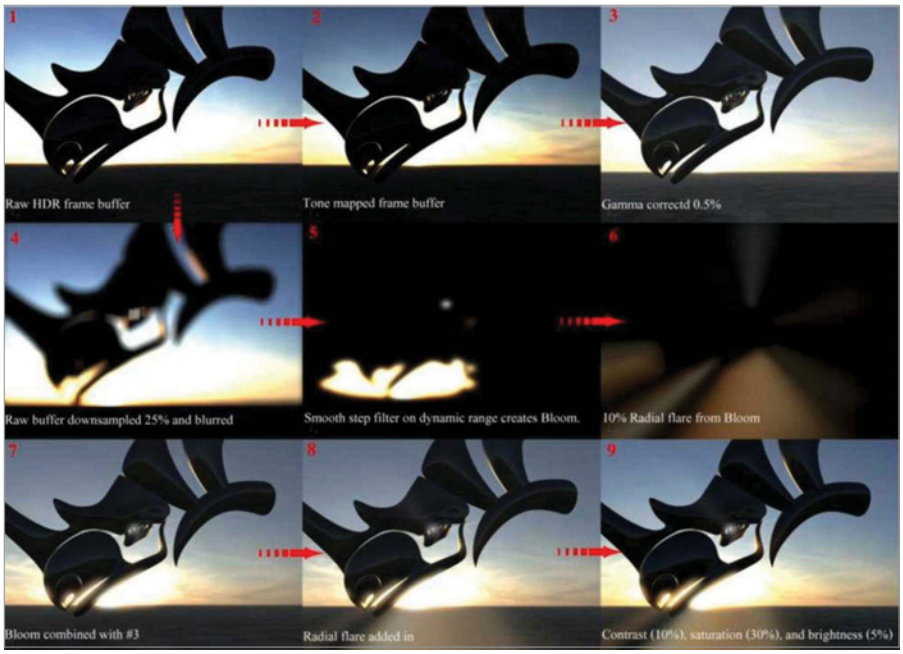


Figure 1: By varying the renderer you use you can produce subtle differences that can make or break an image.

In the world of 3D modeling there are plenty of ways to get your job done. There's the wireframe modeler (which concerns itself with a curve's two end points and all the points in between), surface modelers (which also keep track of all the points enclosed between curves and are really good at describing complex shapes), and at the top of the heap, solid modelers (which know the inside of the model from the outside). The really great 3D modeling programs do all three: wireframe, surfaces, and solids. One such modeler is Rhinoceros 5 from McNeel North America (formerly Robert McNeel and Associates).

Rhino, introduced about 12 years ago, has made great inroads into the industrial design community as a result of both its great modeling ability and its low price—not to mention its terrific translating ability. Continuing a long-standing policy, Rhino 5 is available for free to anyone with version 4 until the next release. Probably the biggest feature of the Rhino 5 release is its availability for Mac in a flavor called Rhino OS X.

And I'm told Rhino OS X (for OSX 10.5 and later) works in a very Mac-like manner. And Windows plug-ins for Rhino will not work in Rhino OS X. You can also get Rhino 5 in either 32-bit or 64-bit versions. Remember that 32-bit machines (the vast majority of all PCs) can't address RAM in quantities of more than 2GB. That means huge files won't just be slow, they won't even load if they are bigger than 2GB.

64 bit machines aren't as limited. They can address as much memory as you can load. (If your files are never that big you probably don't have much to worry about. But if you are shopping for a new computer don't let that dissuade you from looking at 64-bit machines. Even if you don't work on huge files, having that additional bandwidth will make things flow smoother through your machine.)

Visualization

Real-time rendering and shading gives you live materials and textures. This means you'll be able to apply the material and textures you will have on the actual design and be able to rotate and model with it. Who wouldn't like that? Imagine how much easier it will be if you are working on a design that includes many different materials. You'll be able to see at a glance if a part is brass or steel, cast or machined. It'll save time and make your models more realistic. At the moment there's a lot of interest in different renderers. They don't all work the same and will give you different results (see Figure 1). Rhino 5 lets you kick the tires of several. That way you can see what each can do and determine why you might want to use one over another and when. And Rhino 5 will include more sophisticated materials. That means they will act more realistically.

Rhino 5 has some good new things in its interface. In Rhino 5 you will have better control of your lights. There are new capabilities (like edge softness) that will make you look like a wizard. Rhino 5 has tabbed toolbars (I'm still not altogether sure how this is so different from drop down menus, but what do I know?) so you have access to tons

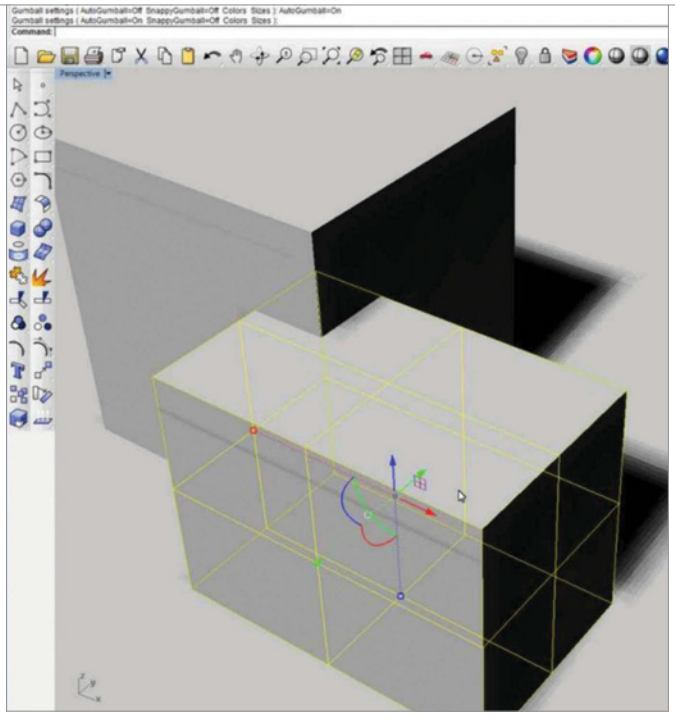


Figure 2: By clicking and dragging on the gumball you can move and rotate your model in all sorts of ways.

of commands without having to take up precious screen real estate. The Gumball (drag handles on steroids) controls orientation of whatever you have selected, not the view (see Figure 2). If you drag the blue and red icon, your selection moves along the plane the icon depicts. And Rhino 5 is even faster than previous versions.

Command And Conquer

A great new command for Rhino 5 is the Shell Poly Surface—a shell (or hollow) command. No longer will you have to build the inside of your model—a tedious and often difficult task that always leaves you open to errors. Rhino 5 uses HDRI backgrounds (which have built-in lighting values). That means the lighting in the background image sets the lighting for your model. If you design beach furniture you can put it on screen with a beach scene in the background and the lighting on your model will be the same. It'll be

almost like you were actually there—or at least look like your product was.

Rhino has always been famous for its ability to read in and out just about any file format. I know people who have never modeled with it, but bought it just for its translating power. It will open just about anything. You can even take solids in or out in DWG format. And speaking of compatibility, a fun, yet useful capability in Rhino 5 is that you can view your Rhino files on your iPhone or iPad, which can help immeasurably on the road at a vendor site.

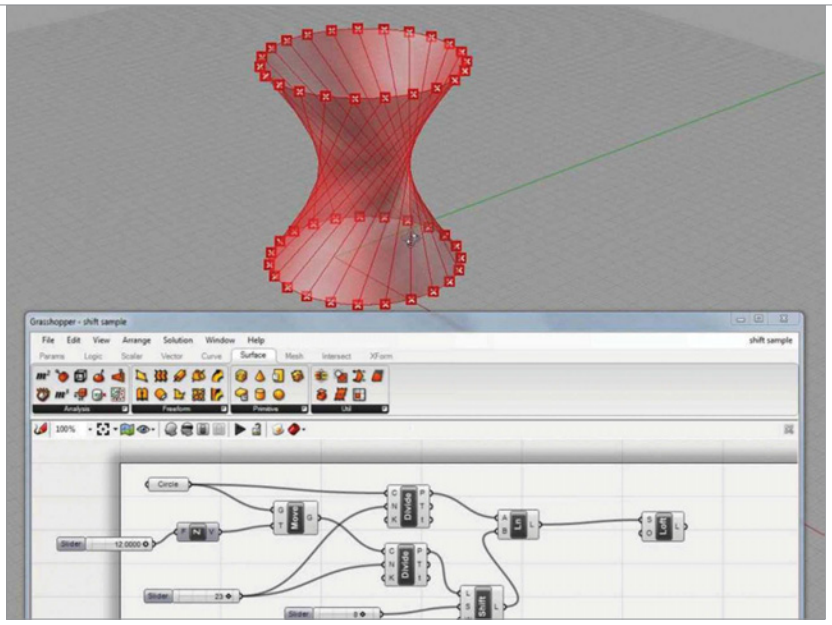


Figure 3: Rhino's add-on Grasshopper is a graphic modeler that lets you control your model by visual means.

Do you like to build models with plastic and glue? Building concept models is one of the fun sides of the business, but don't have to be plastic. You can make them out of card stock and Rhino 5 can help you with this. Surface unrolling can be very handy for form and fit models. Just model your design in Rhino 5 and then unroll the faces into a flat pattern.

Good Stuff & Passion

Rhino 5 isn't just a great modeling tool, it's also a development platform. Companies are making their own add-ons. Even you can "Roll your own" add-ons. The Rhino people have introduced new software that increases your capability. Rhino Python is a new cross-platform scripting language for building add-ons. It's easier to learn than others (like C or Visual Basic). Python is expandable so it grows as your sophistication grows. Grasshopper is a visual programming language (see Figure 3). It's like a drag-and-drop interface editor but with 3D models. Used on shapes that are too sophisticated for standard software (like those driven by databases). You can use it to drive your models by cross-section shapes.

Good design is all about passion. Either you have the passion or you wish to instill passion for your designs in your clients. Rhino 5 is a great tool for designing what you are passionate about. It's not overly expensive at $995, it's pretty easy to learn, and comes with all the right tools. Open the floodgates of possibilities. ■

***Mike Hudspeth**, IDSA, is an industrial designer, illustrator, and author who has been using a wide range of CAD and design products for more than 20 years. He is DE's expert in ID, design, rapid prototyping, and surfacing and solid modeling. Send him an e-mail about this article to DE-Editors@deskeng.com.*

FOR MORE INFO:

> McNeel North America

DFMA Hits the Jackpot

> Design analysis software from Boothroyd Dewhurst helps engineers score 40 percent total savings on slot machine part and assembly costs.

BY NICK O'DONOHOE

IGT uses Design for Manufacture and Assembly analysis software from Boothroyd Dewhurst to cut parts, time, and costs. At right are pictured the former electrical box (top) and redesign (bottom).

Long before the lights start flickering in the video slot machine corner of a casino, a light bulb has to go on over a design engineer's head. And over the heads of an electrical engineer, a mechanical engineer, and a manufacturing engineer as well.

"The simple part of a gaming machine is putting in your money and pushing a button," says Sam Mikhail, engineering manager at International Game Technology (IGT). "The difficult part is keeping every other task relating to the machine nearly as simple. Our customers aren't only the brand-name operators—it's everyone who touches the machine." That includes installation personnel, casino employees reloading the cash system, service technicians, players, and others.

Specifications for the gaming system are quite rigorous inside and out. Because it is an electromechanical product, there are EMF and ESD requirements as well as safety standards to meet. Beyond these, there are security requirements imposed for gaming equipment. "Safety, security, quality, functionality, and cost reduction are our main design goals," Mikhail says. In addition, the slot machines must be customizable for a wide variety of games, with new ones coming out every few months.

But the more complex the internal assembly, the more time-consuming assembly and service can be. Unless the design team strives for simplicity, their product can build in costs up front. "Bear in mind," Mikhail says, "Every moment that these

machines are shut down they make no money for the casino. Ease of service is extremely important so, for designers here, that's a constant challenge."

To meet that challenge, and because of his experience in implementing similar programs in a number of companies, Mikhail led the initiative to implement Design for Manufacture and Assembly (DFMA) analysis software from Boothroyd Dewhurst, Inc., at IGT.

Through the use of the software, one of the design teams in the pilot workshop managed to pare 30 percent off part cost and an impressive 50 percent off assembly times and costs for a critical electrical box used in many of their machines.

Existing Box-Moderate Redesign Comparison

Entries & Labor Time (in seconds)	Existing Box	Box Redesign
Component parts	33 (295.92)	17 (125.29)
Subassemblies partially or fully analyzed	1 (3.75)	1 (5.25)
Subassemblies not to be analyzed (excluded)	0.00	0.00
Standard and library operations	26 (220.50)	12 (103.90)
TOTALS	60 (520.17)	30 (234.44)

Betting on design analysis

Appropriately headquartered in Reno, Nevada, International Game Technology specializes in the design, development, manufacturing, distribution, and sales of computerized gaming machines and systems products. IGT's video gaming machines are instantly familiar all over the world. The company's main product families are video and mechanical-reel slots. Cabinets for the machines have either upright or slanted fronts, depending on the angle of the LCD screen.

Inside the slot machine cabinet is a large array of electronic and mechanical components that perform the behind-the-scenes work for the games: generating random numbers for virtual reels, controlling the sights and sounds that make play entertaining, and managing and tracking payment in and out. "It's very busy inside our machines," Mikhail explains. "As a result, it's also very crowded." Numerous fasteners and limited access points can make assembly and service challenging and time-consuming.

For instance, the electrical box mentioned earlier originally contained two PCBs and a number of hard (plug) connectors wired to it and distributed around the box. The sheet metal box itself had multiple mounting points for parts and several electrical ground points where studs had to be attached by hand and ground wires hooked up. Because there were so many parts in a small space, access was tight and assembly operations difficult. "That box was an obvious place to start a redesign," Mikhail recalls. "In terms of its complexity and our ability to rapidly put a new design in production, it was low-hanging fruit."

Mikhail and other IGT personnel began training on their newly acquired DFMA software, which combines two complementary, closely integrated analysis tools: Design for Assembly (DFA) and Design for Manufacture (DFM).

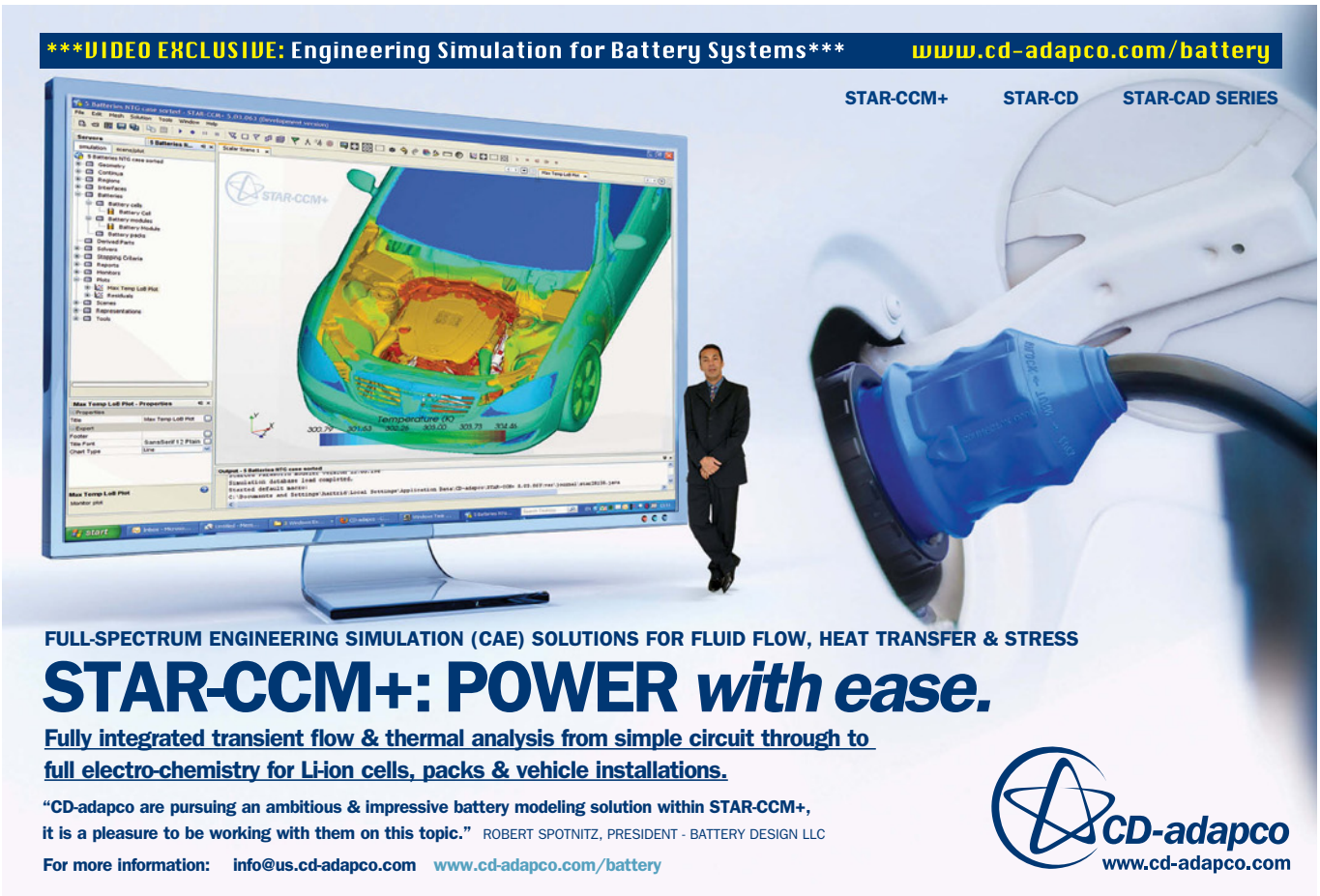
DFA software enables engineers to reduce a product's complexity by consolidating parts. DFM guides designers through the selection of materials and processes. Early in product development, at the concept stage, the software helps engineers starting with basic shapes or CAD models to cost out alternative materials and processes. The extensive process library and cost models in DFM Concurrent Costing help to identify major cost drivers such as machining time, part handling (set-up) time, materials outlay, or secondary manufacturing processes.

The software was a hit at IGT right from the earliest implementation. An interesting by-product of the design discussions during training was a new level of communication and spirit. "Our design teams have always interacted, with members giving their best input from their specialties," Mikhail notes. "What was different with DFMA was the level of creativity it drew out. It turned the team training exercise into an environment that was fun to work in."

Once training was over, it was time to begin a practical, hands-on design exercise.

An assembly in play

The first step was to use the software to benchmark the existing electronic box. Fresh from their training, several team members found that seeing their first real-world analysis triggered new ideas for redesigns. "It was hard to restrain them," Mikhail



recalls, "but I asked them to make notes and wait until we started work on our next analyses."

With the benchmark complete, each design team—which included mechanical, electrical, and manufacturing engineers and a shop technician—worked methodically on two DFMA-guided redesigns: a highly innovative "blue sky" concept and a more moderate reworking of the original box.

The blue-sky version involved eliminating unnecessary fasteners, particularly for grounding. It also included integrating all the connectors into one bulkhead on the printed circuit board, an option that was "attractive, but unrealistic," Mikhail says. There were also additional design constraints, such as the need to retain standardized components that were used across other product lines. "Still," he adds, "the blue-sky design sessions really opened up our creative sides. Someone would make a suggestion so radical that the rest of us would laugh, but suddenly we'd find ourselves thinking how it could actually work."

The blue-sky version resulted in eliminating more than two-thirds of the parts, with assembly time reduction of over 84 percent. Even the more moderate redesign incorporated two PCBs into one and—by integrating connectors, combining grounds, and consolidating or outright eliminating parts—reduce total components by nearlyhalf.

Taking advantage of the freed-up real estate in the new box, the design team relocated several connectors to create room around the plug-ins. The team also shifted components (including mounting them on the lid, bottom, and one side of the box) to make shorter, less complicated wiring runs with simpler harnesses (see Table 1).

The end result was a 30 percent reduction in part costs and a 50 percent reduction in labor cost and assembly time—an overall 40 percent cut in total cost savings. "DFMA gave us a systematic and structured approach to address and satisfy electrical, mechanical, and assembly issues," Mikhail says. "That paid off, even on our first project."

The payout

The redesigned electronic box will be included in future gaming machines from IGT. The new design is expected to reduce assembly and service times, cut potential engineering change orders, and promote design modularity.

More than that, the project validated the use of DFMA as a product development strategy. "Our goal is to promote continuous product improvement and lean design at IGT," Mikhail says. "Now that DFMA has proven its worth, we will go about integrating it in our product design life cycle."

The company will also be looking at their existing gaming machines carefully to determine which components could provide the quickest and greatest potential returns on a redesign. "One thing's sure," Mikhail adds. "Nobody here is going to turn away from a design tool that produces that level of assembly and service time savings." And you can bet on that. ■

Nick O'Donohoe *writes bout technology and design. Send comments to DE-Editors@deskeng.com.*

FOR MORE INFO:

> Boothroyd Dewhurst, Inc.

Roland MDX Milling Leads Questa to Success

> Speed and accuracy are the keys to Questa Design Limited's ability to produce rapid operational parts on demand for a variety of customers.

BY GINNY MUMM

Questa uses the Roland MDX-540SA with a wide variety of production materials, including ABS, polypropylene, and aluminum, for a host of clients, including consumer electronics companies.

Aki Hirano loves a challenge, and each day at Questa Design Limited provides a new one. Questa is a design, engineering and manufacturing firm in Scarborough, Canada, that specializes in high tech, product design and development along with low- to mid-production manufacturing. In the 1970s, it manufactured geophysical instruments for the exploration of Canada's vast mineral resources. With changing times came changing needs, and although the company still manufactures scientific instrumentation, it also designs and produces everything from heat sinks to broadcast video assemblies.

"We do work for a lot of engineers, scientists and other professionals, people who are careful by nature and who depend on our designs to perform for them in the field or the laboratory," says Hirano, vice president of Questa. "For our firm, rapid prototyping is really rapid manufacturing or

digital product manufacturing (DPM), since our clients expect the prototype to function exactly as the finished product would."

Questa operates at the forefront of DPM and each step in its manufacturing process makes maximum use of the initial design data, thereby drastically reducing the need for manual input or user intervention. "What sets us apart is our ability to efficiently handle the entire product development cycle," says Hirano. "Most other companies in Canada specialize in either design or manufacturing. We do all of that and more."

To manufacture prototypes that meet its clients' aesthetic and mechanical requirements, Questa relies on a Roland MDX-540SA milling machine. They use the MDX to produce prototypes with the same tolerances, surface finish, and materials as production volume parts.

To manufacture prototypes that meet its clients' aesthetic and mechanical requirements, Questa relies on a Roland MDX-540SA milling machine.

Questa values the MDX-540SA's versatility, noting that no other rapid prototyping process allows it to use such a wide variety of production materials, including ABS, polypropylene, and aluminum. "Other machines can handle some thermoplastics, but none have the range of the Roland," says Hirano. "With the MDX, we can run the exact material that will be used in the final product."

Questa also appreciates the MDX's easy operational set up, noting that Roland's SRP Player CAM software quickly creates tool paths and the optional fourth axis makes fixturing easier. "The MDX offers us a cost-effective way to try out design alternatives before we present our ideas to our clients," says Hirano.

Questa's client list includes companies in the medical, broadcast, automotive, and consumer electronics industries. It has even designed camera parts and consoles for a company that produces remote broadcast systems that can be used in war zones. The robotic camera and console unit allows a correspondent to produce a live shot broadcast without a camera operator, and send it out via the Internet. Another client produces speakers using enclosures prototyped by Questa, while a third had Questa design a boarding system for motor coach passengers with disabilities.

Questa also produces its own products, such as its innovative skate guard "kootsu." The kootsu was originally designed and modeled on the computer, then run as a prototype in FDM ABS. After checking geometries to ensure the prototyped parts fit together correctly, Questa then produced a model on the MDX using polypropylene, a common injection-molded plastic. When physical testing revealed that polypropylene was too hard and slippery for practical application, Questa ran another model in low-density polyethylene, a softer grade of plastic, which tested successfully. "The Roland allowed us to test multiple materials quickly and easily," says Hirano.

In the current economy, Questa finds its pro-

totyping business shifting from single runs to short production runs. "Fortunately, the MDX can handle both types of runs," says Hirano. Questa also uses the MDX to produce additional parts clients occasionally request, saving set up time on larger production machinery. "With the MDX, there's no post-processing, and no finishing on plastics," says Hirano. "It comes off the machine and goes right to the client."

"It's always hard for me to answer people who ask what we do," says Hirano. "Every project is different, and versatility is critical for our business model. The MDX's range of applications, from prototyping to finished products, really helps us meet the challenges we face every day." ■

Ginny Mumm *is a freelance technical writer based in Southern California. Send comments about this article to DE-Editors@deskeng.com.*

FOR MORE INFO:

> Questa Design Limited

> Roland

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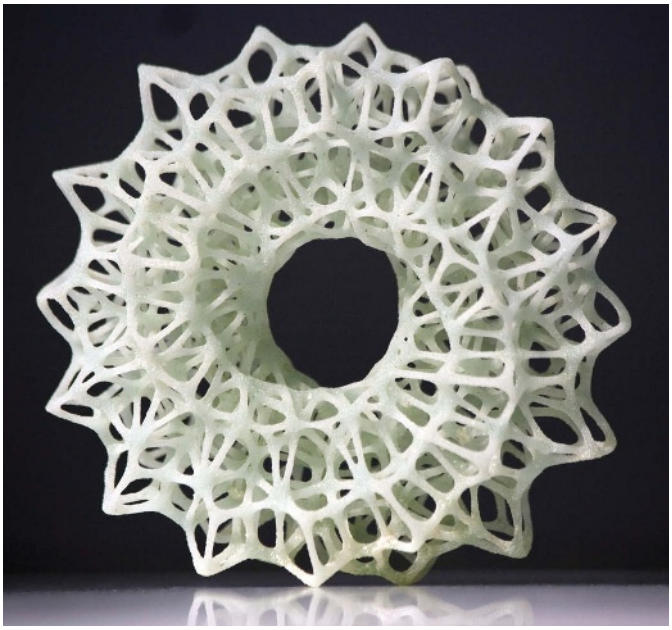
Hot Trends in Additive Manufacturing

> Innovative ways to use and market additive manufacturing are on the horizon.

BY SUSAN SMITH

There are a number of trends gaining momentum in additive manufacturing; and the need for and development of new materials with increasing strength, flexibility, texture, and other qualities continues.



This "Mobius Net" decorative art was printed in a milky white matte glass material from Shapeways. It was designed by Shapeways shop owner Bathsheba Grossman.

First Ever Standards

Originally used for building physical representations of products, additive manufacturing has evolved into an important tool for building usable parts and products. The term "additive manufacturing" is the result of a collaboration of the Society of Manufacturing Engineers and ASTM International to describe this process and set it apart from subtractive processes such as CNC milling.

"Rapid prototyping has meant different things to different manufacturers. It means quick prototyping to one and layered manufacturing to another. Now it's called additive manufacturing," explains Brent Stucker, Ph.D., in a recent press release. Stucker is a member of SME's Rapid Technologies and Additive Manufacturing (RTAM) Community and an associate professor of mechanical and aerospace engineering at Utah State University.

SME's RTAM community approached ASTM to develop the industry's first-ever standards as part of an effort to streamline communication in terms of terminology, design, testing methods, materials, and processing differences.

To address the issue, ASTM formed the Committee F42 on Additive Manufacturing, which includes members of the RTAM community, to write new standards. The initial result is the publication "Standard Terminology for Additive Manufacturing Technologies," now available for purchase online.

▶ The HP Designjet Color 3D Printer represents a first: Stratasys announced the delivery of its first shipment of HP-branded 3D printers for the hardware manufacturer.

ASTM says these new standards will "allow manufacturers to compare and contrast the performance of different additive processes … [and] enable researchers and process developers to provide repeatable results."

Medical/Dental

Still one of the most promising industries for additive manufacturing is medical/dental. Most progress is taking place in Europe, where orthopedics leads the way as one of the fastest growing sectors of manufacturing. Reconstructive devices, spinal implants, arthroscopy, orthobiologicals, hip implants, and knee replacement are among the applications. In the past 18 months, the U.S. has been catching up, especially with the production of copings for crowns and bridges and coating materials for dental applications.

Coatings are also important for implantable medical devices, which have special requirements for wear resistance, increased bony in-growth, and reduced friction. Coatings may need to be biocompatible to avoid harmful interaction with body systems.

Cardiovascular devices constitute the largest segment in the medical device market. These include a wide range of products that make contact with the vasculature or heart: pacemakers, defibrillators, drug-eluting stents, catheters, artificial hearts, and ventrical support systems.

Aerospace

An EOS customer, Royal Plastic Manufacturing, Inc. produces advanced composite parts as an "outsource" manufacturer for larger aerospace and defense companies. Royal has purchased the first EOSINT P 800 system in the U.S. and uses it to sinter high-temperature thermoplastics. Royal also furthers EOS' technology by optimizing the SLS process and developing a PEEK material in cooperation with the U.S. Navy and U.S. Air Force, as well as OEMs, meeting high tolerance capabilities certified to aerospace specifications.

According to a news item on SME's website, Boeing is using rapid prototyping to build an unmanned aerial vehicle (UAV) and link it with a liquid-hydrogen propulsion system; the UAV is expected to be ready for flight next year.

About half the materials used in the building of the Boeing 787 Dreamliner are composites. The design includes increased use of lightweight and high durability composites and advanced aluminum alloys. Carbon fiber and epoxy composites, and titanium graphite laminate have been used in the construction of the low sweptback wings and composites are also used for the nose section.

Gaming and Other Emerging Markets

The availability of color 3D printing in the form

of Z Corporation 3D printers has spawned a new generation of toys. The company FigurePrints, founded by former Microsoft vice president Ed Fries, produces 3D figures created from World of Warcraft game characters created by players. Participants order the figures online and they are built into actual statues using Z Corporation Spectrum Z510 printers.

Demand for FigurePrints is so high that orders are filled on a lottery basis.

Other figurine businesses (ones not linked to gaming) include KarbonKids, wherein a consumer can produce a little figure by choosing from a selection of 500 distinct aspects, each figure taking a mere five minutes to produce. Another is Thatsmyface.com. A consumer submits two jpeg images of him or herself, and using a product called FaceGen can get a figure with their face on an action figure or Barbie doll for $299. This is also accomplished with a ZCorp 3D printer.

Do-It-Yourself Systems (DIY)

Companies such as Bits From Bytes (BFB), MakerBot Industries, and the NextFab Store have been selling a lot of machines based on open-source developments. They allow consumers to get into the act by building their own parts and products.

Consultant Terry Wohlers said that these companies have developed "almost a cult-like following," of younger engineering and grad students who like to make things. "The systems can be bought as kits that they assemble and use to make parts from their 3D CAD data."

Of course, there is not the kind of industry level part quality to be found with higher-end systems from Objet, Stratasys or 3D Systems. RepRap machines and kits retail for far less and are generally used for prototyping or to create products that do not adhere to industry standards … yet.

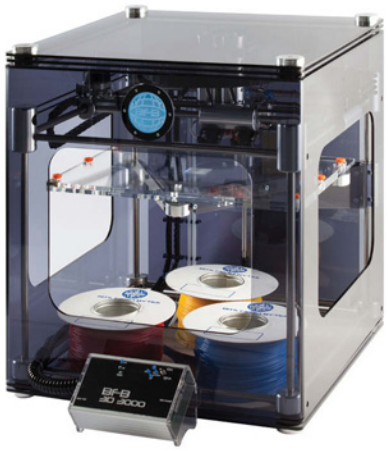
Not itself a printer kit, the BFB RapManPRO 3000 is a similar product that comes fully assembled. This product makes it possible to make more complex build-parts with support, to do so faster, and to build multiple models simultaneously using multiple colors.

Another concept that has been around for a while, but which may now take root more deeply is that of making parts for machines with those machines. For many years, EOS has made as many as 20 parts with its Formiga 100 system for that very system. Stratasys' biggest machine – the FDM900mc, also includes a number of FDM-manufactured parts.

According to Peter Weijmarshausen, CEO of Shapeways, his company offers more of a "marketplace and community" with the aim of making 3D printing technology accessible to consumers. Via its website, the company offers a suite of enabling tools that make it easy for 3D software users to upload and check their models, get instant price quoting, and buy their products. It is also designed for non-3D software users to customize existing designs or buy items from the shops of 3D software users.

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

Shapeways currently offers FDM, SLS (different



◀ The RapManPRO 3000 is the new "big brother" to the RapManUSA Rapid-Prototyping Kit. It is shipped fully-assembled and is considered a budget-friendly fully-functioning, multi-color-capable 3D Printer.

types of materials, different colors), ZCorp, and will re-introduce Alumide, a mix of nylon and aluminum dust. They also offer Objet white, black, and transparent materials, stainless steel and the newly introduced first commercial offering of 3D printing of glass from ExOne. Shapeways does not own its own machines, but outsources production. It has close to 40,000 members and the website has approximately 650 shops run by community members, home to more than 9,000 products.

Systems with a Fresh Approach

Although Objet Geometries came out with the Connex500 in 2007 (the first system to support multi-material 3D printing), it is noteworthy here as it was followed in 2009 by Connex350, a smaller version of the Connex500.

Product developers can print parts and assemblies made of several materials with different mechanical and physical properties in a single build process using the systems' patented PolyJet Matrix Technology. The systems jet materials in ultra-thin layers, immediately curing each layer with UV light. This technology makes it possible for users to pre-set mechanical properties that they want in composite materials. The resulting models closely resemble the look, feel, and function of finished products.

The agreement between 3D printing company Solido and CAD software and service provider SolidVision, meant that Solido's 3D desktop prototype printer, the SD300 Pro 3D printer ($9,950), could be brought to SolidVision's broad base of CAD users. By using their CAD data to directly build in-house designs, users could use those specifications to cut, glue, and layer engineered plastic sheets from a spool, a process known as laminated object manufacturing (LOM).

Previous attempts at LOM had met with criticism because it wasn't capable of producing high detail and resulted in hazardous waste—the SD300 Pro changes that. The SD300 produces detailed, functional parts within 0.1mm accuracy, cuts down on waste, and any excess material and consumable containers are recycled by the company.

Another technology that has been written about but is not yet available is Huntsman Advanced Materials' Araldite Digitalis, a new polymeric additive fabrication system that company spokesmen say is capable of manufacturing large numbers of parts simultaneously at speeds with a pinpoint accuracy not previously possible. It uses the MLS MicroLightSwitch, a new exposure system operating via a computer controlled micro-mechanical shutter system. This system makes it possible for a large surface area of radiation-curable resin to be selectively exposed in a single step, resulting in fast uniform exposure with high accuracy.

Higher-End Systems

Advancements in higher-end systems offering FDM and laser sintering, such as Stratasys Inc. and EOS, range from new relationships to controlled production variables.

Recently Stratasys announced the delivery of its first shipment of HP-branded 3D printers. This is a first for the 3D printer manufacturer: co-developing an exclusive line of 3D printer systems for a major hardware manufacturer. As part of a global manufacturing agreement with HP, the product was developed and manufactured to HP's specification.

Dimension 3D Printing, a brand of Stratasys Inc., recently introduced WaveWash, an environmentally safe cleaning system that dissolves the support material from models made with Dimension 3D Printers. Press materials say the cleaning system is as easy to use as a household dishwasher.

EOS announced its Parts Property Management (PPM) and Parts Property Profile (PPP) capabilities in laser-sintering, particularly plastics. By selecting a laser-sintering speed and part quality, EOS can now provide the kind of controlled production variables that are necessary for optimizing manufacturing costs.

EOS' new metals, a nickel super alloy and an aluminum alloy, are intended for series part production and will advance the number of manufacturing applications for laser-sintering in the coming years.

On the Horizon

What will be game changing in the future? It seems that some of these business models, such as RepRap, Shapeways "communities," and the Stratasys partnership with HP, pave the way for new thinking about ways to use and market additive manufacturing. Although not a new trend, there is also concern about how waste materials from additive processes are disposed of, and what impact they have on our environment.

New processes and materials such as the 3D printing of glass, the ability to use CAD data to directly build in-house designs, the MLS MicroLightSwitch technology that promises high accuracy, new metals and composite materials for medical/dental and aerospace and defense all contribute to shaping the future—perhaps a future in which machines will indeed be used to replicate themselves. ■

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

FOR MORE INFO:

- > Society of Manufacturing Engineers
- > ASTM International
- > RepRap Systems
- > MakerBot Industries
- > Fab@Home
- > Bits from Bytes
- > Objet
- > Stratasys
- > 3D Systems
- > Shapeways
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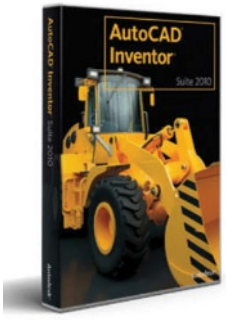

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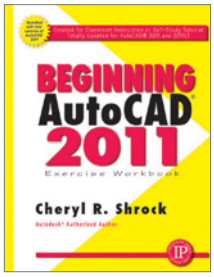

Updated for 2011/2011LT, the Beginning Workbook includes Layer Transparency Control, View Cube and Navigation Bar, Online Help, and Express Tools and comes with a 30-day trial version of AutoCAD 2011. The Advanced Workbook includes the new and enhanced 3D printing, Visual Styles, Grips and Gizmo Tool. Also available … AutoCAD Pocket Reference, 4th Edition. For more information or to order, go to www.industrialpress.com.

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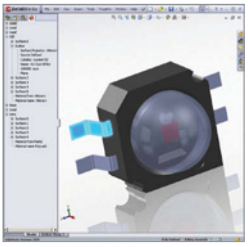

Lambda Research Corporation announces the release of their updated TracePro® Bridge™ Add-in to SolidWorks 2009 and 2010. The TracePro Bridge enables users to assign, view, save and maintain optical properties across iterations directly in their Solidworks model. These complete opto-mechanical models are easily exported to TracePro ready for optical design, ray tracing and analysis which drastically reduces design iteration time.

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Bricsys Releases Beta Version of Bricscad V10 for LINUX

> **Bricsys NV**, the developer of Bricscad, has released the beta version of Bricscad V10 for LINUX.

Until now, Bricscad V10 was available only for the Windows operating system. Since January 2010, a select number of users have tested several alpha releases of a version native to LINUX. Now, Bricscad V10 for LINUX is sufficiently stable and has enough functionality to be released to the public as beta software.

The beta version of Bricscad V10 for LINUX contains the complete DCL and LISP APIs. Existing applications and customizations written for Windows-based Bricscad and/or AutoCAD using these APIs can run on Bricscad V10 for LINUX without modification.

Initially, Bricscad will support two LINUX flavors: Red Hat and Ubuntu. Those wishing to try out Bricscad V10 for LINUX can download the software for test purposes from www.bricsys.com. The first commercial version will be released at the end of June, 2010.

Measurement Computing Releases New Multifunction Data Acquisition Loggers

> **Measurement Computing Corporation** (MCC) has released the LGR-5320 series of stand-alone, multifunction data acquisition loggers. Available from Adept Scientific (adeptscience.com), the data acquisition devices allow users to collect high-speed correlated analog and digital data without a computer.

The LGR-5320 devices, with 16-bit resolution, 16 analog and 16 digital inputs, and four encoder

Alibre Annaounces Alibre Design Personal Edition

> **Alibre Inc.** has announced Alibre Design Personal Edition (PE), a low-cost, easy-to-use 3D design tool.

Alibre Design PE delivers a parametric solid modeling system with integrated 3D solid modeling, part and assembly design, associative 2D drafting, and STL export at a hobby-friendly price. It also includes a set of built-in and online tutorials, and downloadable video training.

The $99 software is well suited to newcomers to 3D design.

"America is going back to work. Large-scale downsizing has released tremendous talent and ideas from scientists, engineers, and business people, now ready to do whatever it takes to start their own businesses," says J. Paul Grayson, Chairman and CEO, Alibre Inc. "With Alibre Design PE, entrepreneurs and inventors will once again 'change the world' and create careers for themselves and jobs for their colleagues."

Alibre Design PE's software tools feature 3D design and visualization; Automatic 2D drawings from the 3D model; Parametric 3D modeling tools, and more.

inputs, perform measurements at up to 200 kS/s, directly to a secure digital memory card. Users can collect data to monitor systems and events without dedicating a PC. The LGR-5320 loggers ship with DAQLog software to configure the devices and retrieve data via the USB interface or SD memory card. Each device includes a 4GB SD memory card and is expandable to 32GB SD memory for collecting up to 16 billion measurements.

For more information, visit adeptscience.com.

LEDAS Releases Driving Dimensions Version 1.3 for Google SketchUp

> **LEDAS Ltd.** has announced version 1.3 of its Driving Dimensions plug-in for Google SketchUp software, a toolset for parametric modification of history-free 3D models.

Version 1.3 supports new platforms and contains several improvements and fixes. It supports Windows 7 and Mac OS X v.10.6 operating systems. The functionality of the multi-document interface (MDI) on Mac platform has been improved. Version 1.3 also includes several fixes of internal errors reported by Driving Dimensions users.

Driving Dimensions plug-in version 1.3 is compatible with Google SketchUp version 6 and 7.1, and has been tested on the 32-bit versions Windows XP, Vista, and 7, as well as on Mac OS X 10.6. Driving Dimensions version 1.3 is based on the latest version of LGS 3D, a geometric constraint solver integrated into a dozen commercial CAD packages.

Omega Launches RDXL120 Compact Portable Data Logger

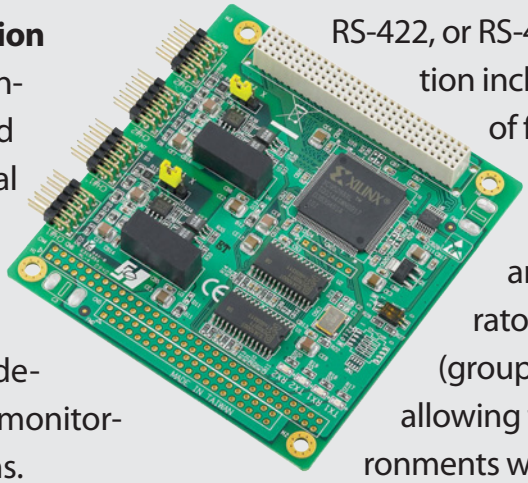
> **Omega's** new RDXL120 series of compact portable data loggers have easy to-read screen display and easy-to-read view TFT LCD, even outdoors, according to the company. The RDXL120 unit has 16 MB internal memory as well as capacity for external storage such as CF or SD card and USB memory. It acquires analog input data with measurement intervals from 100 ms up to 1 hour. The user can set temperature and voltage independently for each channel on this CE marked product. In addition, alarm summaries, log displays, and review functions can be retained and displayed. It also supports remote data acquisition. This unit can monitor automotive engines cylinder temperatures and is designed for applications such as plant maintenance, environmental testing, and process systems. Prices start at $2,750

Aim-TTi, Saelig Release TG5100 Waveform Generator

> **Aim-TTi** and **Saelig** have introduced TG5011, a combined function/arbitrary/pulse generator covering the frequency range of 1µHz to 50MHz. Providing sine waves with low harmonic distortion and low phase noise over the frequency range, the TG5011 is priced at less than $1,400.

The TG5011 incorporates a pulse generator mode that provides wide range pulse width and delay independent of period. Pulse period can be set between 2,000 seconds and 80ns (0.5mHz to 12.5MHz) and the duty cycle can be as low as one in two billion. Rise and fall times are also independently variable over a range. Waveform creation

Advantech Launches ARM-based Programmable Gateways



> **The Industrial Automation Group of Advantech** has introduced the EKI-1121L and 1122L ARM-based industrial communication controllers, which feature a pre-installed embedded Linux operating system for user-developed communications, monitoring and control applications.

These devices are based on an ARM7 SoC (system on chip), featuring dual 10/100 Mbps Ethernet ports, and one or two serial ports, which are software configurable for RS-232, RS-422, or RS-485. The standard configuration includes 16MB of SDRAM, 8MB of flash, and uClinux pre-installed.

The EKI-1121L/1122L are also Underwriters Laboratories (UL) Class 1, Division 2 (groups A, B, C, and D) approved, allowing them to be utilized in environments where flammable liquids, gasses and vapors may be present, common to oil & gas, mining, and chemical processing industries.

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Spatial Releases 3D ACIS Modeler and 3D InterOp R21 3D Development Tool

> **3D InterOp Suite R21 from Spatial** delivers new features, a streamlined interface, and adds support for large-scale point clouds. R21 significantly improves the performance of 3D InterOp, according to the company.

In ACIS R21, the new faceter interface for generating a surface mesh includes pre-defined settings for 3D visualization or analysis plus an expert mode. Mesh-generation performance has been improved with a new quad tree gridding algorithm, which the company says reduces the memory footprint and required number of facets to accurately tessellate a model. And for the metrology industry, R21 helps ensure completion of inspection and measurement paths by providing failsafe slicing of an ACIS model. The release also includes performance-enhancing options for calculating the distance between an entity and a point when assessing the dimensional accuracy of manufactured parts.

Since the previously released version, ACIS R21 includes new capabilities like the ACIS Faceter, efficient handling of large amounts of point data, the capability to handle more complex geometrical conditions for manufacturing, and failsafe slicing.

There are also new CATIA V5 translation capabilities and translation performance improvements. The 3D InterOp Suite also includes new CAD sup-

port for CATIA V5 R20 read and write, SolidWorks 2010 read, ProE Wildfire 5, Siemens NX7, Inventor 2010 read, and Parasolid v22 read and write.

A1 Technologies Offers UNIMAT Modular Machine Construction System

> The **A1 Technologies** portfolio of 3D design and manufacturing tools for model making, design, prototyping, and education now includes the UNIMAT. A modular machine construction system designed to meet the needs of small-scale prototyping or production application, UNIMAT is manufactured by TheCoolTool company.

The UNIMAT range of products has been developed based on traditional subtractive principles of manufacture. The product line consists of the UNIMAT 1, the UNIMAT MetalLine, the UNIMAT PowerLine, and UNIMAT CNC. The system's modularity, offers users a number of possibilities.

The UNIMAT 1 Classic package, which includes a jigsaw, drill press, milling machine (horizontal and vertical), and metal lathe, can be used for professional model making, training, an introduction to engineering, and by schools.

The MetalLine is modular, but built from metal

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components for durability, stability and precision. The MetalLine system can be upgraded to UNIMAT-CNC. The slides of the machines are equipped with 2A stepper motors the reproduction of work pieces and the processing of 3D solid models. The machine can read STL files.

Radius Portable Workstation Features the 6-Core Intel Processor

> The Radius portable workstation from **Next-Computing** features the 6-core Intel Core i7-980X Extreme Edition processor.

Intel's new 6-core desktop processor is more energy-efficient and runs cooler than previous Intel Core i7 models, according to the company, despite the higher number of cores and a fast 3.33GHz clock speed. The processor also features Intel Turbo Boost and Intel Hyper-Threading Technology, giving it up to 12 threads of simultaneous data processing.

With the new processor, network analysts can process high-bandwidth network traffic more quickly, resulting in faster diagnoses and improved network up-time. Data recording applications can handle more simultaneous input streams, giving a clearer picture of a system's problems. ■

Top Three Mechatronics Trends

JOHN HANKS
National Instruments

The complexity of devices and systems has increased significantly in recent years, requiring a mechatronics system-level approach to design. This approach enables engineers to integrate mechanical and control design, quickly realize a prototype, and reuse algorithms in the final embedded deployment platform. Growing investments in the medical, life sciences, and renewable energy fields as well as developments in industrial machines are fueling this system-level trend.

This approach significantly improves the design process by integrating the best available development practices and technologies to streamline design, prototyping, and deployment. By dividing the design process into parallel threads, engineers are able to implement a more efficient development process. In the past, a team developing a control algorithm for a mechanical system had to wait for a physical prototype. Now engineers can get started earlier using a virtual prototype based on design models and simulation data.

> Software has a key role in the future of mechatronics, embedded systems.

In addition to reducing development time and its inherent costs, this approach enables vivid collaboration between design teams and provides system performance data in the early development phases. A digital model of the complete system allows teams to jointly optimize the overall system while maximizing performance.

Yet a successful mechatronics design process requires integrated design tools. During the past few years, tool providers have heavily invested to support this design approach. Companies such as National Instruments created interfaces to provide seamless integration

between different tools. This enables engineers to create virtual prototypes of their systems with a seamless path to embedded hardware and to reuse code and make the most of investments made in the design and simulation phases. During prototyping and deployment, algorithms need to be implemented on embedded hardware.

During deployment, engineers have a variety of options to cut development time. These include designing a custom control system at the component level to optimize cost and deploying to commercial-off-the-shelf (COTS) embedded systems. Reaching the most appropriate decision based on these tradeoffs is often the difference between earning a profit and experiencing a loss. To test market acceptance before a cost-optimized custom design is built, "application ready" subsystems are often used to prototype or as a deployment platform.

Over the last couple of years there has been a trend toward customizable embedded platforms that offer the simultaneous flexibility of a custom layout and rapid implementation associated with COTS hardware. About seven years ago, National Instruments introduced the RIO (reconfigurable I/O) platform. A programmable plug-in board for PCs featuring an FPGA and built-in analog and digital I/O offered customers a way to embed software algorithms in hardware using the graphical development tool NI LabVIEW. Since then, this technology has evolved and is currently used in rugged industrial-grade embedded hardware as well as board-level products. High-level graphical programming tools provide a system-level design approach by abstracting the complexity of low-level drivers and board support packages, streamlining the design process.

Software plays a key role in the future of mechatronics and embedded systems. By providing a system-level view on different design aspects and abstracting the complexity of the latest technologies, software tools enable engineers to implement high-performance systems for the challenges of tomorrow. ■

Over the last couple of years there has been a trend toward customizable embedded platforms that offer the simultaneous flexibility of a custom layout and rapid implementation associated with COTS hardware.

John Hanks *is VP of Product Marketing, Data Acquisition, and Industrial Control at NI. Send e-mail about this commentary to DE-Editors@deskeng.com.*

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