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by Steve Robbins

DE is on the Case

Just a year ago, we reported on how multi-core workstations could be used to create a cluster. With computers using the new Intel Xeon processors, a modern workstation may have 12 cores, many more than an engineer would use while creating CAD models, or using email, Excel, or Word. Granted, engineers could use these cores with some software that was optimized for multi-core processing — like some analysis and visualization software, Labview or MathWorks — but often those cores just sat idle in an engineer's workstation. When engineers did want to tap into those extra cores, some software vendors charged for additional licenses.

Now, a year later, workstation clustering continues to advance. Many analysis software vendors are providing more cost-effective plans to access multiple cores. Multi-threaded software that takes advantage of multiple cores is becoming the norm. Virtualization technology is allowing workstation cluster computing power to be easily assigned and managed.

You might be using computers that are ready to configure into a virtual workstation cluster.

Show Don't Tell

But we wanted to do more than just tell you about the advances of workstation-based cluster computing. We wanted to show you an example of how a workstation cluster could be set up, and the real-world benefits it could provide. We found that example in Irvine, CA, at Parker Aerospace, a division of Parker Hannifin. *DE's* contributing editors Kenneth Wong and Peter Varhol recently visited Parker Aerospace to bring you the details on how the company turned four HP workstations, used by their engineering team in their regular day-to-day work, into a virtual cluster without affecting the performance of the design engineers' typical workload.

The workstation cluster was built using Parallels Workstation Extreme so that some workstation resources could be assigned to the cluster and some could be used for the engineers' day-to-day tasks, like CAD. This allows the workstation cluster resources to be used during the day while engineers use their workstations, not just when their workstations are idle after hours.

Better Designs Faster

When an engineer wanted to perform a simulation, he or she used to load the project into a scheduler to wait for its turn on the company's dedicated cluster in its data center. Big or small, the engineer sometimes had to wait days or weeks for the work to return. Now, engineers send their smaller simulations to the four-workstation cluster. This not only saves time, it allows engineers to create better designs via additional simulation and analysis. And the dedicated cluster returns large jobs faster because it's not bogged down with smaller jobs. Everyone wins.

Creating a workstation cluster is scalable. You only assign the cores you won't be using. And you can change those assignments easily if your workload changes and you need more power. You can use your existing multi-core workstations and add more if needed. If you can't convince the boss to spring for a dedicated high-performance computing cluster, you might be using computers that are ready to configure into your own local, virtual workstation cluster. If not, you will probably be upgrading soon and might be able to show management how cost effective upgrading to the right computers can be.

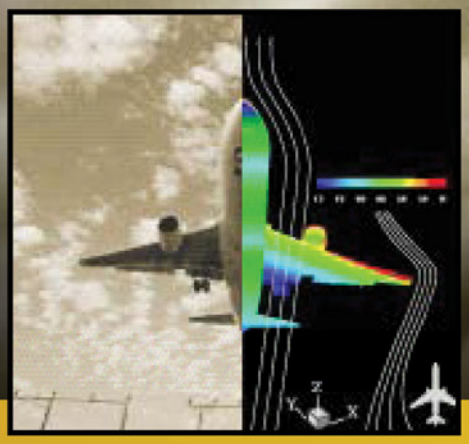
The *DE* team is very excited about reporting on the Parker Aerospace story. In addition to the articles in this issue, we will continue to cover Parker in the next two issues as we take this story to its finish. We will be releasing video of our visit to the company, and have also written a white paper on how Parker Aerospace implemented its workstation cluster. You can get a copy of the white paper at deskeng.com/workstationcluster.

Show Us Your Story

We would like to report on other applications our readers are using to create better designs. We know that you, our readers, come up with new and innovative ways to solve problems every day. Let us know what systems, technologies and processes you are using to help you perform your job better.

Send your ideas and stories to de-editors@deskeng.com. In the subject line, type "DE is on the Case," which is the name of our new series of in-depth case studies. We will review every submission, and, who knows, we might just make your case study the cover story. DE

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



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COVER STORY

Workstation-based Virtual Cluster Speeds Simulation

16 Parker Aerospace, a top-tier aircraft component manufacturer, was relying on its dedicated high-performance computing (HPC) cluster to process all its simulation and analysis jobs. This led to efficiency-draining bottlenecks. By combining its workstations into a virtual cluster, the company's engineers have the resources they need to perform higher quality simulations as part of the up-front design process. They can now consider a greater number of design alternatives, ultimately leading to the creation of optimal products.

ON THE COVER: Multicore workstations have the computing power to speed simulation. Images in the photo illustration courtesy of ANSYS and HP.

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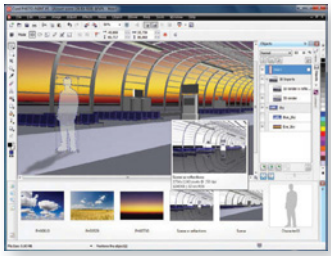

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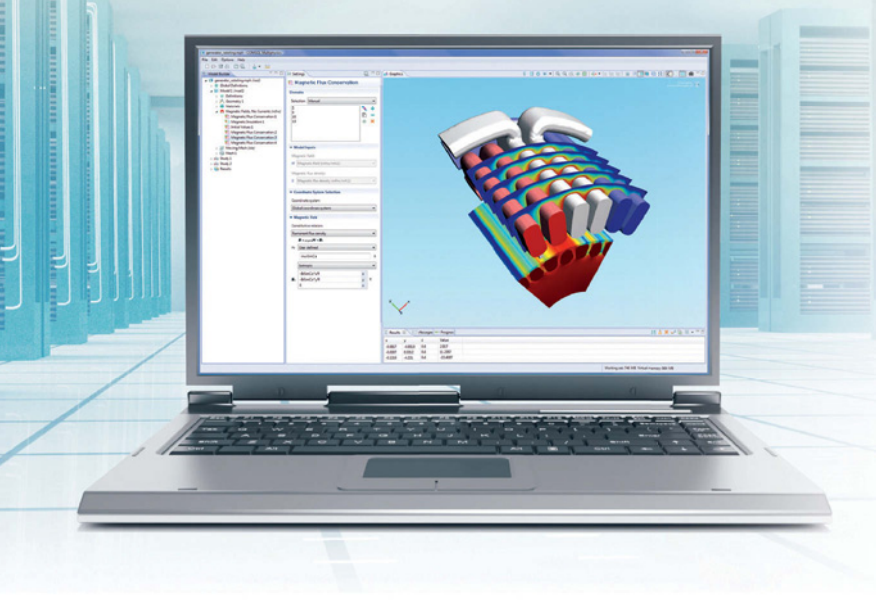

High-performance computing has become key to dramatically speeding up the design process. The technology has become so mature and flexible that it is possible to configure very small experimental clusters ad hoc and excel at much grander scales, reaching previously unseen performance levels. The blend of COMSOL, cluster, and cloud provides you with a powerful tactical toolset that enables you to conquer today's largest and toughest technical challenges.

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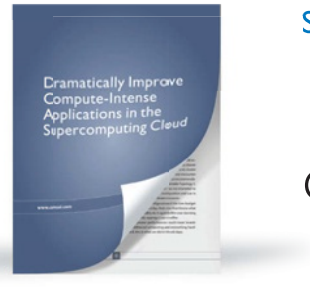

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Answers for industry.

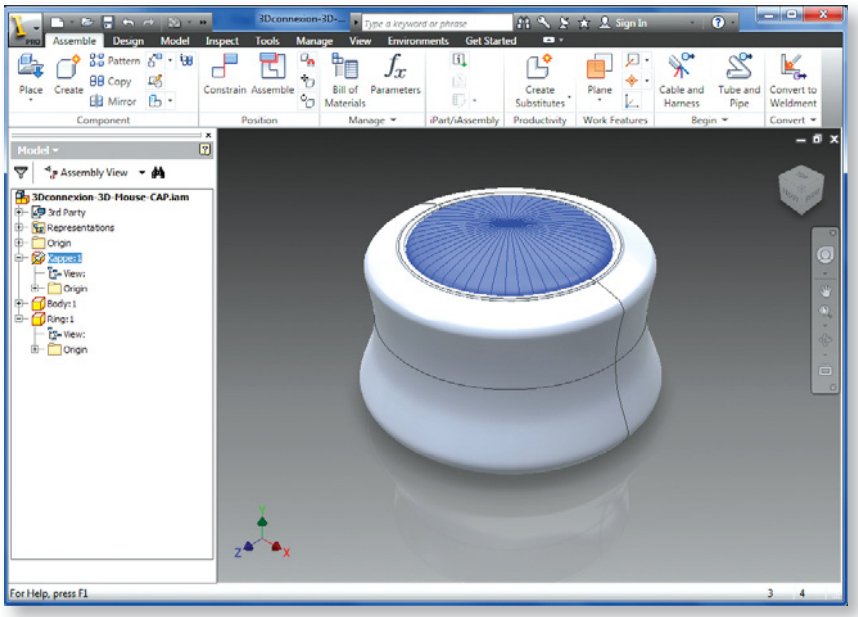
SIEMENS

by Kenneth Wong

Design a 3D Mouse, Win a $5,000 CAD Workstation

Conventional mice, as many of you know, have been a major source of wrist injuries from repeated motion. True, the invention of the computer mouse made text input and selection a lot easier. But it also brought a host of ergonomic dangers previously unknown to computer users. Now, with the emergence of touch computing, most mobile devices are bypassing the mouse by allowing you to navigate 3D models using your fingertips. (See "The Great iPad Race: DWG on the Go," June 21, 2011, and "The iPad Army's Latest Conquest: Teamcenter," April 7, 2011, at the Virtual Desktop blog.)

So what should the mouse of the future look like? 3Dconnexion, a specialized 3D mice developer, is going to entice you to get involved in its brainstorm. The company is running another 3D Design Challenge, dubbed "3D Mouse of the Future."



3Dconnexion's 3D mouse controller (shown here inside Autodesk Inventor), part of 3Dconnexion's design challenge called "3D Mouse of the Future."

Here's how it works. You download a zip file containing a 3D model of 3Dconnexion's standard controller (affectionately known as "hockey puck" in some circles). The zip file contains several industry-standard 3D formats, including STEP, IGES, OBJ and SolidWorks. Next, you "design your ultimate 3D mouse—no holds barred! The only criteria is to ensure your design integrates 3Dconnexion's existing controller cap," the company says in its announcement.

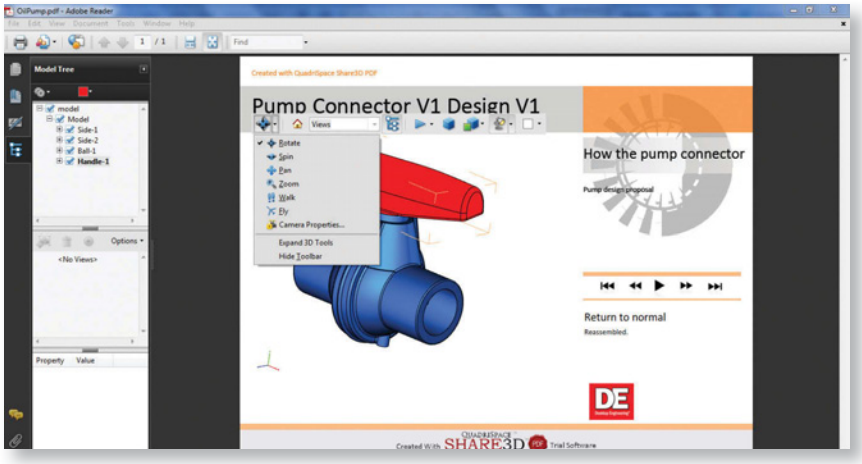
At the end of each month, a panel of judges will pick three winners for first, second and third prizes. If you're picked, you stand to receive a SpacePilot PRO 3D Mouse (first prize), SpaceExplorer 3D Mouse (second prize) or SpaceNavigator 3D Mouse (third prize). The challenge will wrap up at the end of September with the selection of the Grand Prize winner, to be picked by public votes from monthly winners. The Grand Prize is a custom workstation valued at as much as $5,000.

For more information, visit 3Dconnexion.com/challenge. DE

A Template-driven Approach to 3D PDF Authoring

QuadriSpace, which specializes in developing software for 3D data reuse, is taking a dramatic step to reach out to more people than ever. Its latest product, SHARE3D PDF ($199, with $49 for maintenance), gives you a template-driven approach to creating interactive 3D PDF documents.

The software comes with robust support for industry-standard neutral files (STL, IGES, STEP, OBJ and so on), along with the ability to import native parts from SketchUp, Rhino, AutoCAD, SolidWorks and Autodesk Inventor. Once the CAD file is in SHARE3D PDF, you'll see the model, along with its model tree (for assemblies with structures).



A 3D PDF document published in SHARE3D PDF shows the embedded 3D model, interactive links and a toolbar for rotating, spinning and cross-sectioning the design.

SHARE3D PDF lets you create a series of illustrations that work like keyframes, with editable backdrops and text fields. There's a basic material library, so if your model lacks luster, you may apply common materials such as glass, metal, paint or plastic. Keep in mind, though, that the stock library is very basic and the program is not meant for producing impressive renderings.

Moving parts around is fairly straightforward. You can use the Move Parts tool under the Illustrate tab to drag components along an axis. (No part rotation option is provided, however.) The software comes with a rich set of templates (found under the Publish tab), with preset text fields and placeholders for logos and corporate images.

A few quirks I noticed: When in layout mode under the Publish tab, there's little or no text formatting options, so you're stuck with the text as formatted in the template. There's no easy way to resize the fields in the template, so it's difficult to see how the published results will look if the text flows beyond the designated space. By default, the layout window always displays the entire page, with no option to zoom.

The published documents are complete with active buttons, allowing the recipient to follow along your presentation flow. The software adds animation to provide transitions from one keyframe to another. Because the document is a 3D PDF, if you have a reader capable of visualizing 3D PDF, you'll be able to spin, rotate and inspect cross-sectional views of the embedded model.

At $199, SHARE3D PDF is worth considering just for the PDF creation alone. You'll also need to spend at least $299 for a copy of Acrobat X Standard from Adobe just to get the ability to publish PDF documents. DE

by Kenneth Wong

Autodesk Launches Its Own CFD Package

It must have been Autodesk's plan all along to offer its own computational fluid dynamics (CFD) product. But before it could offer something under its own name, it had to go out and find one worthy of the purpose. In the acquisition of Blue Ridge Numerics (maker of CFdesign) in March, Autodesk felt it had found the right technology. So in August, Autodesk launched its own product: Autodesk Simulation CFD.

The new offering "builds on computational fluid dynamics capabilities that Autodesk gained in the Blue Ridge Numerics acquisition in March 2011," according to the announcement.

"Making informed, up-front decisions about air flow, fluid flow or electronics cooling is critical to help design and manufacture safer, quality products or construct more energy-efficient buildings," said Buzz Kross, Autodesk's senior vice president of manufacturing.

Product Fusion

So what did Autodesk bring to the table, besides rebranding Blue Ridge Numerics' established product? The short answer is, Autodesk Inventor Fusion. The standalone direct-editing package, Autodesk points out, will let engineers "modify or simplify geometry quickly and easily from virtually any CAD system when running simulations."

Unlike Autodesk's flagship parametric modeler Autodesk Inventor, Inventor Fusion offers a lower learning curve and easier ways to create and edit 3D design via direct editing (by pushing, pulling, and rotating faces and features).

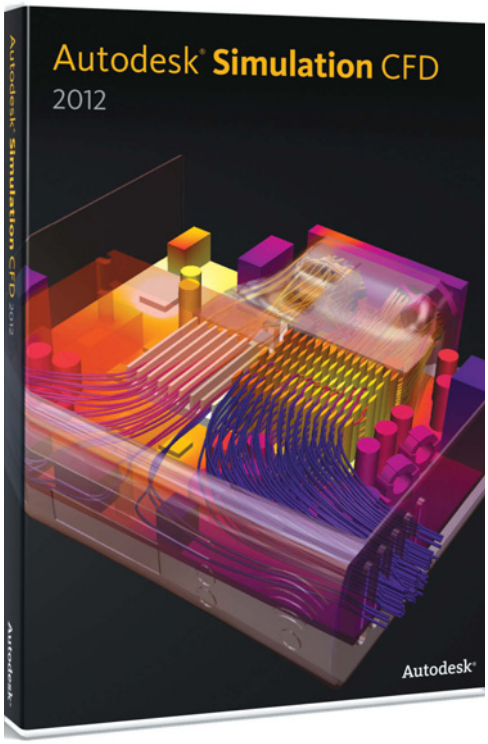
Luke Mehelcic, Autodesk's CFD product manager, clarified the subject. "Inventor Fusion is included in the box with Autodesk Simulation CFD," he said. "When you install, you will have access to both. This includes a connection tool that takes your Fusion models directly into Autodesk Simulation CFD to create design studies."

One Click Simulation

The announcement emphasizes, among other things, what Autodesk describes as One-Click Simulation. Under this method, users may rely on the software to scan the CAD geometry and automatically identify and load certain input values they would otherwise be forced to specify on their own (flow inlets and outlets, for example). They may also rely on the software to identify and suppress non-essential features to speed up CFD solving.

Another feature, dubbed Design Study Automation, will let you set up multiple design scenarios and solve them simultaneously. The function will let you simulate fluid flows in your design under various thermal values, materials and boundary conditions before leaving CAD. Still another feature, Remote Solving, will make it "easy to harness all available computational power on any user's network," the announcement states. The feature comes at no additional cost to users. However, because solver and interface are licensed separately, you may need to purchase additional licenses if you wish to run multiple solvers at the same time.

Mehelcic explained by depicting two different remote-solving usages: "For example, if I have a laptop that is not powerful enough or needs to be running other applications, I can set up the simulation on my laptop and choose to run it on an open engineering computer while I accomplish other things. This would not have a cost associated with it." On the other hand, "[If] I have an engineering desktop computer that I want to run a simulation on, and I have another simulation that I want to run simultaneously on another system, this would require two solver licenses," which requires additional cost.



Autodesk Simulation CFD is based on the technology acquired from Blue Ridge Numerics in March.

For sharing CFD results with those who may not have a compatible software program to view analysis outcome, Autodesk offers Autodesk Simulation CFD Viewer. The free, downloadable viewer can be used as a standalone program or as a plug-in to Microsoft PowerPoint, Microsoft Word or a web browser. DE

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by Kenneth Wong

3D Systems and Alibre: From Partnership to Acquisition

You might remember that, in May, rapid prototyping printer maker 3D Systems and CAD software maker Alibre struck up a partnership to bring you a RP-CAD bundle for as little as $1,500. It appears the partnership was just prelude to an acquisition.

"There was already a deal in progress at the time we announced the marketing partnership in May," Abe Reichental, president and CEO of 3D Systems, revealed. "It was coincidental, in that our 3D printer channel manager approached Alibre to discuss and suggest a partnership, not knowing the two companies were already engaged in advanced acquisition discussion. So we just allowed [the marketing partnership] to happen organically."

Create and Make

In August, 3D Systems bought Alibre Software, bringing an affordable CAD package into its portfolio.

"With Alibre in our portfolio, we are personalizing and integrating design and manufacturing productivity," Reichental explained in the announcement. "The combined affordability and user friendliness of our expanded 3D content-to-print solutions offer a clear and compelling choice for engineers, designers and makers to create and make instantly, at work and home."

Beside traditional engineers and designers, Alibre also caters to hobbyists, tinkerers, homegrown inventors and craft-fair traders with its Alibre Personal Edition ($199). One of the hurdles new users must overcome is Alibre's parametric modeling—well-known among longtime CAD users, but not always easy to grasp for beginners.

"Classic parametric technology requires too much of a learning curve," Reichental said, adding that it excludes less-expert users. "We believe there is room, there is space—particularly for the do-it-yourself users and garage entrepreneurs—to create a simple, intuitive CAD package for those audiences. And also for youngsters—kids in elementary, middle school and high school ages to partake in this exciting 3D revolution."

Direct modelers like SpaceClaim have had great success by allowing users to use Google SketchUp-style push-pull modeling methods to create 3D geometry, bypassing the need to learn parametric principles altogether. Other parametric software makers, such as Siemens PLM Software, PTC and Autodesk, are revamping their own flagship parametric CAD packages to include more direct-editing features.

A Simple Plan

Reichental wasn't specific about how he plans to simplify Alibre software, but one possible approach may be to follow in the footsteps of rival packages like Siemens' Solid Edge with Synchronous Technology, PTC Creo/Direct and Autodesk Fusion to include more direct-editing tools. It's worth noting that Alibre offers push-pull modeling in its higher-end professional package, but not in its low-cost Personal Edition.

For Alibre software users, little change is expected, as Reichental plans to use Alibre's own distribution channel and support network to keep the well-oiled sales machine going.

"We're very impressed with the quality of [Alibre's] reseller channel … we're excited about their own online, outbound sales capability," he said. His grand plan is to "evolve Alibre from a company into a brand."

"In our mind, we're not in this to be CAD vendors," he added. "We're here to offer design productivity tools. That will include some of the SYCODE plug-ins."

India-headquartered SYCODE, which develops and markets plug-ins for major CAD packages, was founded by Deelip Menezes, who also maintains a blog about the CAD industry. In April, 3D Systems acquired Menezes' company and gave him directives to establish 3D Systems India.

"We're particularly excited about the opportunity to expand the field of use in bona fide education and consumer applications at entry level, and in full-fledged manufacturing applications on the high end," said Reichental.

Part of the challenge in preparing 3D models for 3D printing is the need to strip out certain features or to adjust the geometry to make the model fit for print (increasing the thickness of wafer-thin walls so they can be printed without the risk of collapse, for example). Bundling a consumer-level 3D printer with an easy, intuitive 3D editing software will go a long way in making 3D printing more accessible, especially in emerging markets where buyers usually don't own or routinely use CAD software.

For more, listen to the complete audio interview with Abe Reichental at deskeng.com/virtual_desktop/?p=4071. DE

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

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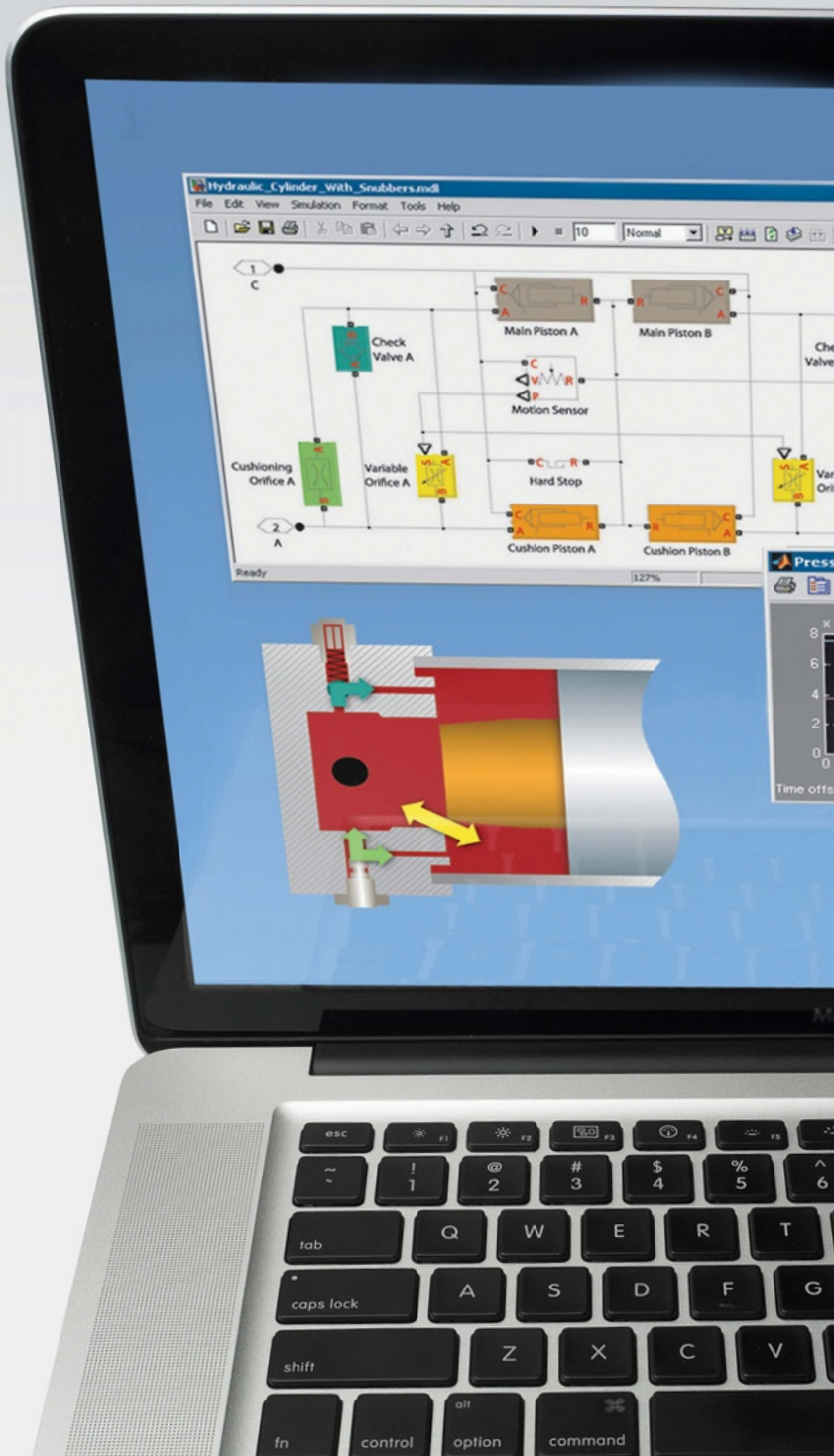

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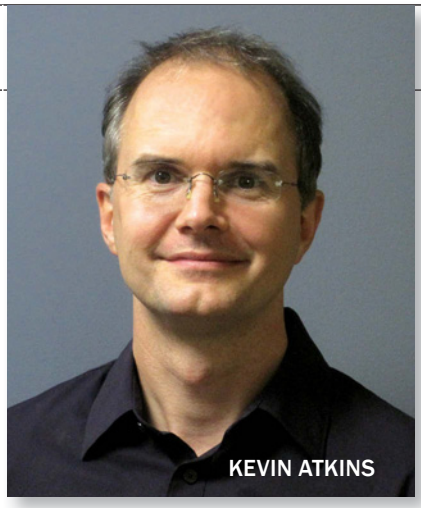
BY JIM ROMEO


KEVIN ATKINS

Today's design environment is getting more complex, and designers are most reliant on precise and complex engineering software solutions to help them with sophisticated 3D modeling. Bringing forms and models from concept to design can be challenging—and that's precisely the need that Sensable's FreeForm Plus Organic Design System seeks to fulfill.

Kevin Atkins is a corporate applications engineer for this product line at the Sensable Corp., based in Wilmington, MA. *DE* spoke to Atkins to understand his product and how it helps the engineering design community:

Q. Tell us a little about the FreeForm Plus Organic Design System.

A. *It is designed specifically to model complex, organic forms that otherwise take too long or are just not possible to create in traditional CAD modelers. It uniquely allows designers to combine multiple geometry types, including surfaces, solids, meshes and voxels, in one integrated environment. FreeForm is complementary to traditional CAD packages like Pro/E, SolidWorks and Rhino, allowing users to easily incorporate sculptural details into solid models and prepare models for tooling, whether for mold or die creation.*

Q. How exactly does it work?

A. *FreeForm combines voxels, haptics (force feedback) and an intuitive user interface to provide product designers with incredible speed, creative freedom and ease of use. Because FreeForm is based on voxels—think 3D pixels that can easily be repositioned in space—it removes the constraints of topology, such as mathematical definition, geometry format and order of operation, that are required in traditional CAD programs. Users model by holding a Sensable Phantom force feedback device instead of a computer mouse. The device pushes back on the user's hand, allowing users to literally "feel" the digital clay model as they sculpt and carve in a manner similar to traditional clay modeling. They can even "pop through" to the inside of the digital model and sculpt from the inside out.*

Q. How does this help shorten the time to manufacture, in your view?

A. *Designers with products that need complex organic shapes, intricate sculptural details and textures face particular challenges, because most 3D design systems take far too long to create these types of designs—if they can do them at all. FreeForm provides fast 3D modeling as well as a full complement of advanced tools that enable designers to analyze how easily their models can be manufactured, tools such as draft analysis, repair tools and creating complex parting surfaces. These tools allow the designer to strike the perfect balance between aesthetics and manufacturability prior to handing them off—reducing engineering reviews and design iterations, and expensive and time-consuming retooling costs.*

Q. What features do you believe are most appealing to end-users?

A. *For projects requiring sophisticated, complex deformations, FreeForm's Lattice Deform tool provides an interactive way to target and restrict deformations to very specific areas of the model—or allow multiple pieces to be deformed as a single unit. For example, working with a multi-piece model of a strategy-game miniature soldier with an intricately detailed uniform and accessories, the designer can simultaneously reproportion the 3D shapes of all items at once.*

Some CAD systems are great for making manufacturable models, but cannot make complex organic models; others can make very complex models, but cannot evaluate or modify them for manufacturability. FreeForm is capable of doing both, with tools such as real-world units and measurements, draft analysis and automatic correction, articulation, thickness analysis and never-fail shelling.

Q. How is FreeForm priced, and what's an expected return on investment (ROI)?

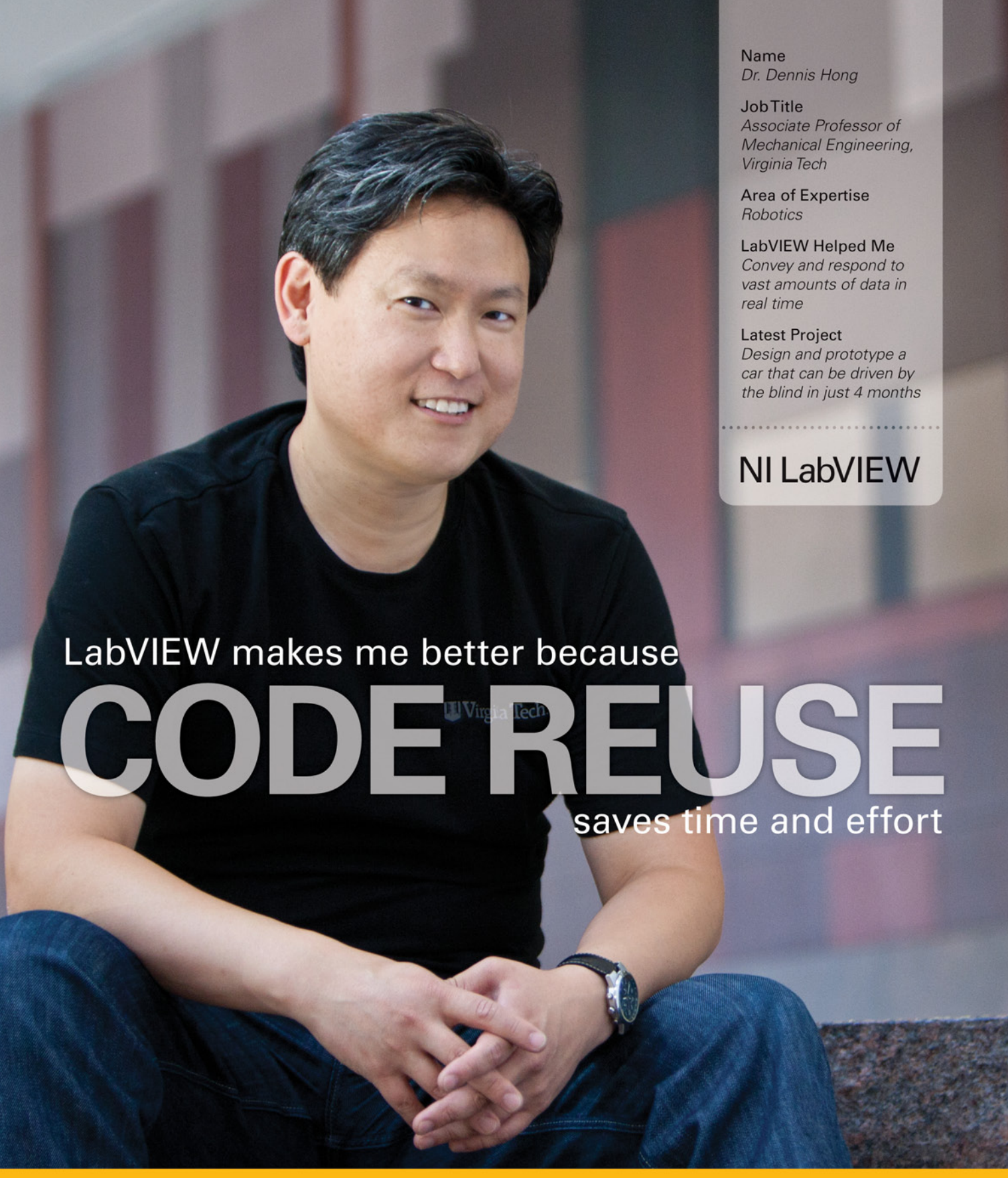
A. *Sensable's 3D Design products include top-of-the-line FreeForm Plus organic design system for manufacturability, FreeForm organic design system, and Claytools digital sculpting system. Pricing starts at $5,900.*

The economic benefit and ROI to using FreeForm is huge. FreeForm helps companies save weeks or months from total design to manufacturing—getting their goods to market faster, and capturing timely market opportunities that otherwise would have been missed. We have many customers who recoup the cost of purchasing FreeForm many times over in just the first year of use. DE

Jim Romeo *is a freelance writer based in Chesapeake, VA.*

INFO ➜ Sensable: Sensable.com

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



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NATIONAL INSTRUMENTS™

Building a Virtual Workstation-based Cluster

Parker Aerospace pumps more computing cycles from multicore HP Z800 workstations while using ANSYS HPC.

BY KENNETH WONG

Parker Aerospace's Bob Deragisch has a personal reason for wanting to make the best aircraft systems and components: His son is an airline captain.

Bob Deragisch, Parker Aerospace's manager of enterprise systems, needed a way to tame a whale of a high-performance computing (HPC) job—growing at an ever-increasing pace that was difficult to manage and control. The aerospace business unit he supports uses ANSYS software to simulate, among other things, airflow and fluid flow inside valves and pumps, and the effects of stress on them.

"We're looking at hundreds to thousands of individual components, analyzed together as a unit," he explains. "These are [hydraulic and fuel systems] that have to fly for 30 to 50 years and meet certification requirements. We test them for all foreseeable situations, all operating conditions."

The vast amount of calculation required makes most of these tasks ill-suited for individual workstations. It was the type of analysis that could only be completed in HPC. But the daunting struggle of the in-house HPC server to keep up with the demand was evident in the job queue that stretched out like a long tail. No amount of additional processors or server racks seemed enough to bring down the stack of pending analysis runs.

Deragisch began to wonder: Is there a way to supplement the server's shortage with the horsepower from engineers' workstations?

The answer came to him when he recalled SETI@home, a scientific experiment that uses web-connected computers to search for extraterrestrial intelligence. Researchers at the University of California-Berkeley have figured out a way to bundle together all the donated computing resources—unused CPU capacity that average home users have decided to dedicate to SETI's cause—into a single virtual server, powerful enough to analyze the mounds of telescope-acquired data in an attempt to pinpoint signs of intelligent alien life. Deragisch would use a similar method to turn a bunch of HP Z800 workstations into a virtual cluster, powerful enough to share the burden with the dedicated HPC server.

The success of this experiment, which led Parker Aerospace to deliver much more robust designs within the same timeframe, is now part of the company's IT strategy. The exercise was made possible by, among other things, the highly

parallel nature of ANSYS software, Windows HPC Server 2008 DCC (Distributed Computing Cluster) software, Parallels Workstation Extreme virtualization platform and assistance from Intel and HP.

The Setup

"Workstations are becoming extremely powerful. They are cluster nodes in their own right," notes Deragisch.

As he looked into the possibilities, Deragisch estimated that adding more Intel Xeon 5600 processors to the workstations would be far less expensive than expanding the HPC server with additional racks, floor space, cooling requirements and processors. His choice was the HP Z800 workstation, equipped with a pair of six-core Intel Xeon 5600 processors.

The engineers' 3D mechanical CAD software, which performs single-threaded operations most of the time, ate up roughly 10-20% of the workstation's horsepower. So, in each workstation, Deragisch reserved two to four cores for the engineer's primary workload. The remaining eight to 10 cores were delegated to the pool of computing resources to draw from, as part of a cluster. This workstation-based cluster's function was to process small and medium-sized jobs, to relieve pressure on the HPC server.

Parker Aerospace's workstation-based setup is different from what some call cycle scavenging or cycle stealing, where all idle cores are made available as potential cluster resources. By contrast, Parker Aerospace created a cluster using a message-passing interface (MPI). In Parker Aerospace's setup, workstation users are guaranteed access to a finite number of cores for their primary tasks, even though their machines are part of a cluster.

Whereas most clusters are assembled in a Unix or Linux environment, standard workstations almost always come with Windows operating systems (OS). The HP Z800 workstation runs 64-bit Windows 7 OS. Therefore, Deragisch's solution was to use Windows HPC Server 2008 DCC, which lets users preserve Windows 7 on their desktops while the rest of their computing cores function as parts of an HPC server. Partitioning the virtual cluster into head nodes and processing nodes was done using Parallels Workstation 4.0 Extreme, which leverages Intel Xeon CPUs and Intel Virtualization Technology for Directed I/O (VTd) to create an environment where workstations could share resources.

[Parker Aerospace's workstation-based cluster] is a brilliant use of resources. Microsoft HPC server software works great in a rack-mounted server environment, but for the smaller design shops that have workstations only, this allows them to run HPC workload on workstations.
—Mike Long, Technical Solution Specialist, Microsoft Technical Computing

ANSYS HPC Licensing

Parker Aerospace uses ANSYS Mechanical, ANSYS CFX and ANSYS Icepak for structural, fluids and electronics thermal management, respectively.

"We really want to encourage our customers to take advantage of [HPC] so they can examine their designs from the system level, not at the component level," says Barbara Hutchings, ANSYS' director of strategic partnerships. "ANSYS HPC pack licensing allows extreme scalability at an incremental cost. It can take advantage of hundreds, or even thousands of cores at a very modest cost."

"Some software we use becomes prohibitively expensive when running on dozens of cores, because we'll need a license for each core," adds Deragisch. "Getting ANSYS HPC Pack offered us a significant advantage."

"The ANSYS software Parker Aerospace was using was Microsoft HPC-enabled," observes Mike Long, technical solution specialist, Microsoft Technical Computing. "There's a built-in job scheduler in the HPC product that allows ANSYS product users to simply specify from their graphical user interface the number of cores they want to use."

Hutchings explains that ANSYS "did a lot of development work to optimize our software packages for HPC, so it's off-the-shelf capability—no extra work required from Parker Aerospace."

Microsoft HPC DCC suite is part of Microsoft's vision to promote technical computing, powered by HPC, as a way for scientists, engineers and analysts to simulate and study the complex interplay of variables, as seen in biomechanical, electromechanical, financial, genomic and climate systems.

Long says he believes building the cluster as a Windows environment (as opposed to Unix or Linux environment) gives users an advantage: "You start out with people who are already familiar with Windows, so they're not required to submit jobs to

Taking a Deeper Look

This article and the What's New Q&A on page 22 are the first two articles in a series that take an in-depth look at one company's engineering practices. *Desktop Engineering*'s editors visited Parker Aerospace to bring the story to you via magazine articles, podcasts, online videos and a white paper, which was sponsored by Intel and HP. We hope this in-depth coverage will provide an example of how your company can adopt readily available technologies that can give you the time and tools to optimize your designs. Find out more at deskeng.com/workstationcluster and if your company would like to be the subject of an "On the Case" story, email us at de-editors@deskeng.com.

We realized that today's workstations are tremendously underutilized. We made a conscious decision to identify and execute a new strategy in order to achieve greater value from our hardware and software investments. The results speak for themselves: We have significantly increased our throughput, and we are using all the available technologies at Parker Aerospace to expedite design decisions from applications like ANSYS, CFDesign and LS-Dyna.
—Bob Deragisch, Parker Aerospace's Manager of Enterprise Systems

a Unix or Linux cluster." This eliminates the hassle of converting jobs to a Unix- or Linux-compatible format, he points out.

Wired Workstations

Because all the cores from individual workstations must work on the same dataset in parallel, network connectivity—the speed with which the machines "talk" to one another—is critical to the performance of the virtual cluster.

"Because you're taking a single computation, dividing it into pieces, and running it on several processors, at some point those processors have to communicate with one another, because the pieces of the problem they're working on are interdependent," says Hutchings. "We have done a ton of software tuning to optimize the message-passing component of our products."

Each HP Z800 workstation comes with onboard network interface cards (NICs). Those who need to pass a large volume of data in a workstation-based cluster may opt for additional 10G NICs to speed up message passing among individual nodes. The new Intel iWARP provides direct node-to-node memory transfers to further increase performance.

Each workstation node has two Gigabyte-Ethernet switches connecting it to the network. With Intel VTd I/O, Parker Aerospace dedicates one NIC to the enterprise network; the other acts as HPC fabric.

Shorter Queues, Better Design

After Parker Aerospace's workstation-based cluster came online, engineers began seeing relief in the bottleneck.

"Some analysis jobs run for hours or days," noted Deragisch. "Now, these long-running jobs no longer tie up all our resources, and smaller runs can be executed on the workstation 'cluster' to dramatically shorten our job queues."

The supplementary computing capacity from the workstation-based cluster, which came at a modest investment in additional hardware, freed Parker Aerospace's dedicated HPC server to concentrate on larger jobs with fewer interruptions, allowing the company to explore more design alternatives.

Deragisch says the wall clock time for the wait for results is shorter for two reasons:

1. The short/medium jobs are no longer run on the company's dedicated HPC server, so the number of jobs pending is fewer.
2. Because the short/medium jobs run on the workstation-based cluster, and do not have to wait behind long-running large jobs, the overall turnaround time for these smaller jobs is shorter.

"The short jobs are not competing with the large jobs for server cluster resources," he adds. "On the basis of individual jobs, [you might see] little or no improvement, maybe even a slight degradation when running on workstations versus the HPC server. But it's not just about individual jobs; it's about substantially reducing the queue of jobs sitting on what was previously a single resource [the HPC server], by offloading small and medium jobs to the workstation-based cluster."

"Certainly there are small [design and engineering] shops that don't have clusters today. They probably can't justify buying a dedicated cluster," notes David Rich, from Microsoft's technical computing division. "But if they get used to using a cluster through their workstations, they might discover that there's enough return on investment to buy a small, dedicated cluster."

ANSYS' Hutchings says she believes familiarity with, and deployment of, HPC among engineers will eventually lead to better designs, as users will be able to examine models with higher fidelity. In other words, their models will feature greater mesh density and more geometric details, providing a more accurate depiction of the designs under consideration. In addition, with access to HPC, engineers and designers can

A Comment on Solid State Drives

In Parker Aerospace's tests to replace traditional hard drives with the more stable, higher performance solid state drives, Bob Deragisch sometimes saw additional power gains. But he cautions, "If you're running on very few cores, the benefit from the lack of latency and responsiveness of solid state drive doesn't help that much. When you get to hundreds of cores, solid state drives make a tremendous difference—roughly a 30% to 50% reduction in computing time. Gains from using solid state drives depend upon the I/O (input/output) profile of the application as well; some applications are I/O-intensive, and solid state drives are of significant benefit in this instance."

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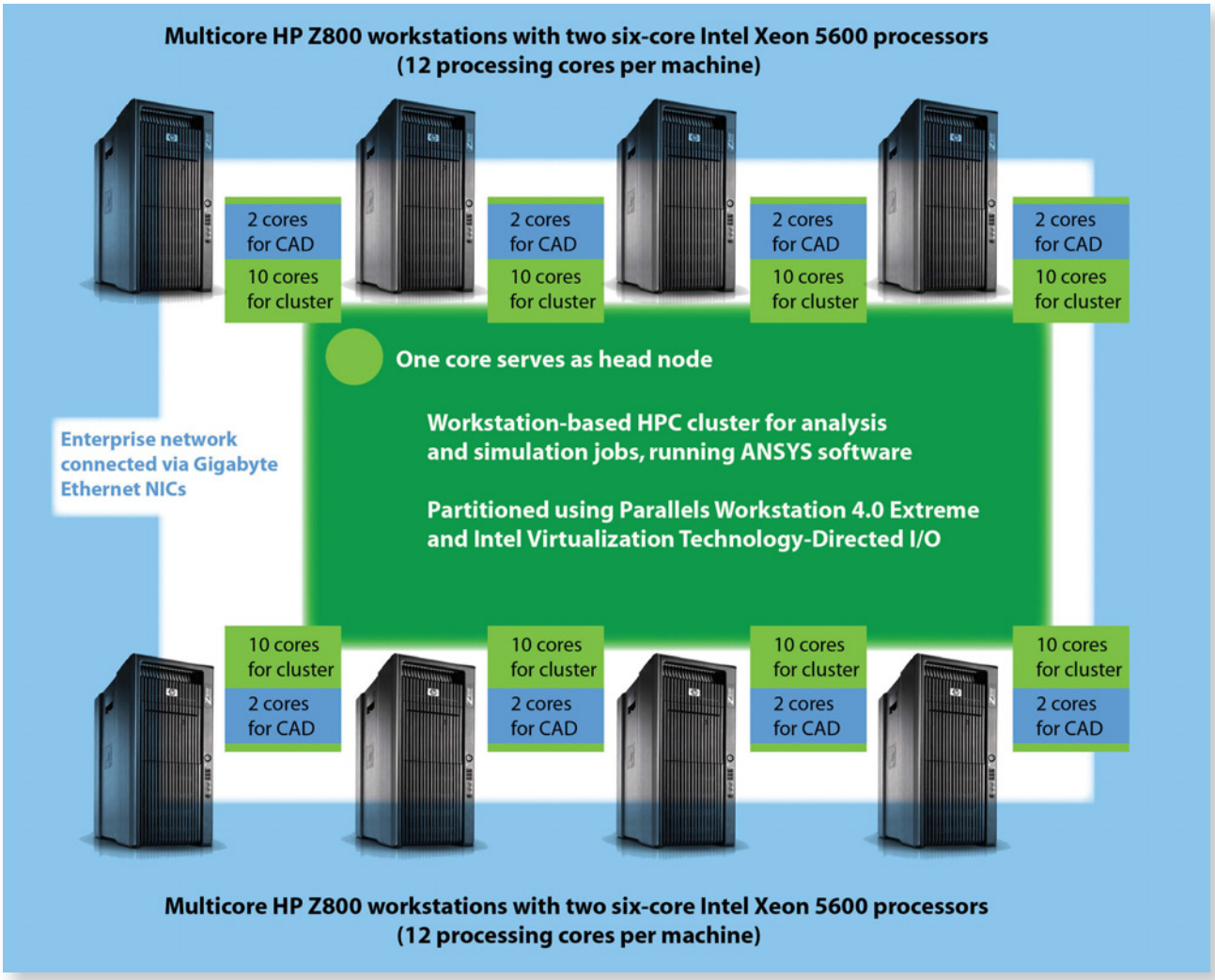

conduct simultaneous studies of multiple design iterations, allowing them to select the best option afterward.

Currently, the high cost of HPC resources puts sophisticated computer-aided analysis and simulation beyond some manufacturers' reach. Thus, the use of this technology is often confined to validating a concept, or proving that a product would perform as intended in practice. ANSYS and its partners expect the rise of HPC will reverse the trend. They hope that, with more affordable HPC setups like that of Parker Aerospace, designers and engineers will begin identifying the most promising concepts in the early phase, then spend the rest of the development cycle perfecting the design.

Deragisch has a personal interest in delivering more robust fuel, hydraulic and flight control systems for aircraft: "My son has just been made a captain. He flies every day." DE

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

Editor's Note: *This article is part of a package of related content that includes an article written by* DE *on behalf of ANSYS for its magazine, as well as an HP and Intel-sponsored white paper.*

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Workstations Work as Clusters

BY PETER VARHOL

The workstation-based high-performance computing cluster that Parker Aerospace uses to speed its simulation turnaround times (see "The Core of a Workstation-based Cluster" on page 16) was made possible by the nature of the company's principle hardware—the HP Z800 Workstation. *DE* contributing editor Peter Varhol interviews HP executives to discuss the characteristics that made it ideal for clustering. Responses are provided by Tom Salomone, HP segment manager for CAD and Design Engineering Industries; Dan Bennett, an HP technical consultant for the Z Workstations series; and Mike Diehl, the HP Z800 Workstation product manager.

Q. What are the primary characteristics of the HP Z Workstations that make them adaptable for workstation-based cluster computing?

A. *The HP Z series family provides great computing power, and a great interactive experience for someone sitting at the workstation. At the same time, you are using otherwise unused resources on the workstation to contribute to a distributed compute solution. The HP Z800 Workstation is especially appropriate for this type of usage pattern, in particular because it's a dual-socket design; that is, it can have two Intel Xeon processors, each of which can have up to six cores. Another key, and a very important point in terms of the technology included in these workstations, is the use of Intel's Xeon processors, because they support a technology Intel calls VT-d, short for Intel Virtualization Technology for Directed I/O.*

Q. Why is the support for Intel VT-d so important?

A. *The way we're implementing this workstation cluster computing model is to use Parallels Workstation Extreme, and it uniquely takes very good advantage of Intel's VT-d technology. That allows their software to implement virtual machines on the workstations, which can be directed to use only certain parts of the workstation.*

Q. The traditional way of clustering workstations is often known as cycle stealing, but that's not what Parker Aerospace is doing, correct?

A. *Correct. Any time you're running multiple things on a workstation, you're competing for resources, and unless there's an intelligent way of putting bounds on one of those tasks, so that it does not steal the resources of the workstation, it's going to slow down the engineer interacting with the computer. And that's what Parallels Workstation Extreme does. It takes advantage of some of the design characteristics of the HP Z800 Workstation. For example, the dual network interconnect provides a means for clustering on a fast private network, while also giving the interactive engineer a separate connection on the enterprise local network. That really helps in terms of keeping workloads separate.*

Q. And that's also important because the cluster workload is dependent upon a fast network interconnect, right?

A. *That's correct, although it depends on the workload. Some applications and jobs have to move a lot of data, and would really benefit from this configuration. For example, the HP Z800 Workstation has enough power and available slots to be able to put two high-end graphics cards into the workstation. The engineer sitting at the workstation has access to one of those graphics cards for work, while the other card could incorporate a GPU that could be used to accelerate the execution of the cluster job, if the application supports GPU computing. That would be very useful for jobs that have a high ratio of floating point operations. And GPU companies like NVIDIA are reaching out to application companies to support GPU computing as a part of their solver engines. Combined with the HP Z800 Workstation running Parallels Workstation Extreme virtualization solution, this could be a very powerful solution.* DE

Tom Salomone

Dan Bennett

Mike Diehl

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

INFO ➜ **Hewlett-Packard:** HP.com
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For the full story on how Parker Aerospace implemented its virtual workstation cluster, download the white paper at deskeng.com/workstationcluster.

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Bundle of Joy

Corel Designer Technical Suite X5 is a collection of tools designed to provide a complete illustration workflow.

BY DAVID COHN

The needs of engineering, marketing and technical publishing are quite different. Engineers require tools to help them design products so that they can be manufactured. Marketing needs pretty pictures for ads and brochures. And the tech pub folks often want simplified drawings for catalogs and manuals. It's quite common for each team to create entirely new images from scratch—a disconnect that results in wasted effort and inaccuracies.

Corel Designer Technical Suite X5 aims to eliminate that disconnect. Users can start projects based on almost any source material—including numerous CAD formats, most vector and raster file types, or from scratch—to create illustrations, diagrams and technical documentation, and produce output for print or online distribution in an equally wide array of formats.

The Heart of the Suite

Central to the Designer Technical Suite is Corel Designer, the company's specialized application for vector drawing, page layout and diagramming. In 2001, Corel acquired MicrographX; Corel Designer is the successor to that product. If you've ever worked with CorelDraw, the Designer interface will seem quite familiar.

The program provides a collection of tools to help users create technical illustrations. There are tools for creating and editing shapes, adding text and callouts, and so on. You can rotate objects into the desired orientation, add dimensions, insert tables for bills of materials, and add various artistic effects.

Although Designer is actually a 2D program, one of its most interesting capabilities is being able to draw on planes aligned to appear to be 3D. Once these planes are created, you can easily draw and place text so that it looks like it is part of a 3D object. The new X5 release features enhanced isometric drawing capabilities with improved gravity snapping and temporary dynamic guides that appear based on snap points to help users align, draw and move objects in relation to other objects. Users can now modify objects in isometric views and create persistent rounded corners. There's also improved callout capabilities with automatic renumbering.

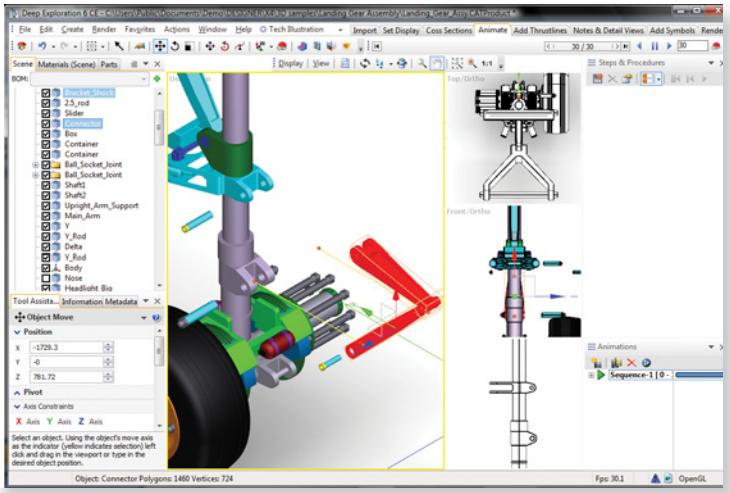
While an artist could certainly use the tools in Corel Designer to create new illustrations from scratch, a big

part of the program's power comes from its ability to open more than three dozen different file formats, including CAD drawings saved in AutoCAD DWG format, PDF files and native Adobe Photoshop and Illustrator files. Once open in Designer, you can use any of Designer's tools to convert those assets into a finished technical illustration.

CAD Conversion Tool

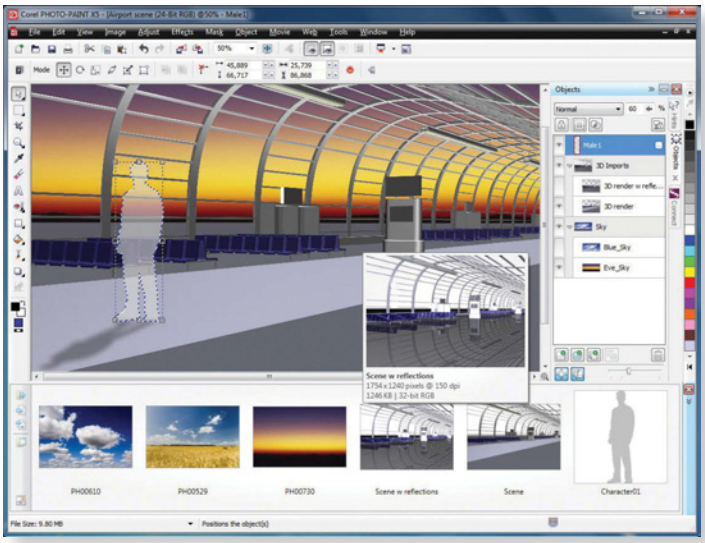
But the Corel Designer Technical Suite X5 doesn't stop there. The package also includes Right Hemisphere Deep Exploration CSE. With Deep Exploration CSE, you can open AutoCAD DWG files—as well as various other formats including 3DS Max, VRML, SketchUp and drawings produced in Creo (formerly Pro/ENGINEER) and CATIA.

Because most CAD programs can save files to one of the supported formats, CSE might be enough. But those who prefer to work with their native CAD formats can purchase Deep Exploration CCE (a $1,699 add-on), which adds support for more than 80 additional formats, including Inventor, SolidWorks and NX, as well as IGES, STEP and SAT.

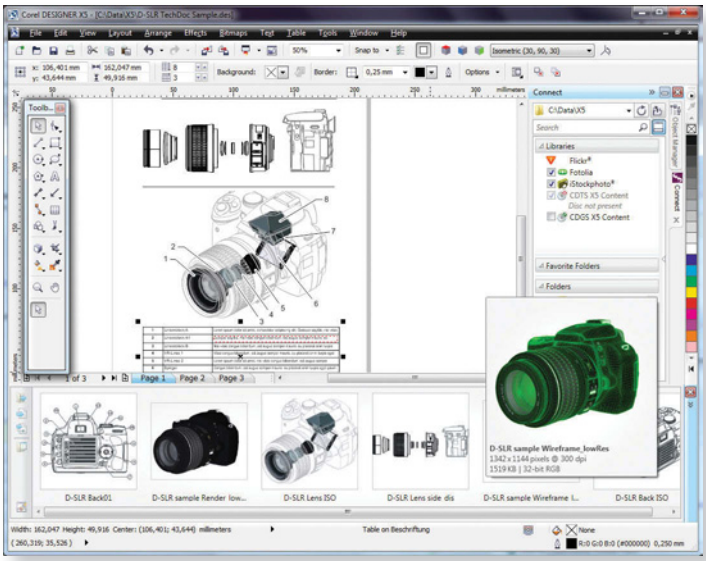


Integration with Right Hemisphere's Deep Exploration CCE lets users open CAD models, adjust parts as needed, and then send the results to Corel Designer or Photo-Paint.

Once any of the supported CAD files is open in Deep Exploration, you can apply cross-sections and exploded views. Deep Exploration includes dedicated workspaces for technical illustration, high dynamic range (HDR) rendering, training, and sales and mar-



3D models exported in bitmap format can be refined and enhanced in Corel Photo-Paint.



Corel Connect can be used as a standalone program or as a docker in Corel Designer, CorelDraw, and Corel Photo-Paint. Assets in the docker are synchronized in all of the Technical Suite programs.

keting materials, so you can quickly achieve the desired look. While working in Deep Exploration, you can still see the entire part assembly tree and manipulate individual objects.

Once you've got the model displayed the way you want it in Deep Exploration, you can send vector data to Corel Designer or raster data to Corel Photo-Paint with a single click. If you send a rendered image to Photo-Paint, you can then use tools to create the desired effect, such as converting colors to grayscale, and then send the bitmap image to Designer or CorelDraw.

Although Deep Exploration is a standalone application, it is tightly integrated with Corel Designer. When working in Designer, selecting 3D Import automatically launches Deep Exploration so that you can open and prepare a 3D model. And in addition to the tools in Deep Exploration for quickly sending files to Designer or Photo-Paint, there are also batch conversion tools for converting or rendering files.

Lots in the Box

Since first introducing CorelDraw in 1989, Corel Corp. has long been known for its award-winning graphics software. The Ottawa-based company also has a reputation for bundling lots of different tools with each of its programs.

Nowhere is that more evident than in this latest Designer Technical Suite. The package includes nearly a dozen separate components. In addition to Designer, Photo-Paint and Deep Exploration CSE, Technical Suite X5 now includes a full copy of CorelDraw, the latest version of Corel PowerTrace for raster-to-vector conversion, the Corel CAPTURE screen capture utility, the SWiSH miniMax Flash animation software, the PhotoZoom Pro photo enlarger plug-in for Photo-Paint, Microsoft Visual Studio Tools for Applications (VSTA) and Microsoft Visual Basic for Applications (VBA). There's also a wide assortment of fonts, photos and clip art. Our installation consumed more than 6.5GB of disc space.

The new Corel Connect application is a standalone content browser that helps users search for and preview content stored both locally and online, then quickly add that content to their designs. Once content has been located, you can place it into a tray at the bottom of the Connect window. You can then open the content in CorelDraw, Designer, Photo-Paint or in its native application (if available). You can also simply drag content from Connect and drop it into an active CorelDraw, Designer or Photo-Paint document.

Among the new features and enhancements in the latest version of Designer is a new color management system. While the software includes presets for various standards, users can now adjust any setting and embed color profiles within saved documents to help ensure color fidelity throughout the production process.

The new X5 version of PowerTrace has been enhanced,

and users report that it produces better raster-to-vector results than ever before. Designer's overall performance is also improved, with support for multi-threading to take advantage of modern, multi-core processors.

Once you've completed your illustration, Technical Suite X5 provides lots of output options. Users can save to a wide assortment of formats, including PostScript Level 3, PDF, PDF/A, WebCGM, S1000D and Flash.

A Complete Suite

With all of the different applications included, Corel Designer Technical Suite X5 presents a bit of a learning curve. Of course, if you've used a Corel product before, you'll likely catch on pretty quickly. For those who take the plunge, Corel Designer Technical Suite X5 delivers a very complete, cost-effective solution for your technical communication needs. DE

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

INFO ➜ Corel Corp.: Corel.com

Corel DESIGNER Technical Suite X5

Price:

- **Full copy:** $999
- **Upgrade:** $499
- **Right Hemisphere Deep Exploration CCE Add-on:** $1,699

System Requirements:

Operating System: Windows 7, Windows Vista (SP2 or later), or Windows XP (SP3 or later); 64-bit or 32-bit

CPU: Intel Pentium 4, AMD Athlon 64, or AMD Opteron 1GHz or greater (2GHz or greater recommended)

Memory: 1GB RAM (3GB recommended, more for 64-bit Windows)

Disk Space: 1.4GB free disk space for installation (1.6GB for typical installation without content; up to 6.7GB needed to install extra content)

Video: 1024x768 VGA, Microsoft DirectX v9 (3D hardware accelerated graphics card with 256MB of RAM, OpenGL 2.0 and Shader Model 3.0; support for HDR rendering.

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

The Value of Color

DE looks at a range of vendor options that create direct- from-the-system color parts beyond the classic white, off-white and clear results.

PAMELA J. WATERMAN

Most people can tell you the exact scene in the 1939 film The Wizard of Oz when the production switches from sepia/black-and-white to full Technicolor. That stunning achievement was the result of switching out physical film types to run three different strips, sensitized to red, green and blue, through one large camera at the same time.

Switching from black-and-white to color in today's world of rapid manufacturing technologies, particularly in additive manufacturing (AM), can be a much less labor-intensive job.

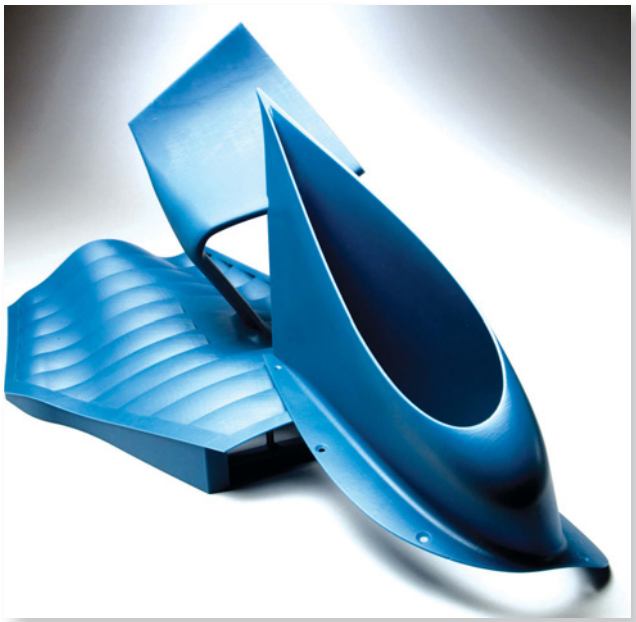
Why Color?

"Most 3D printing and rapid prototyping technologies work in monochrome, where only one color is used—and that is the base color of the material," says Joe Titlow, vice president of product management for Z Corp. "The definitions of what it means to print 'in color' differ widely between technologies."

If you're talking Technicolor AM, Z Corp. equipment leads the pack. But life is always full of trade-offs; Z Corp. materials are targeted to the visual and prototyping markets, and may not have the strength or surface finish needed for certain applications. Other vendors, such as Stratasys, envisionTEC, 3D Systems and Objet Geometries, offer dozens of materials with enhanced properties such as superior stiffness or high heat deflection temperature, but only come in single-color materials with a few multi-color variations.

But why color in the first place? Titlow says the benefits possible with color cover a wide range that not everyone sees when first evaluating AM systems. For example, users can create individual parts (each a different color), assemble them and clearly differentiate each part within an assembly. Some color systems can handle two colors on a single part to create a label, complete with text—or to differentiate a small section from a larger one.

Look beyond these uses, and color also offers new ways of viewing traditional models and data. A system that can create photorealistic color variations across a build volume opens up the manufacturing world to final-appearance prototype parts and packaging designs. It supports architects, urban planners, scientists and health professionals with full-color 3D models depicting buildings, geographic information and CAT scans. And it offers a truly 3D approach to viewing stress or temperature variations analyzed with FEA or CFD software.



F1 racecar parts were built in high temperature Accura Bluestone composite resin on a 3D Systems SLA machine. ***Image courtesy 3D Systems.***

Full Spectrum of Color Options

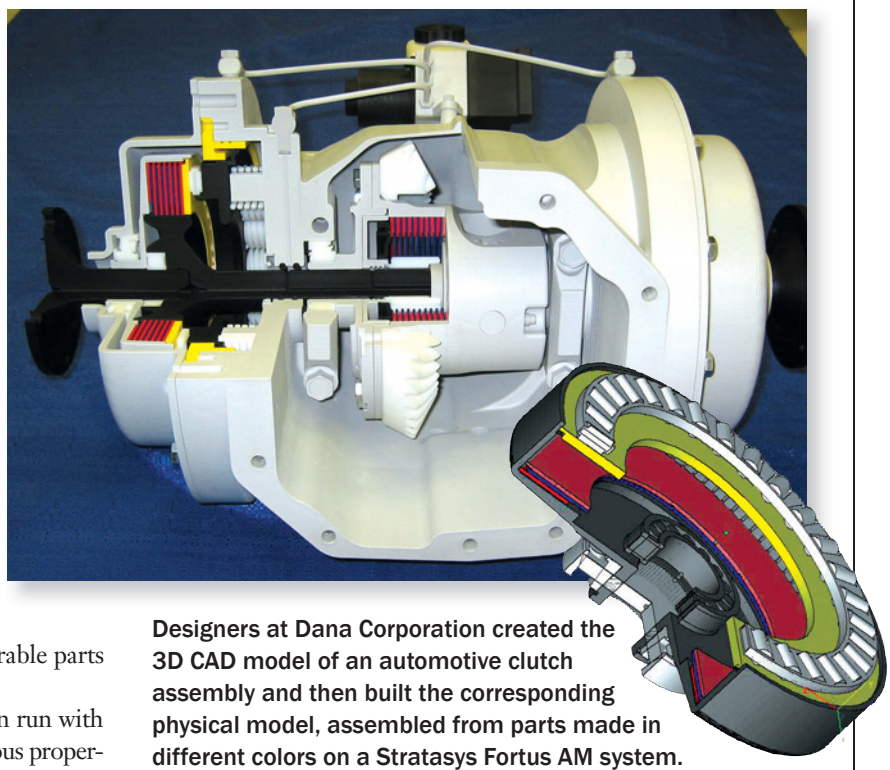
Z Corp. offers five models in its 3D ZPrinter line, three of which build parts with fully ranging colors. Standard 24-bit HP color-inkjet printer heads mix cyan, magenta, yellow, black and white inks into a clear binder-fluid. Done on the fly during printing, this approach offers a natural set-up for applying more than 390,000 different colors within each layer of the powdered, plaster-like base material.

The resulting pixel-level color variations help Z Corp. customers convey complex information to potential clients in many ways. For Stanley Black & Decker, this approach lets designers generate concept prototypes without computed numerically controlled (CNC) machining or time-consuming hand-painted detailing. Models can be turned around in 48 hours, enabling more concept-model generation earlier in the development cycle.

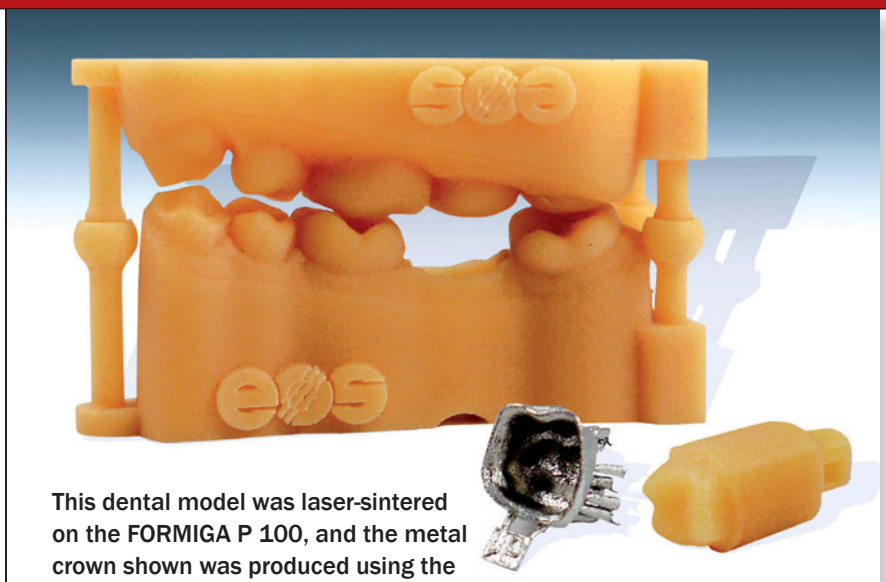
From another point of view, Z Corp. customer Hydroforming Design Light AB finds color is critical for demonstrating the value of hydroforming to potential clients. Compared to drawing or stamping, the process uses pressurized water to expand aluminum or steel into molds. Its consistent, even force minimizes weaknesses in finished parts, but it is a more expensive process. Z Corp.-printed parts have replaced PowerPoint slides for communicating the details of finite element analysis (FEA)-determined stress levels across part geometry. The color variations clearly show how hydroforming avoids manufacturing problems.

A very different AM technology, fused deposition modeling (FDM), builds up parts from actual industrial thermoplastics delivered to the equipment as pure-color filaments. Developed by Stratasys, FDM operates across a broad line of systems, creating durable parts suitable for functional testing and end-use.

The Stratasys Fortus production systems can run with nine different thermoplastics, optimized for various properties such as tensile strength or flame/smoke/toxicity certifica-



Designers at Dana Corporation created the 3D CAD model of an automotive clutch assembly and then built the corresponding physical model, assembled from parts made in different colors on a Stratasys Fortus AM system. ***Images courtesy Stratasys and Dana Corporation.***



This dental model was laser-sintered on the FORMIGA P 100, and the metal crown shown was produced using the EOSINT M 270. The model was made in PA 2105, a colored polyamide that offers color contrast with dental prostheses, making the veneering process easier. *Image courtesy EOS.*

tion. Three of these are variations of acrylonitrile butadiene styrene (ABS) plastics that come either in solid colors such as black, dark gray, red, blue, olive green, nectarine and fluorescent yellow (as well as ivory), or translucent versions of red, amber and natural.

By building parts from different colors (switching out the color reel each time), designers can put together assemblies where each part clearly stands out. This type of application is useful for Stratasys customer Dana Holding Corp., a Tier I automotive supplier whose products include cooling systems, differential cases and under-the-hood filtration systems.

"During the design stage, we add colors to the components of assemblies (such as an automotive clutch)," says Bruce Vanisacker, designer for Dana's Rapid Prototyping/CAE Services. "Then we build FDM prototypes in the same colors."

The Fortus parts help the designers visualize whether assemblies meet key form and fit requirements. In some cases, adds Vanisacker, the parts are so strong they can be used for performance evaluation, too.

envisionTEC is a German AM company with a strong presence in the dental and jewelry industries. Its photopolymerization process, based on mask projection using Digital Light Processing (DLP) technology, takes a different approach than SL to solidifying layers of photosensitive resins. Materials for the company's Perfactory and Ultra systems include a number of color options with varying material properties.

Color of the Beaten Path

Color options are not the exclusive realm of industrial AM systems.

- 3D Systems is the new owner of the RapMan Kit (do-it-yourself) and BfB3000 (assembled) systems developed by Bits from Bytes. These AM systems deposit melted plastics through a heated nozzle (double and triple nozzle upgrades available). Biodegradeable poly lactic acid filament stock comes in solid black, white, purple, yellow, blue and green and translucent clear, red, blue and green. ABS material is available in white, black, red, blue, green and yellow (bitsfrombytes.com)
- Mcor Technologies is a growing presence with its plain-paper lamination system. You can load the unit with stacks of colored paper per your desired design and generate functional striped parts (mcoretechnologies.com)
- Chefs at the French Culinary Institute in NYC (psfk.com/2011/01/3d-printing-at-the-french-culinary-institute-video.html) have been experimenting with two generations of Fab@Home AM systems, using liquid and paste versions of frosting and other foods, while a group at the University of Exeter have been focusing on printing in chocolate (epsrc.ac.uk/newsevents/video-audio/corporate/Pages/chocolateprinter.aspx).

Color Me Innovative

From here on, the actual colors for a given system tend to be secondary to material properties, but still yield some interesting results, particularly in the case of Objet Geometries.

Objet's PolyJet systems operate by jetting photopolymer materials in ultra-thin layers onto a build tray, with each layer cured by UV light immediately afterward. For the company's line of Connex 3D Printing systems, a dual-jet operation lets users fabricate composite on the fly. This PolyJet Matrix process simultaneously jets two proprietary materials chosen from 14 different base materials (of the same type/different color or different types) and combines them in specific concentrations.

The result is 51 possible "digital materials" whose properties vary in flexibility, hardness, temperature-handling and toughness. Although Objet says the company is focused more on these aspects than color, transparency and opacity, the approach does let users create parts with some creative variety. Because the various base materials come in blue, black, white and transparent, different combinations can produce 11 shades of gray, artistic patterns, rubbery soft-touch sections and even color-transparent areas.

Not surprisingly, the broad line of equipment from 3D Systems can build parts in quite a few different colors besides white—but again, it's pretty much a case of one color per material. For example, depending on the stiffness you need, photopolymer resin options for stereolithography (SLA) equipment include gray, opaque gray, blue, peach or light green.

3D Systems Multi-Jet-Modeling 3D Printers offer the VisiJet line of acrylic plastics in blue, gray, dark blue and dark green—each with its own values for tensile strength, flexural strength and elongation at break. And the company's selective laser sintering (SLS) systems create plastic parts in black and gray, depending on whether you choose the ABS-like DuraForm EX or DuraForm GF (glass-filled) options.

In the realm of rapid subtractive manufacturing, Roland DGA remains a cost-effective player for applications without internal geometries and where true end-materials are desired. Color choice is up to you when you use, for example, actual ABS plastic stock on the company's MDX-540 desktop milling machine.

Variations on a Color Theme

For several vendors' systems, third-party sources develop and market dozens of compatible materials that give users more choices for final properties; several of these come in colors.

EOS markets AM systems that sinter either plastic or metal powdered materials. In 2009, the company took majority ownership in Advanced Laser Materials, a Texas business dedicated to invigorating the development of powder-based AM materials. ALM President Donnie Vanelli says that achieving color can be a challenge for sintering systems, because you basically blend white nylon 12 with black carbon filler: "The result is more of a salt-and-pepper effect, giving the material a dark gray look."

ALM also offers 605A, an aluminum-filled nylon similar to EOS' alumide material. What's special is that polishing one of these parts creates an appearance almost like metal. In addition, ALM just announced the availability of its own 850 Black material, a straight black nylon with the pigment in the powder itself.

Huntsman is an international business whose Advanced Materials division is heavily invested in formulating SLA resins for easy processing, high throughput and a range of mechanical properties. Its RenShape SL line includes SL 7820, which produces dark-brown to black parts, while two of the materials listed as medical grade support "selective coloring" (more about that later).

DSM Somos is another material supplier for SL systems. The company has been involved in this field since the early 1980s, paralleling the development of 3D Systems' equipment. Nearly two dozen material options are offered, each with properties that give SLA users more choices for their specific system and application needs.

Among these are DSM Somos ProtoTherm 12110, a high-temperature, water-resistant resin that happens to be cherry red, and ProtoGen 18920, which creates gray ABS-like parts and exhibits different material properties depending on machine exposure control.

Speaking of control, engineers are often at their best trying to push the standard operational limits of a given piece of equipment. This fact is evidenced by a recent online discussion within the Additive Manufacturing Users Group on LinkedIn.

SLA system users compared notes on how to darken a precisely defined section of an SLA part during the build process to highlight an internal detail. The approach is to vary the laser exposure-time in that area; the trick is to do so without distorting, melting or charring the part. Suggestions included running a fan directly across the build layer and always exposing the smaller area first to give a double-exposure more time to cool down.

Huntsman's RenShape SL H-C 9100 and Y-C 9300 resins are designed for just such specialized laser applications. Normally clear, the areas on a layer where users selectively target more energy turn violet in color; the two versions are optimized for different wavelength laser sources.

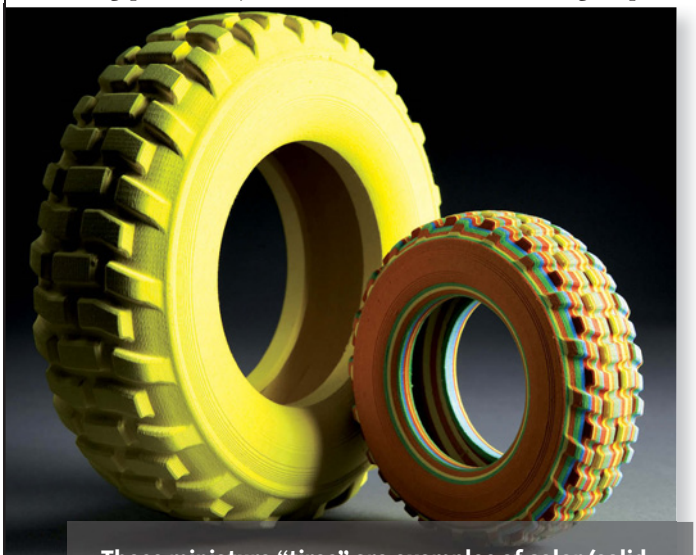
Color Footnotes

No discussion of color in rapid manufacturing is complete without mentioning two other aspects of the topic: casting and post-processing. First, systems from Solidscape (now part of Stratasys), envisionTEC, 3D Systems and Roland DGA run materials in impressive colors ranging from clear, vivid purple to deep amber to photosilver. However, the resulting parts are "just" models for lost-wax casting or producing rubber molds; they're not seen by the end consumer.

Second, most AM parts can be post-processed with surface color by dyeing, impregnating or painting some or all of a part or assembly.

And for a third possibility, Roland DGA markets the VersaUV LEF-12, an interesting inkjet overprinting system that applies CAD-directed, 6-color imagery directly onto the surface of 3D parts as thick as 3.94 in.

If only Turner Entertainment had it this easy. DE



These miniature "tires" are examples of color (solid and striped) parts built by using layers of colored paper in an Mcor Technologies Matrix system. Parts are approximately 3 in. and 1.5 in. diameter. ***Image courtesy Mcor Technologies.***

Color via Consumer Demand

Dassault Systèmes 3DVIA design software subsidiary has teamed up with service bureau Sculpteo to 3D print anyone's design through an online service. Parts can be built in white or black plastic on Sculpteo's in-house EOS Formiga P100 system (example price $42 for a 2-inch part) or in full color on the company's ZCorp 650 3D Printer (example price $48 for a 2-inch part: 3dvia.com).

For a stand-out variation on classic photography, 3DPhotoWorks can take a 2D color digital image and give the image a dimensional feel. The process uses a computer algorithm to separate various aspects of the data, create a bas-relief substrate with a depth up to 1.75 inches and print the image on the raised shape (3dPhotoWorks.com).

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

INFO ➜ **3D Systems:** 3Dsystems.com
➜ **Advanced Laser Materials:** ALM-llc.com
➜ **Dana Holding Coporation:** Dana.com
➜ **DSM Somos:** DSMsomos.com
➜ **envisiontec:** Envisiontec.com
➜ **EOS:** EOS.info
➜ **Huntsman Advanced Materials:** Huntsman.com/advanced_materials
➜ **Hydroforming Design Light AB:** designlight.se
➜ **Mcor Technologies:** Mcortechnologies.com
➜ **Objet Geometries:** Objet.com
➜ **Roland DGA:** RolandDGA.com
➜ **Solidscape:** Solid-scape.com
➜ **Stanley Black & Decker:** Stanleyblackanddecker.com
➜ **Stratasys:** Stratasys.com
➜ **Z Corporation:** Zcorp.com

Taking **Full Advantage** of Your Workstation Power

Virtualization with the HP Z800 Workstation lets engineers truly multitask.

BY PETER VARHOL

Virtualization with the HP Z800 Workstation with Intel® Xeon® processors lets engineers truly multitask.

How often do you have the luxury to do just one thing? Today we no longer work serially, we perform multiple tasks in parallel. The HP Z8 00 Workstation with Intel® Xeon® processors running virtualization software can do the same thing.

Technical computing is undergoing a revolution that is radically changing how engineers work. This revolution is being driven by new capabilities of engineering workstations, making it possible to create and analyze designs faster and in much more detail than in the past.

Hardware and Software Leap Forward

Engineering workstations such as the HP Z series are entirely different computers than past desktop systems. The processors themselves are very different — 64-bit addressing is included in all processors, on-chip caches are far larger, and multiple cores proliferate. Busses connecting processor, memory, and I/O have significantly greater bandwidth, letting more data and code get to these cores in a given period of time.

Engineering software vendors have jumped on these new hardware capabilities, and CAD engineers benefit by the many innovative ways of using hardware and software to become better and more productive engineers.

Engineering software vendors like ANSYS, Autodesk, Dassault, PTC, Siemens and others recognized the advantages presented by HP's Z800 Workstations with Intel® Xeon® processors. They have optimized their software to leverage the available computational resources. The result is you, the engineer, now have access to powerful workbenches where you can create, test and modify in a tight, highly productive, design loop. These powerful workbenches can host integrated tools that combine the advantages of CAD with benefits of CAE. They are helping to make simulation-based design a reality and not a dream.

Virtualization Increases Flexibility

To take this concept further, assume you want to run a higher fidelity model and you know that model reaches beyond the capability of your workstation. Today's HP Z800 Workstations with Intel® Xeon® processors support a highly efficient and effective virtualization technology. Intel calls this technology Intel Virtualization Technology for Direct I/O (VT-d for short). This technology, along with the appropriate virtualization software, allows you to not only create resource partitions on your workstation, it helps you create a cluster of workstations that can act as a local compute cluster, or a micro cloud, capable of providing significant additional computing resources without impacting interactive design activities of your fellow engineers. Using virtualization you can get results back much faster.

Adopting Analysis-Driven Design

Today's HP Z800 Workstations powered by two Intel® Xeon® processors provide an interesting dilemma to consider. You can continue to work serially or you can work in parallel and evaluate more designs and innovative ideas in less time. You can adopt the concepts of analysis-driven design rather than using analysis as only a post-design tool that points out why a design fails after it is created.

Now that you have tools like the HP Z800 Workstation with Intel® Xeon® processors, you have the ability to fundamentally change your design process. DE

For more information on an HP and ANSYS Solutions please go to www.hp.com/go/solver or call 800-888-0261.

It All Adds Up

The beginnings, benefits and business of design-driven manufacturing with laser sintering.

BY ANDREW SNOW

It's no surprise to any engineer that we learn by designing. Lately, what laser sintering adopters learn by design—and teach one another—is a new approach to manufacturing.

Here's a recent example: Design consultancy firm Within Technologies partnered with 3T RPD, a prototyping and additive manufacturing firm in the UK, to explore a bold new design for a heat exchanger. Neither company was aiming for the conventional shell, tube or plate type of exchanger.

Within used its Within Enhance optimization software to generate a strong, lightweight structure of repeated sub-elements, including teardrop-shaped tubes for efficient heat dispersion. Inside the tubes were "turbolators," a series of baffle-like struts that increased internal surface area and disrupted liquid coolant flow to maximize heat transfer.

On the outside of the tubes were self-supporting, integrated cooling fins. Each sub-element was optimized so that the final heat exchanger could be reconfigured into almost any shape required (for instance, to fit inside an irregular space under a race car hood). Overall, the final compact, scalable design was as geometrically complex as a beehive—and just as difficult to imagine manufacturing.

3T RPD used direct metal laser sintering (DMLS) to manufacture the struts, tubes and fins all at once. The resulting structure is optimal in many ways: in weight—reduced up to 80%—in strength and in functionality.

This story is a microcosm of what designers are discovering worldwide: that rapid prototyping systems fill a market niche and, in many cases, enables the series production of designs that are too costly or time-intensive to create by traditional methods.

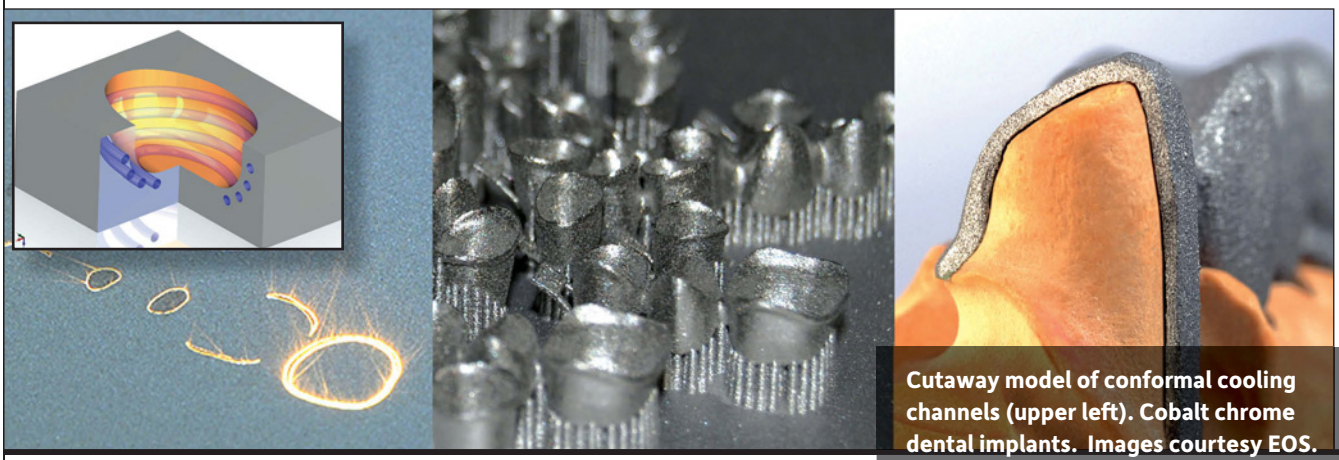
There is a market-wide transition occurring among what were formerly called rapid technologies, additive fabrication, 3D printing, rapid prototyping, etc. In fact, ASTM International committee F42 recently decided the term "additive manufacturing" is now a more all-encompassing term for these technologies, regardless their acronym and end use.

Growing Parts: A Growing Business

Additive manufacturing via laser sintering is inherently different from molding and subtractive processes such as cutting, drilling or grinding. It builds parts from the bottom up, working from a 3D CAD file that is divided into cross-sections. After the equipment deposits a single uniform layer of powder onto a build platform, the CAD data guides the laser to sinter the powder. The platform then lowers, and the process repeats layer-by-layer until it completes a three-dimensional part. The manufacturing sequence is automatic and can run unattended.

This process promises a number of benefits for designers:

- No tooling, minimal set-up and fixturing, and hardly any design change costs or amortization. Design tweaks have no downstream expenses attached, and can continue even during series manufacturing.
- Reduced turnaround times, particularly for low-volume series production. For example, the standard casting process for metal dental implants limits technicians to making 20 a day; DMLS can produce up to 450 patient-matched dental crowns and bridges within 24 hours.
- Substantial weight reduction. Components made with laser sintering can be lighter than their conventional counterparts.



Cutaway model of conformal cooling channels (upper left). Cobalt chrome dental implants. Images courtesy EOS.

Titanium humerus for a proposed prosthetic limb. ***Image courtesy DEKA.***

• Nearly unlimited geometric complexity of parts. This capability enabled an unmanned aircraft manufacturer to produce all of the primary structures for advanced high-lift technologies, such as leading-edge blowing, circulation-control flaps, and airflow plenums, with the same plastic laser sintering equipment.

• Part consolidation that integrates functionality, eliminating product assembly times and secondary operations. To demonstrate the strength of its lightweight laser-sintered nylon components for aircraft, EADS built the "Airbike," a rideable bicycle with each wheel, its bearings and the axle integrated into a single manufactured unit.

• Creation of features that are difficult in traditional processes. Toolmakers, for instance, no longer need to drill straight channels to carry off heat. Instead, they can "grow" integral, conformally cooled serpentine channels that twist or spiral as needed to give maximum cooling efficiency.

• Mass customization. The European Union-funded consortium Custom IMD is developing fully customizable dental and orthopedic implants, including a craniofacial plate made of polyetheretherketone (PEEK). Additive manufacture of these plates will be less expensive than cutting the titanium plates now in use.

In a single manufacturing process, you can create a spiral, a chain link, a hinge—virtually any shape of which you can conceive. And the part produced next to it, in the same batch, can have a completely different shape, or even be a completely different part. Those capabilities enable design-driven manufacturing: designs that embody pure functionality, with no compromises because of manufacturability restraints.

Building the Future

The near future offers even more promise, as laser sintering could change the way we manufacture, the business of manufacturing, and even the way we think about design.

Where is laser sintering going next? More materials, driven once again by industry demands, are in the works: metal alloys for aerospace and automotive applications, and plastics with characteristics previously not available for laser sintering. Companies that make end-products with laser sintering are beginning to explore the demanding validation and certification procedures of aerospace and medicine.

ASTM International technical committee F42 is developing standards for additive manufacturing. At press time, a sub-task team is developing process control strategies for laser sintering. It's only a matter of time until there are military and aerospace specifications for both the materials and the process.

The Advantages Accumulate

Because laser sintering systems aren't dedicated to building a single item, and are scalable across many industries, manufacturing can switch instantly from one product line to another, driven by market demand. They also offer more rapid production than other methods, shortening time-to-market.

Laser sintering can provide strategic advantages as well. In place of centralized, "big smokestack" manufacturing, companies can localize their production and reduce their shipping and logistics for laser-sintered parts.

The new technology can even benefit more traditional manufacturing: Companies can mitigate the risk of new high-volume product lines by gradually scaling them up, batch-producing laser-sintered initial versions inexpensively instead of investing upfront in machining, hard tooling, injection molding and other costly, high-production equipment.

But the primary business benefit of laser sintering may come from the design freedom it provides. Mass customization can be used to enable input for personalized products that turn customers into stakeholders. Because laser sintering isn't bound to any single design by fixturing or tooling, it provides continuous opportunities for innovation, rather than having to wait for the next scheduled generation of a product. In the same way, it levels the playing field for small companies to compete with large ones without constant reinvestment in equipment.

Finally, as those who already manufacture with laser sintering can testify, it brings design imagination to life, in every shape possible. DE

Andrew Snow *is regional director, sales, at EOS of North America.*

INFO ➜ **3T RPD Ltd.:** 3Trpd.co.uk

➜ **BestinClass:** BinC.biz

➜ **Custom IMD:** CustomIMD.eu

➜ **DEKA:** DEKAresearch.com

➜ **EADS:** EADS.com

➜ **EOS of North America:** EOS.info

➜ **Within Technologies Ltd.:** Within-Lab.com

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

Computing for the *Mobile Engineer*

Engineers on the move need more than just a single laptop.

BY PETER VARHOL

Engineering on the go is dependent on a powerful server such as Eurocom's Panther 3, with a Xeon 5600 processor, up to 24GB of memory, a RAID storage interface, and gigabit Ethernet.

Engineers have always had to travel to where their projects are located. Whether the project is a major construction effort, or a collaboration on an automotive or aerospace system, design engineers may spend anywhere from a few days to months at a time away from their normal business offices. There are also consulting engineers who spend virtually all of their time traveling from one project to the next.

But the computing power a mobile engineer needs has been difficult to come by. Today, some high-end laptops can make acceptable engineering workstations.

The Intel Core i7 quad-core processor includes an eight-way multi-tasking capability and additional L3 cache for speeding up data and instruction transfers. These processors also use Turbo Boost Technology and Intel Hyper-Threading technology for added computation performance. Many of these systems also incorporate NVIDIA graphics processing units, which can also be used to execute applications designed to make use of fast GPUs. And while these systems often top out at only 8GB of memory, that's enough for many types of designs.

But even a powerful laptop isn't enough for many engineering projects. The lack of memory can limit processing performance and the size of data sets. Plus, while the quad-core processor helps when running applications with a high degree of parallelism, a second processor could come close to doubling performance under some conditions.

There are several ways of supplementing a laptop client for engineers who travel, but need more horsepower for their work. One is cloud computing, which enables the cli-

ent to control processing that is done on a remote server or server cluster, accessible through Web protocols. A second option is to take advantage of local computing power, by joining the network at the current work location. It may even be possible to set up a virtual private network (VPN), so that the engineer can connect to the home office network via the Internet.

Both of these alternatives have questions and limitations. While engineers can tap virtually unlimited computing power in the cloud, or back at the home office, the Web interconnect is painfully slow for a lot of work—meaning that the client at best serves as the user interface, and does little or no processing by itself.

And connecting to the local network, if there is one available, opens the door to security issues on both sides of the connection. For the engineer, it may be necessary to protect the intellectual property being developed, and joining a new network provides an entry point into the system. For the local network, whether partner or customer, letting a system not under its direct control become part of the network may not pass muster with the organization's security policies.

You Can Take It with You

A third option, however, is beginning to emerge. Call it "engineering on the go." It involves not only engineering laptops as client workstations, but also a full-fledged computer network and one or more servers with enough capacity and performance to take on many different types of engineering design projects, including analysis and simulation. The idea is to take your entire computing environment with you, including servers, workstations, and network infrastructure.

It's not as difficult as it may sound. Most professionals already carry a laptop with them that could serve as a low- to middle-end engineering workstation replacement. Routers need only be as large as the number of Ethernet ports they have, and cabling can be purchased inexpensively at the destination, or shipped separately.

The server might be a more challenging prospect. At the heart of the engineering-on-the-go concept is the server on the go—a capable engineering server that can provide the computational back end for design and low- to mid-range analysis and simulation tasks. While it might be odd to think of a laptop as a server, what really matters is the power of its components.

Most laptop configurations can run Windows Server or a Linux server operating system, but don't have the performance necessary to be used for engineering applications. To outfit such a system would require looking at processor options, memory and cache expansion capacities, and network

Workstations such as Eurocom's Neptune provides a lot of memory for design tasks, as well as an Intel Core i7 Extreme Edition processor.

bandwidth capabilities. You won't get a configuration that replicates a high-end tower or rack-mounted server, but you may get close to comparable performance.

Together with engineering laptops using the quad-core Intel Core i7 processor, these servers can form the backbone of a network that can serve many design engineering and lower-end analysis functions. In addition to providing computational resources, it can provide centralized and protected access to other networks and the Internet, enforce security policies, provide access to storage, and offer a number of other functions.

Why would an engineering team go through the trouble of assembling a high-end computational network like this? In effect, engineers take their own full network with them on project deployments. An individual engineer can put a server and an engineering workstation laptop in a carry-on bag, and have the beginnings of a network set up within a few minutes on-site. It can provide many of the benefits of a network over an individual laptop.

A more full-featured network-computing environment can be shipped in the baggage compartment of a passenger aircraft. A properly padded steamer trunk can easily carry half a dozen laptop-sized systems, along with a router and enough cabling to get started.

Concept Buy-in

If engineering on the go fits your way of working, the first question you're likely to have is where you can go to find systems to fit with mobile engineering. Most mainstream computer manufacturers offer high-performance laptops that can serve as desktop replacement systems for general use. However, in most cases, these systems max out at 8GB of memory, which simply isn't sufficient for most engineering uses.

Instead, engineers need systems that can accommodate up to 16 or 24GB of memory, with at least four cores for design and rendering, and normal office work. Outfitted with high-end graphics cards, design and rendering still remain the best uses. However, it will also be possible to do some low-end analysis computations. At worst, engineering on-the-go systems can set up problems that can be sent off to the home office—or to the cloud—for analysis.

Most of the major systems vendors, such as Dell, Lenovo and HP, typically have a small number of such high-end offerings. Alternatively, specialty suppliers focused on engineering and other performance markets, such as ASUS, Eurocom and other small players, offer systems specifically geared toward the mobile engineer.

While high-performance systems using the Intel Xeon processors have been around for about three years, the engineering on-the-go concept was coined by Eurocom, a maker of laptop systems for a variety of uses. Eurocom's Panther 3 highlights the server part of the solution, with a 6-core Xeon 5600 processor, up to 24GB of memory, and gigabit Ethernet, while the Neptune workstation includes

up to 32GB of memory and an Intel Core i7 Extreme Edition processor.

"Engineering on the go represents the reality of many of today's professionals," says Mark Bialic, president of Eurocom. He notes that security was a primary justification for the concept. "Many of our customers on a distant project can't trust that they're protecting their intellectual property. They can't have that confidence using a local system or network."

Some engineers see it as a matter of convenience. Jim Turney, an independent engineering consultant, carries a Xeon laptop server from Dell on all of his assignments. "I have everything I need, from my design applications to a firewall," he adds. "I even carry a small router so I can join a network at the company I'm working for."

Not an Office Replacement

Clearly, engineering on the go isn't a replacement for hardwired clusters and powerful servers and workstations in a traditional office environment. The systems supporting a fixed network often have multiple processors and more cores; in the case of clusters, they may be running dozens or even hundreds of cores.

But many engineers have to go to the project, rather than have the project come to them. The need for mobility places difficult constraints on both engineers and the hosting organization, and the options are limited. Engineering on the go provides one of the best alternatives for many circumstances. It reduces reliance on local network services and providers, while protecting engineering data that may be sensitive or confidential. It may also provide a level of computing reliability not available locally. And because of the size and relative power of the servers, it is readily transportable to just about anywhere. DE

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

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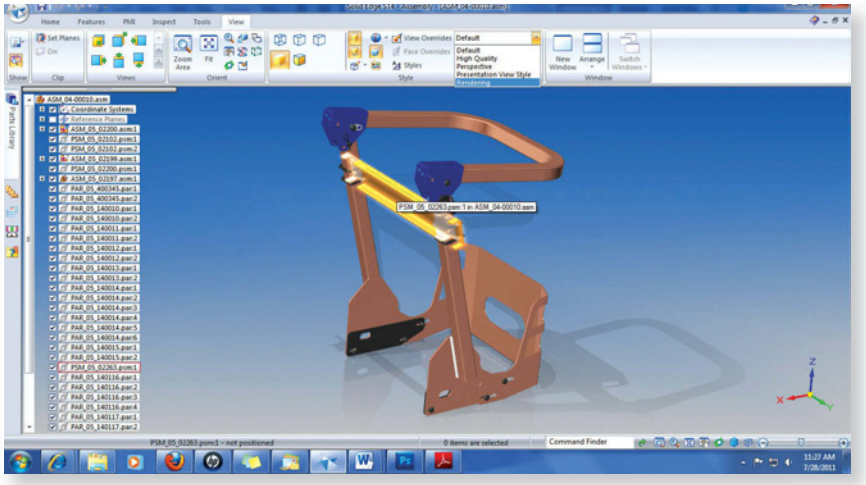
More Options, More Opportunity

Solid Edge with Synchronous Technology 4 shifts the focus from form creation to productivity, assembly management and advanced analysis.

BY KENNETH WONG

In the third release of Solid Edge with Synchronous Technology (SE with ST3) from Siemens PLM Software, the software took a major step (one small step in programming, one giant leap for CAD): It managed to consolidate history-free modeling and history-based modeling into a single environment. In Siemens PLM Software's lingo, history-free modeling—creating geometry via push-pull action with little or no regard for feature history—is called Synchronous. Its older cousin, history-based modeling, is called Ordered. The ability to move features from Ordered to Synchronous, then back to Ordered if one wishes, was a milestone, not just in the brief history of SE with ST, but in the history of CAD.

SE with ST4, which debuted in a global launch event in May, introduces a number of noteworthy interface refinements, assembly management tools, and analysis functions to the software. They're not milestones in themselves (it would be unrealistic to expect every release to be a milestone), but they add up to improved productivity.



SE with ST4 lets you work with richer graphics—complete with ground plane reflections and shadows.

For the Visual Creatures Among Us

Now that multi-core CPUs and GPUs have pumped up graphics processing in standard CAD workstations, many CAD software packages are taking advantage of the added horsepower. Autodesk Inventor 2012, for example, gives you the option to work with models in a photorealistic mode, complete with ray-tracing and reflections in high dynamic range (HDR) images. SE with ST3 gives you the option to work with ground plane reflections and shadows.

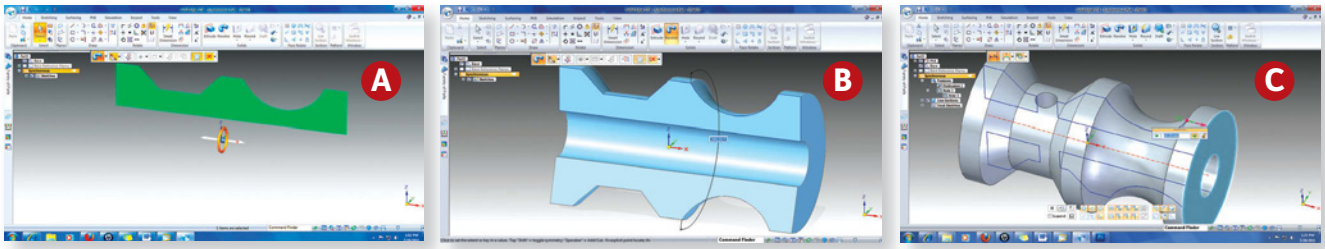
If you'd like to work in a more graphics-rich environment, you may choose High Quality or Rendering, available in a dropdown window under the View tab. It also gives you the option to set the sharpness of your display, from levels 1 to 5. The higher the level, the better the contrast. However, bear in mind that a higher setting requires more computing time, so your system response will noticeably slow down if you don't have a machine powerful enough to compensate for its demand.

SE with ST4 does not give you the option to work in ray-traced mode. Rather, if you'd like to produce a photorealistic, ray-traced look of your design, you can get into the Explode, Render, Animate (ERA) mode under the Tools tab to render your scene. You can render the entire scene, or just a portion of it by window-selecting the area you want to render.

Revolution in Navigation

One of the most effective uses of the steering wheel control in SE with ST4 is the ability to use its rotation circle to execute the Revolve command.

Suppose you have a 2D profile you need to revolve 360° to create a solid. You may choose the Revolve command in the menu, as you would normally do.



Using the steering wheel, you can instantly execute a Revolve on a 2D profile (A, B). The resulting solid contains a nested 2D cross-section, available for dimension-driven edits (C).

But, bypassing the menu altogether, you may also align the control's rotation point to an axis at the base (or top, as the case may be) of the 2D profile and click on the wheel. This activates the Revolve command automatically (you'll see the Revolve icon appear in the input bar). Now, all you need to do is enter the desired degree of rotation to complete the command.

The use of this command automatically creates a 2D cross-sectional plane nested inside your solid. This 2D cross-section can be edited, much like a dimension-driven sketch. The numeric changes you make will be reflected in the solid part created from it.

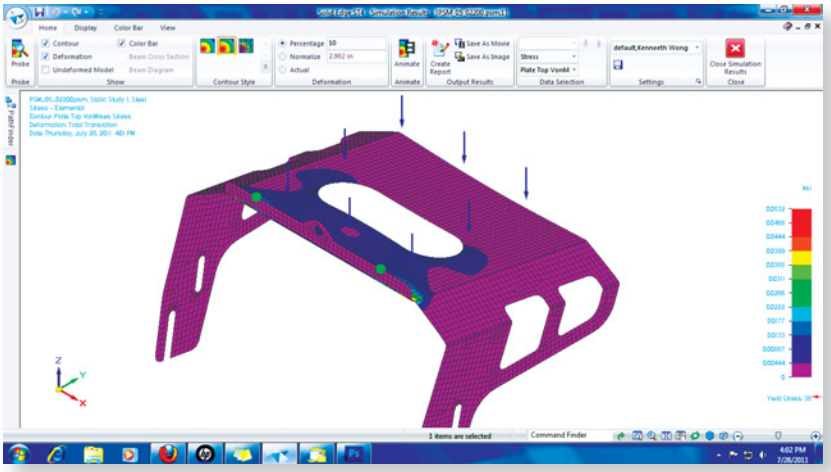
Directing your Copy

In assembly mode, placement of copied parts gets easier because you can now use the steering wheel to position your copied parts.

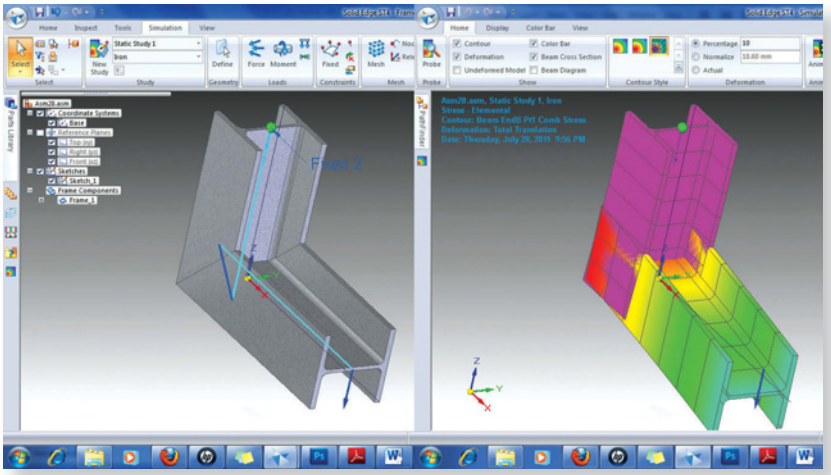
Suppose you need to place two caps at both ends of a pipe. You may select the cap on one end, position the steering wheel to the midpoint of the pipe, then steer a copy of the cap to travel along a perfect arc in 180°, ending at the opposite end of the pipe. Upon executing this command, ST4 will seek out and identify logical relationships based on what's in the initial cap (mated faces and aligned axes, for example). Then, ST4 will prompt you with a choice to suppress the existing relationships, repair them or accept them as transferred to the new position.

Going on a Tangent

The new release gives you an easier way to place holes on cylindrical objects,



In Simulation mode, you can use mid-surface analysis function to simplify meshing and solving of sheet metal-like parts.



A new mesh type, Beam element, lets you simplify structural frames and beams into single lines, with nested volume and material information.

such as shafts. It lets you drag holes along the circular surface on a tangent, which eliminates accidentally placing holes misaligned with the center axis of your cylindrical objects. If your design already consists of a nested 2D cross-section (like the revolved solid mentioned above), you'll see the 2D profile updated, with the cutout corresponding to your holes once you complete the command.

Facing Relationship Hiccups

In SE with ST4, you can use the Face Relate tab to automatically build relationships between faces that don't have any correlations.

For instance, you may select several faces tilted at different angles, then select the Parallel option to force them to align themselves as parallel surfaces. If you want this relationship to persist, you can choose the Parallel Persist option—essentially instructing the software to retain the parallelism during subsequent modifications.

While the concept is simple, the process seems (at least to me) more complex than necessary. The series of options you need to select is not always easy to grasp. To make the parallel execution possible, you'll have to pick the appropriate choices for extend/trim treatment, model/set priority, and single/multiple alignment. If you have a pair of faces, the relationship seems simple enough. But if you have more than one face, the order in which you select the faces affects how the alignment is performed.

At times, face relationships may also come in conflict with ST4's built-in Live Rules (the set of rules that define how features and faces align with one another during your push-pull operations). In some instances, you may need to cancel or suspend Live Rules before the desired face relationship can be established.

In my view, a simpler implementation of this function may serve its purpose better.

Mid-plane Drifters and Framers

In Simulation mode, SE with ST4 gives you the option to analyze designs using mid-planes only—a handy feature for those working closely with sheet-metal parts and solid parts with flat features. When opening a part suitable for mid-plane analysis, the mid-surface generator lets you create a 2D surface of your flat (sheet metal-like) feature by offsetting from a chosen face (outer or inner). With the mid-surface in place, you may apply forces, define pressure, fix points, then mesh and solve the analysis scenario. The resulting deformation, stress distribution and displacement are available for output in animation, along with numeric values.

Similarly, you can now use single straight lines to represent frame structures for analysis. When conducting stress tests on frame assemblies, you'll see Beam as one of the meshing options available. The function allows you to reduce 3D structural frames into 1D lines with nested volume and material information. In giving you the option to represent plate-like features as flat surfaces or frames as straight lines in analysis, SE with ST4 simplifies the meshing and solving process—leading to quicker results without a compromise in accuracy. For those who have

a better understanding of meshing, SE with ST4 gives the option to specify the mesh-map profile to use.

In Simulation mode, you can override or temporarily suspend material and volume definitions in your parts. With this option, you may, for instance, run analysis on a part originally specified as steel at 3-in. thick as if it were an iron part at 4-in. thick. The quick, flexible approach lets you try out different materials and volumes in stress analyses, without the need to change part geometry or create multiple versions of the same part.

Other Improvements

In drawings, if you have a table (say, a bill of materials) with a stack of cells populated by identical numeric values, you may now combine them into a single cell block for a cleaner look. In creating exploded views, you can now manually draw flow lines to get better control over how they look.

In assembly mode, you now have the option to place a constraint with a range—essentially allowing you to create a range of motion with limits where, without this limitation, the subassemblies may travel along an axis infinitely (for instance, a shaft fitted into a pipe).

From Conceptual Design to Production

With a novel take on history-free modeling, the debut of SE with ST forced many of its competitors to re-examine their own code. Many CAD programs now incorporate some versions of history-free push-pull editing, fundamentally changing the trajectory of mechanical CAD.

In SE with ST4, a workflow that combines ordered (parametric) and unordered (history-free) modeling continues. But R&D efforts in ST4 reflect an effort to move beyond the wow factor, to settle on a more thoughtful, efficient interface for part modeling and assembly management.

Simulation tools in previous versions of SE with ST were robust enough for basic linear stress analysis. The addition of mid-surface analysis and beam-element analysis advances its reach. SE with ST's initial claim to fame may have been easy geometry creation, experimentation and conceptual design. Refinements in SE with ST4 show maturity—a sign that the software is ready to take its rightful place in production-grade work. DE

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.com.*

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Benefits of Digital Metrology

Manufacturers save time with 3D metrology.

BY DEBBIE SNIDERMAN

DE spoke with four manufacturers who use 3D metrology tools in their day-to-day operations. We found how scanning, digitizing and automated probing physical parts helps design engineers save time and money—and even obtain more business.

It is much quicker for Kooks to develop new exhaust header tubes by digitizing its connections with a CMM probe tip mounted on a Basis 3D arm.

Kooks Custom Headers: New Products, Designed to Fit

One manufacturer, Kooks Custom Headers has produced custom exhaust systems for car owners and the automobile racing industry for more than 50 years. Designing a new custom exhaust previously involved bending a tube and checking the fit at interference points (steering, motor and suspension) one at a time. If it didn't fit, another would be bent. Depending on the vehicle's intricacy, it could take a week-and-a-half to design an exhaust header set coming from a motor, according to design and manufacturing engineer Rick Kranz.

Kooks R&D department recently began designing exhaust systems by digitizing a car's underside with a probe tip on a Baces3D Arm CMM (coordinate measuring machine) system and Rhino CAD software to check interference points and generate surfaces. Designers can now manipulate digital representations of tubes independently or as a single unit using Rhino files in Tezet Tubing software. Tezet generates bend data and downloads it directly to production bending machines.

The custom race header for a top sportsman-class drag car is a perfect fit.

It now takes three days to complete an entire design. After confirming the new part fits on the car and performs well, the CAD files are also used to design weld tooling to make production fixtures.

"Built the old way by hand, fixture building took a week, and fabrication was inconsistent from one part to the next, causing production problems," Kranz recalls. "Now, with digital prints and laser cut fixtures that can be made in one day and used over and over, there's no comparing the accuracy. It saves us money since there are

no rejects, and all pipes fit every time."

Kranz also looks forward to stopping producing and storing "golden parts," physical templates engraved with a number, date and rev. "We have hundreds—from years of manufacturing—taking up valuable floor space," he adds. "The most expensive thing in manufacturing is square footage. After we go all digital, we'll have more room to put equipment."

C-CAT: Portable Live Inspections

Carbon-Carbon Advanced Technologies Inc. (C-CAT), a rapid prototyper and flight hardware manufacturer of large-scale, carbon-carbon composite structures for aerospace, military, government and industrial clients, uses portable CMM systems, a Leica LTD700 Laser tracker, a Leica Absolute Interferometer tracker, and wireless contact Leica T-Probes during assembly.

C-CAT performs live inspections of its high-temperature composites that change shape during processing as a quality check, to ensure things haven't unexpectedly moved during the build process, and at interim processing stages, after thermally cycling materials.

"We're able to check areas quickly, allowing us to manufacture hardware faster than in an R&D environment," notes Quality Assurance Director Raj Narayanan. "Instead of stopping to use old manual measurement tools such as gauges, we can measure while processes are running."

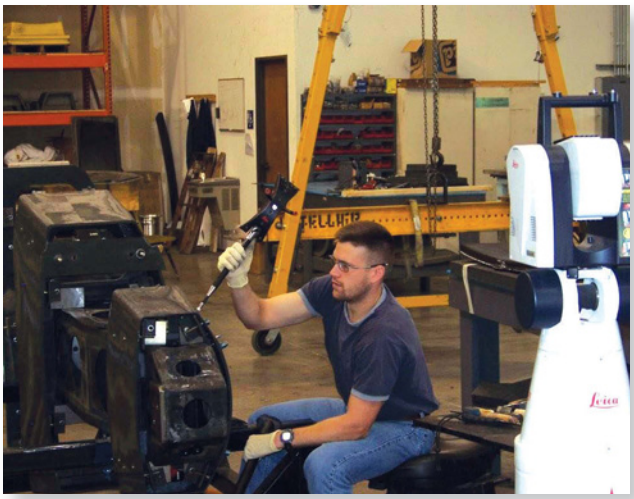
By checking 1,000 points on a surface in five minutes, he says his team can tell the shape across 16 ft. of a smooth, large, aeroshell surface with 500,000 data points—and tell exactly what it is doing in less than an hour.

"That value can't compare to measuring by hand or with another device," he adds. "It would take 10 times as long, and we wouldn't be able to check other points."

Narayanan estimates C-CAT saves millions of dollars on large-scale projects, where hundreds of complex fixtures, gauge blocks and jigs are required for each massive structure design. Even fixtures for small structures are so intricate that they come at a very high cost.

"We are able to eliminate or drastically reduce the tooling required during assembly," he explains. "When complex tooling is needed, we are able to build and validate it quickly using our laser tracker."

C-CAT can also bring its portable metrology tools to vendors who don't have inspection capabilities, and measure critical parts as they are being made. Being able to verify specs and check whether dimensions had changed before delivery is another important timesaving capability, according to Narayanan.



A C-CAT technician performs a live dimensional assessment of the inside structure of an aeroshell test vehicle for hypersonic flight theory to determine part placement accuracy.

Synergeering's FaroArm inspects a 4-cylinder intake manifold.

3D CNC Inc.: Verifying Precision with Automation

3D CNC Inc. is a precision tool-and-die manufacturer fabricating close tolerance components (typically + .0001 in.) for more than 90 customers in computer, medical, dental, military and aerospace industries. Its 3D inspections on a Zeiss Prismo Navigator CMM with a Vast Gold Active Sensor and Calypso software, and 2D inspections on an OGP Avant with an automated scanning probe are performed to:

- ensure incoming parts match prints;
- verify that work in progress remains in spec, after critical processing steps and before shipping to customers;
- create prints from customers' broken parts to fabricate more or reverse-engineer mating parts; and
- verify tolerances or designs on parts for third parties.

# Passes	Tolerance	Mfg Time
1	+/- .002	1 hour
2	+/- .001	1 hour 15 min
3	+/- .0005	1 hour 30 min
4	+/- .0002	1 hour 45 min
5	+/- .00015	2 hours
6	+/- .0001	2 hours 15 min
7	+/- .000075	2 hours 30 min
8	+/- .00005	2 hours 45 min
9	+/- .000025	4 hours 45 min

TABLE 1: After inspecting a customer's incoming part, 3D CNC creates a chart of manufacturing times performs cuts with varying tolerances (Material: Carbide, Thickness: 0.125-in.; cut length: 1 in.). Charts such as these present cost-saving options to designers when it is possible to reduce over-design.

"It took four to 10 times longer to inspect using 'open layout' inspection methods involving granite surface plates, dial indicators, vision systems, and gauge box electronic height indicators," Quality Manager Ken Wraspir recalls. "Adding extra time to create complex fixturing, it took up to 4 hours to inspect a single part. Our automated CMM now gathers more information in less than 30 minutes."

By making inspection results available to customers' design engineers, the team can be certain their parts meet tolerance, eliminating time spent debugging or re-measuring.

3D CNC's metrology tools also help its customers save money by reducing unnecessary over-design. Incoming parts are measured to demonstrate realistic manufacturing times and costs for varying tolerances (see Table 1). System capabilities and explanations of which tolerances require non-standard tooling are presented to help designers take advantage of cost-saving production options. One customer was able to reduce manufacturing costs in half by designing tight tolerances only in critical areas after a review with metrology personnel, for example.

Synergeering Group, LLC: Process Control for Repeatable High Accuracy

Synergeering Group, LLC offers rapid prototyping and manufacturing of large parts made with custom RapidNylon (glass-filled nylon) material and a laser sintering processes. Its 7-axis Quantum FaroArm with Laser ScanArm V3 scanner head and PolyWorks software are used to control processes that make highly accurate and functional parts for automotive, military, aerospace, medical and consumer appliance industries.

In a flexible manufacturing facility that mixes builds,

products and customers on the same processing equipment, inspecting every part takes too much time. Scanning calibration samples that test processing limits, with extreme wall thicknesses and differing geometries, helps the team quickly locate process and equipment problems, and understand how much their equipment has drifted. Failure modes are recognized, and coarse or fine adjustments are made so they don't have to spend time on damage control or rejects.

"By constantly chasing our processes and fixing them, we can maintain high degrees of accuracy. This prevents problems ahead of time, and saves time troubleshooting problems later on," says Synergeering Owner Thomas Gogoe.

Before, removing samples from fixtures and manually measuring with gauge blocks, calipers, rulers and CMMs with probe tips took a long time, was expensive, and didn't provide the data fidelity needed to understand production processes beyond primitive shapes.

Now, line-of-sight measurements are made on samples still in fixtures, and the high-fidelity metrology enables much finer process control, creating parts with high value to customers. Some prototype parts are so accurate that customers use them as fully functional production representatives for testing.

"Metrology processes also lowered our throughput time, and are key for making our lead-time predictable. We complete most projects in less than a week," Gogoe says, "and even large parts, like a V8 motor with intakes, can go from a CAD model to part in three days." DE

Debbie Sniderman *is an engineer and has her own manufacturing and R&D consultancy. Contact her at VIVLLC.com.*

INFO ➜ **3D CNC:** 3dCNC.com

➜ **C-CAT:** C-CAT.net

➜ **FARO Technologies:** Faro.com

➜ **GoMeasure3D Baces Arm/Tezet:** GoMeasure3d.com/baceshome.html

➜ **Kooks Custom Headers:** KooksCustomHeaders.com

➜ **Leica:** Metrology.Leica-geosystems.com/en/index.htm

➜ **OGP Avant:** Smartscope.com.cn/en_page/video_systems/avant.htm

➜ **PolyWorks:** Innovmetric.com

➜ **Rhino:** Rhino3d.com

➜ **Synergeering:** Synergeering.com

➜ **Zeiss Industrial Metrology:** Zeiss.com/imt

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Lofty Goals Demand Precise Positioning

SpaceX looks to accomplish tasks that are literally out of this world.

With the retrieval of Dragon from the Pacific Ocean, Space Exploration Technologies (SpaceX) became the first commercial company to launch and recover a spacecraft from Earth orbit. Placed into space atop the company's Falcon 9 launch vehicle, Dragon completed two orbits with speeds topping 17,000 miles per hour. After its three-hour, 50,000-mile flight, Dragon splashed down at the predicted time.

This was the first flight under NASA's Commercial Orbital Transportation Services (COTS) program, designed for companies to demonstrate International Space Station (ISS) resupply capabilities. Following completion of COTS missions, Dragon will begin regular flights to the ISS. For these missions, SpaceX will again turn to its portable coordinate measurement machine (PCMM) systems to maintain the precision it achieved when first launching and returning Dragon from orbit.

SpaceX is a different kind of company, thanks in part to its founder, CEO & CTO Elon Musk, who was co-founder of PayPal and is the CEO of Tesla Motors.

In a post-flight press conference, Musk said, "The reason I'm doing SpaceX is that I just happen to have a very strong passion for space, and I want us to become a true spacefaring civilization, and even a multi-planetary civilization. That is my goal for SpaceX."

To make his goal a reality, SpaceX is changing 40-year-old paradigms with a family of launch vehicles and spacecraft that increase reliability and performance while reducing costs—ultimately by a factor of 10. The underlying philosophy is a focus on simplicity to both increase reliability and lower cost for vehicle development and launch services.

According to Larry Mosse, SpaceX's tooling operations manager, the company counts on its PCMMs to help deliver this reliability and cost reduction. And it counts on Verisurf metrology software to drive all these devices in a powerful, yet simple way.

"Verisurf metrology software is doing its part in maintaining precision in the shop and on the launch pad," says Mosse. "We use it for everything from tooling fabrication to pre-launch preparation."

Falcon 9 lifts off from SLC-40 for the first test flight of Dragon Spacecraft.

Ground Control

Falcon 9 lifted off from Cape Canaveral AFS launch pad SLC-40 at 10:43 a.m. EST on Dec. 8, 2010. At 10:46 a.m., the first stage separated. At 10:52 a.m., Dragon entered Earth orbit. At 2 p.m., Dragon splashed down in the Pacific Ocean.

According to the company, Falcon 9 delivered Dragon to orbit with "near bull's-eye insertion," and Dragon then splashed down safely into its targeted landing zone.

The accuracy of the flight path required careful alignment of Falcon 9's sections and precise launch vector positioning. The SpaceX crew used its PCMM metrology systems, which included Leica trackers and Verisurf software.

Falcon 9 is 157 ft. tall with the Dragon spacecraft, and has a 12-ft. diameter. Nine of SpaceX's Merlin engines power the first stage; the second stage uses a single Merlin Vacuum engine. Final assembly of this piece of engineering is completed at the launch site.

To position and align Falcon 9's components, SpaceX used Leica laser trackers and Verisurf's BUILD application,

SpaceX founder, CTO and CEO Elon Musk stands with Falcon 9 at Cape Canaveral AFS.

which is a virtual gauge. The trackers fed measurement data directly to Verisurf, which reported, in real time, the accuracy of each section relative to the CAD model used in design and manufacturing.

After assembly, the SpaceX crew raised Falcon 9 into its vertical launch position. To follow its intended flight path, launch specifications allowed the vector of the vehicle to deviate by only 0.02° over the 157-ft. length. Mosse says that they again turned to the PCMMs to confirm a "ready-to-launch" status.

"The specs allowed the nose to be off of vertical by 6 in.," he explains. "Verisurf reported that we had only a one-hundredth's-inch deviation East to West, and three-hundredths from North to South—and from the ground up, all sections were at their nominal positions."

Mosse notes that this alignment accuracy was possible because of the controls used in manufacturing and assembly operations at the company's Hawthorne, CA, facility.

"We have a set of five fixtures that are used to position rocket components and drill a pattern of 144 holes," he offers as an example. "These holes dictate the alignment of Falcon 9's sections."

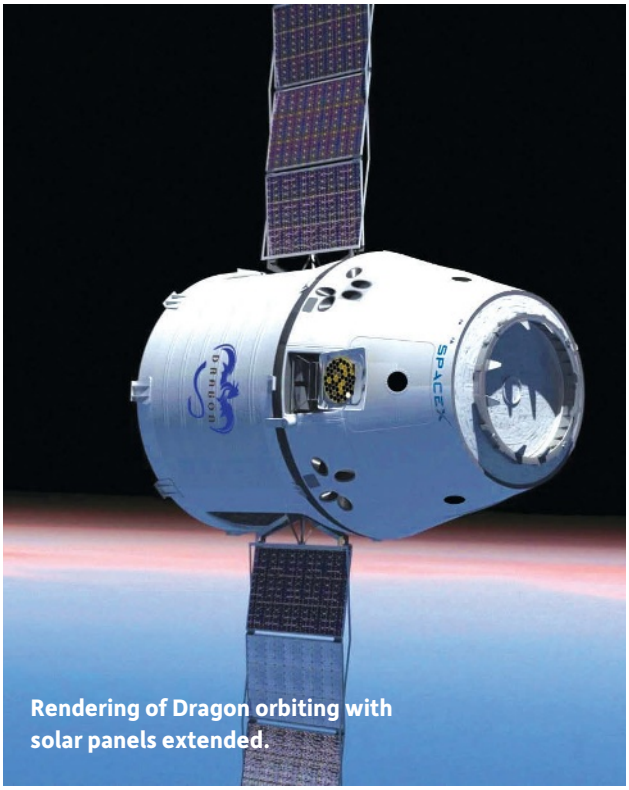
As he did in pre-flight preparation, Mosse used Verisurf to place the fixtures before committing to the drilling operations.

"With Verisurf, we are looking directly at the CAD model and the measurement results," Mosse states. "We see the measurements reflected against the 3D model. This makes the process faster and reduces mistakes."

He notes that before Verisurf, his team had to interpret page after page of 2D drawing dimensions.

"We had to rely on people's ability to visualize 3D measurements from 2D drawings, which results in interpretation problems," he says.

Before assembly, Mosse used his PCMMs to measure parts and tooling during fabrication and manufacturing. For example, SpaceX will drive both Leica trackers and Romer arms with Verisurf when measuring composite tooling or weld fixtures.



Rendering of Dragon orbiting with solar panels extended.

"We inspect these items to the CAD data. In many cases, we will inspect to profile tolerances only," Mosse says. "We aren't drawing free, yet, but like the rest of the aerospace industry, we are striving to implement model-based definition to achieve its many benefits."

For SpaceX, the most important benefit is time. Model-based definitions with profile tolerances eliminate the time to document an engineering drawing; reduce the time to create inspection plans and reports; and accelerate identification and resolution of manufacturing issues. With an aggressive schedule of more than 30 Falcon 9 launches over the next four years, including 12 space station deliveries, every moment counts.

SpaceX's philosophy is that through simplicity, it can deliver more reliable vehicles at a lower cost. SpaceX counts on Verisurf to help deliver on this goal.

"With Verisurf, we have very quick assurance that we are in the proper 3D space," Mosse says. DE

This article was contributed by Verisurf.

INFO ➜ Leica: Leica.com

➜ **Verisurf:** Verisurf.com

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Tools of the Month

1 ROMER Introduces CMS108 Inspection and Reverse Engineering Solution

ROMER Inc., (romer.com) a brand of Hexagon Metrology Inc., has launched the CMS108, a non-contact laser scanner available for its portable coordinate measuring machines. Romer says the CMS108 is adept at scanning a range of materials with enhanced sensitivity to color and surface finishes. It mounts with a kinematic joint to the seven-axis ROMER portable CMMs, which include the Absolute Arm SE and the Infinite 2.0 SC Arm.

Geomagic and Nikon Metrology Offer 3D Scanning

Geomagic (geometricglobal.com) and Nikon Metrology (nikonmetrology.com) have announced a new cooperative agreement that enables Nikon Metrology to fully integrate and offer its range of handheld 3D laser scanners with Geomagic Studio, Geomagic Qualify, and Geomagic Wrap. This partnership enables customers to seamlessly collect scan data directly from Nikon scanners into Geomagic Studio software. Similarly, scan data is immediately passed to Geomagic Qualify to graphically compare as-built parts with digital reference models.

2 FARO Gage Uses Bluetooth

FARO Technologies, Inc. (faro.com) has enhanced its FARO Gage product line with hardware and software improvements designed to simplify users' measurement workflow and enhance the product's portability. Thanks to Bluetooth wireless technology, users can now inspect and transmit data up to 30 ft. away—even through walls—without the need for cables. FARO Gage also features all new measurement software.

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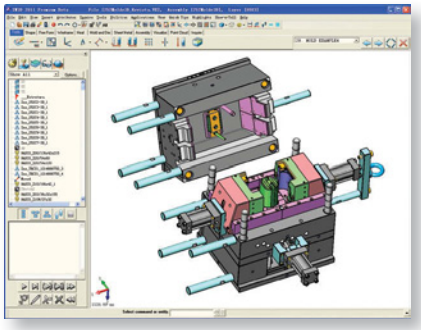
Editor's Picks

by Anthony J. Lockwood

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



ZW3D 2011 CAD/CAM System Released

ZW3D 2011 to offer new direct editing function and auto-feature machining.

ZW3D 2011 is a 3D CAD/CAM application suite that can serve you all the way from concept through 5-axis machining. It will be available in levels—Standard, Professional, Premium—that accommodate different enterprise requirements.

Some things are really interesting to me about this version. First, it offers direct editing design with parametric dimensions created automatically. The QuickEdit feature provides context-sensitivity so that if you touch or click, say, a face, ZW3D offers you the tools for that location. Then there's a tool called SnapPick. It automatically drives a point you specify to intersections and critical points

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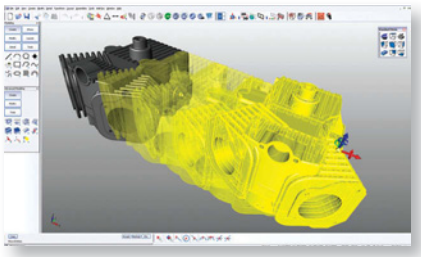

Kubotek USA Releases KeyCreator 2011

Faster file importing, 64-bit support, and new dynamic editing functionality among enhancements.

KeyCreator from Kubotek USA is the successor to the venerable and revered CadKey of yesteryear. CadKey earned its chops and a devoted user base by being powerful and easy to use. KeyCreator has done that reputation proud over the years.

KeyCreator 2011 has been enhanced with features to make editing, extracting, and modifying geometry in native or imported CAD formats faster and more accurate. Its 3D DynaHandle has been improved with a new look, new control and selection features, and more options.

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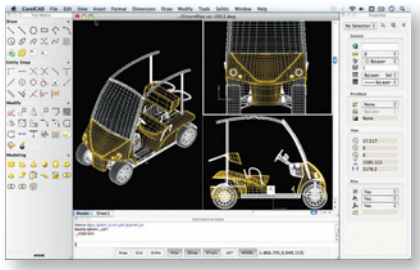

Corel Adds CAD to its Technical Portfolio

CorelCAD offers 2D/3D design tools and compatibility with industry-standard CAD tools.

Corel has a history of developing applications that are the workhorses of operations in many small- and medium-sized firms. Corel Designer Technical Suite, for instance, is widely acclaimed as being both affordable and powerful. So, it's no stretch to say that the recent introduction of CorelCAD piqued my interest.

CorelCAD is a 2D/3D solid modeling CAD application for Windows and Mac that's suitable for designers, engineers, and architects. It works natively with the DWG file format, lets you customize and save as workspace environments, and you can navigate between 2D and 3D.

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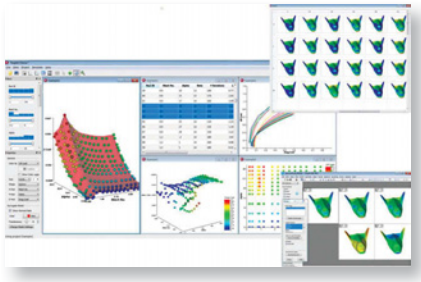

Simulation Analytics Tool Finds CFD Anomalies and Trends

Tecplot Chorus integrates metadata analysis, post-processing, and simulation data management.

Tecplot has announced a soon-to-be-released application called Tecplot Chorus. Basically, this is a simulation analytics management tool for you engineers and scientists needing to discover trends and anomalies in all those large data sets your CFD studies produce. That is, what Tecplot is said to be designed to do is help you quickly figure out which CFD run is associated with a particular point on your metadata plot so that you can find, visualize, and examine the underlying fluid-dynamic phenomena of the piece of data that caused these variations.

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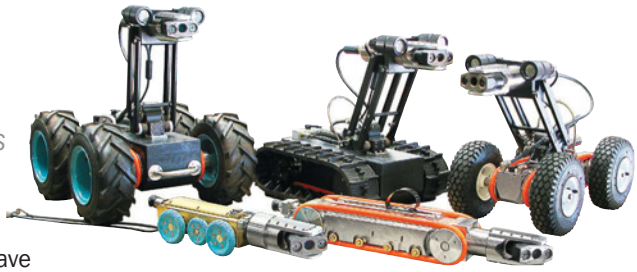
SPOTLIGHT

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

MFG.com Quickens the Cobra

Cobra Technologies obtains high-quality parts and reduces overall lead times by using the supplier discovery site.



Cobra Technologies designs and manufactures video pipeline inspection equipment, pipeline data collection and management software for sanitary and storm sewers. For nearly 20 years, Cobra inspection units have been sold to municipalities, contractors and government entities.

Finding qualified suppliers for custom parts and components, however, is often like playing a game of "eeny, meeny, miny, moe" for the Smyrna, GA-based company. In these economic times in particular, with many manufacturing companies having gone out of business, finding competent suppliers that have the right capabilities and capacity can be a difficult task.

There are a variety of ways companies have traditionally found suppliers, including online and offline directories, trade shows, search engines and advertisements. However, these methods of supplier discovery are fairly superficial, and it is difficult to find suppliers precisely matched to your needs that have capacity, at the exact moment you need them. It is also difficult to gain immediate visibility into references and pricing.

Previously, Cobra relied upon a small group of local suppliers that it had worked with in the past.

"We were looking to add to our supply base and ultimately find additional suppliers that made quality parts, at a lower cost while reducing our overall lead time," notes Ken Hockstein.

Prior to MFG.com, Cobra Technologies used traditional methods of supplier discovery, and had little visibility into true market pricing. Additionally, its lead times were often as long as several months. Cobra Technologies was looking for a platform to source its new parts and components more efficiently.

"We had heard about MFG.com for several years," Hockstein recalls. "Last year, we decided to just give it a try. We are thrilled with the results."

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Design Collaboration Produces Tooling 'Right the First Time'

Provides aerospace company with aluminum tooling for a carbon composite seat shell.

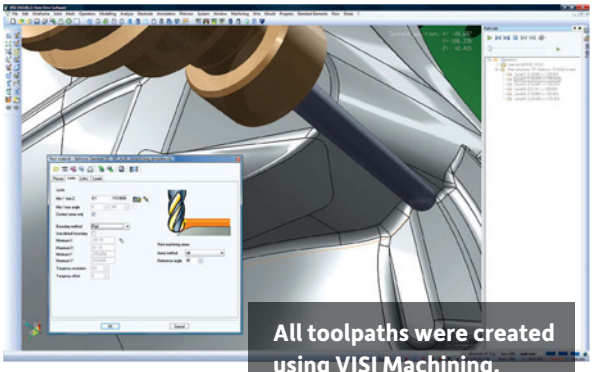
BY MARK FREEBREY

The volatile nature of fuel prices has forced the aerospace industry to make weight reduction a high-priority focus. Reducing the weight of aircraft seating significantly reduces aviation fuel consumption and carbon dioxide emissions throughout the operational lifetime of the aircraft, with every bit of weight contributing to the running costs of an aircraft to the carrier.

DeltaCAD Ltd was founded in Devon, England, in 2010 by Dean Challis, a design engineer with considerable CAD/CAM and tool design experience. It provides a comprehensive range of design and manufacturing services, from 2D drawings to 3D modeling and CAM programming.

For this project, the original CAD model was provided by the customer as a Unigraphics NX file. The part analysis and tool design was performed using VISI Modeling from Vero Software.

"VISI is very tolerant of non-native data," Challis points out. "Often, when models are originally designed, the manufacturing requirements are not always known. To make a part manufacturable, it is vital to interact with the data and make the relevant changes."



All toolpaths were created using VISI Machining.

With authority from the original design team, the tooling was modified to remove undercut areas and apply blend radii on sharp edges, he says, adding, "Typically, blending can be a very complex task—and it is often necessary to explode a model into surfaces and manually apply the CAD modifications. VISI is very strong at switching between a solid and surface environment, and this allows us to make complex changes where other CAD systems often fall over."

The manufacture of the tooling was performed by Casting Support Systems Ltd, a company that supplies large tooling to the investment casting, plastic molding and gas turbine industries. In conjunction with its sister company Versa-tote, Casting Support Systems is also a forerunner in the design and manufacture of returnable transit boxes, picking and order tote boxes for distribution and storage facilities across Europe.

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Upfront Engineering is Real Business

Those who have been patient travelers on the boulevard called concurrent engineering have recently seen the pavement start speeding by at a breathtaking rate. Engineering software programs are running faster and smoother. Sophisticated design, analysis and manufacturing tools are pushing deeper into an upfront engineering process once centered largely on building basic CAD geometry.

This new convergence and integration of CAD/CAE/CAM tools is helping engineering transform from a "means-to-an-end" journey—aimed at getting products on shelves and into showrooms—to a real business strategy, with a clear avenue for addressing profitability at the point of design.

The goal of concurrent engineering has always been to drive everything as far upfront as possible. With product lifecycle management (PLM) vendors and specialized engineering firms striving to break down unproductive organizational silos and interlink departments and supply chains, it is becoming increasingly foolhardy for financial managers to overlook the role upfront engineering is playing—not only in driving innovation, but in attacking avoidable costs.

Concurrent engineering ... is now in its adolescence.

Tangible Results

Using process automation templates for CAD-to-finite element analysis (FEA)-to-CAD hand-offs, a major American automotive original equipment manufacturer (OEM) last year saved three to four weeks on an analysis of an oil filter adapter. For a cylinder head deck lift analysis, time used for model setup dropped from about two-and-a-half days to less than 30 minutes. Greater ease-of-use is helping analysts and designers improve quality and speed as they tackle new performance benchmarks.

Even quite exotic and complex FEA-related analyses, such as evaluation of composite structures, are becoming more integrated within the design process. Design optimization, margin-of-safety checking, and manufacturing analysis of composites can now be done in a loop that connects CAD, FEA, material selection and virtual design testing more quickly—and less manually—than ever before.

Results on a recent wind blade design showed up to 25% cuts in weight and 70% cost-to-manufacture improvements on individual ply drops. Moreover, the same tools have met NASA's most stringent tests for space flight durability on an all-composite prototype space capsule.

The reach of upfront engineering is also touching production system operations in ways almost unimaginable a few years ago.

Process automation and design optimization in the steel and heat treating industries, for example, are allowing engineers to select configurations best suited to perform within a range of desired manufacturing behavior. Tool settings, materials and design geometry are all treated as an interrelated set of conditions. These customized information loops work from sensors and controls at the production level, and return data to the integrated CAD/FEA package for checking and re-analysis. Up to 40% improvement in yields has been reported. For such capital- and material-intensive industries, this is a huge business gain.

What's Next?

Concurrent engineering, formed as a strategy in the mid-1980s, is now in its adolescence. The integrated all-digital development path associated with PLM is becoming more mature as a foundation for effective upfront engineering—where the most problems get solved and where the greatest opportunities arise.

We often think of the whole of design only in CAD-centric terms. However, the very core direction of a design can be formulated well before modeling, as information develops from teams with members as diverse as marketing and procurement. Someday, perhaps, design programs will offer feedback even as models are in the concept stage, with little detail beyond crude geometric shapes.

Boothroyd Dewhurst's Design for Manufacture and Assembly (DFMA) methods and tools quantitatively guide decisions about basic features, material and process choices that live on into documentation, factory throughput, service, warranty and end-of-life costs. This approach sheds light on how early information can have an impact on the total organization. DE

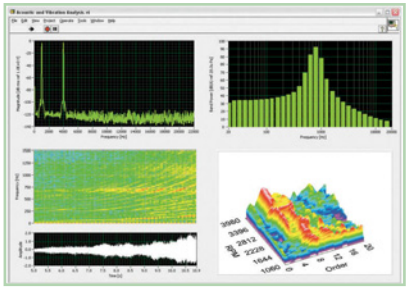
Miles Parker *is president of Parker Group in Providence, RI, and has observed and written about product development for more than 25 years. He can be reached at mparker@parkergroup.com*

Hardware Integration

1 The 25th-anniversary version of LabVIEW, National Instrument's system design software, can interact with many hardware devices or deployment targets, including the new multicore NI CompactRIO controller and the NI PXIe-5665 RF vector signal analyzers. LabVIEW driver software supplies seamless integration across multiple types of instruments, buses, and sensors, according to NI, including data acquisition devices; boxed instruments; modular instruments; motion controllers and motor drives; machine vision and image processing hardware; wireless sensors; and field-programmable gate arrays (FPGAs).

Built-in Analysis and Signal Processing

2 LabVIEW offers analysis and mathematical routines that natively work together with data acquisition functions and display capabilities. This makes it possible for them to be built into any application. In addition, LabVIEW provides analysis routines for point-by-point execution. These routines are designed specifically to meet inline analysis needs in real-time applications. Users can access thousands of engineering-specific functions, including frequency analysis and curve fitting.

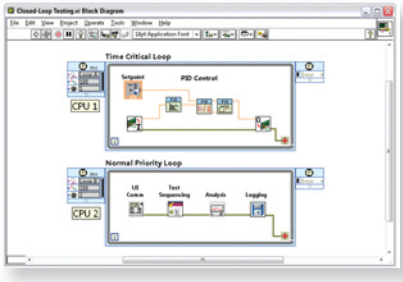


Data Visualization

3 NI LabVIEW contains a collection of drag-and-drop controls and indicators so engineers can create user interfaces for their application and effectively visualize results without integrating third-party components or building views from scratch. Power users can customize the built-in controls via the Control Editor and programmatically control user interface elements.

Automatic Multi-threading

4 Programming in LabVIEW involves creating graphical code that resembles a flowchart. This is known as dataflow programming. Instead of writing a sequence of commands that execute one-by-one, LabVIEW programs contain variables and operations that connect one variable to the next. The LabVIEW compiler automatically determines the order of commands to execute to produce correct results. This also means that, with LabVIEW, when two parallel sections of code are independent of each other, they can run at the same time on different cores of a multicore processor. In addition to programming multicore CPUs, LabVIEW can be used with other parallel hardware, including FPGAs, graphical processing units, and computing clouds.



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TECH SPECS

- NI LabVIEW can run on most common OSs and deploy code to an array of hardware targets. LabVIEW development systems are available for Windows, Mac, and Linux, and users can run LabVIEW code on all three, as well as on dedicated real-time operating systems.
- Development systems options: LabVIEW Base, Full, Professional and NI Developer Suite.
- NI LabVIEW 2011 system design software is priced from $1,249.

For full system requirements, visit ni.com/labview/requirements.

sc11.supercomputing.org

SC11

Seattle, WA
Connecting communities through HPC

November 12-18, 2011

Seattle, WA
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SC11, the premier international conference on high performance computing, networking, storage and analysis, will convene **November 12-18, 2011 in Seattle, Washington.** This year's conference will bring together communities to facilitate information exchange, discussions and new collaborations for research and education related to innovating high performance computing applications and advanced scientific discovery and scholarship.

The program will highlight the latest technological advances in the field, with examples of their applications, many of which will be showcased on the exhibit floor by industry and research organizations.

Conference Thrust:

- **Data Intensive Science** — which focuses on the challenges and opportunities for addressing the exponential growth and demands in the generation and analysis of data.

Technical Program Focus:

- **Sustained Performance** will place a spotlight on how to achieve real, measurable productivity using leading-edge computing, networking storage and analysis across a diverse range of science and engineering disciplines.

New This Year

- **State of the Practice**, a new element in this year's technical program, will provide a venue for discussing best practices involving provisioning, using, and improving the critical systems and services in high performance computing, networking and storage.
- **Scientific Visualization Showcase**, also new to this year's technical program, will be presented in a museum/art exhibit-style environment so attendees can experience and enjoy the latest in science and engineering HPC results expressed through state-of-the-art visualization technologies.

Don't miss the full day of technical sessions on Friday, November 18, the last day.

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