DE
Desktop Engineering®
TECHNOLOGY FOR DESIGN ENGINEERING
February 2013 / deskeng.com

Review: ThinkPad W530 P.42
Large-Format 3D Printing P.49
Future FEA Pre-Processors P.45

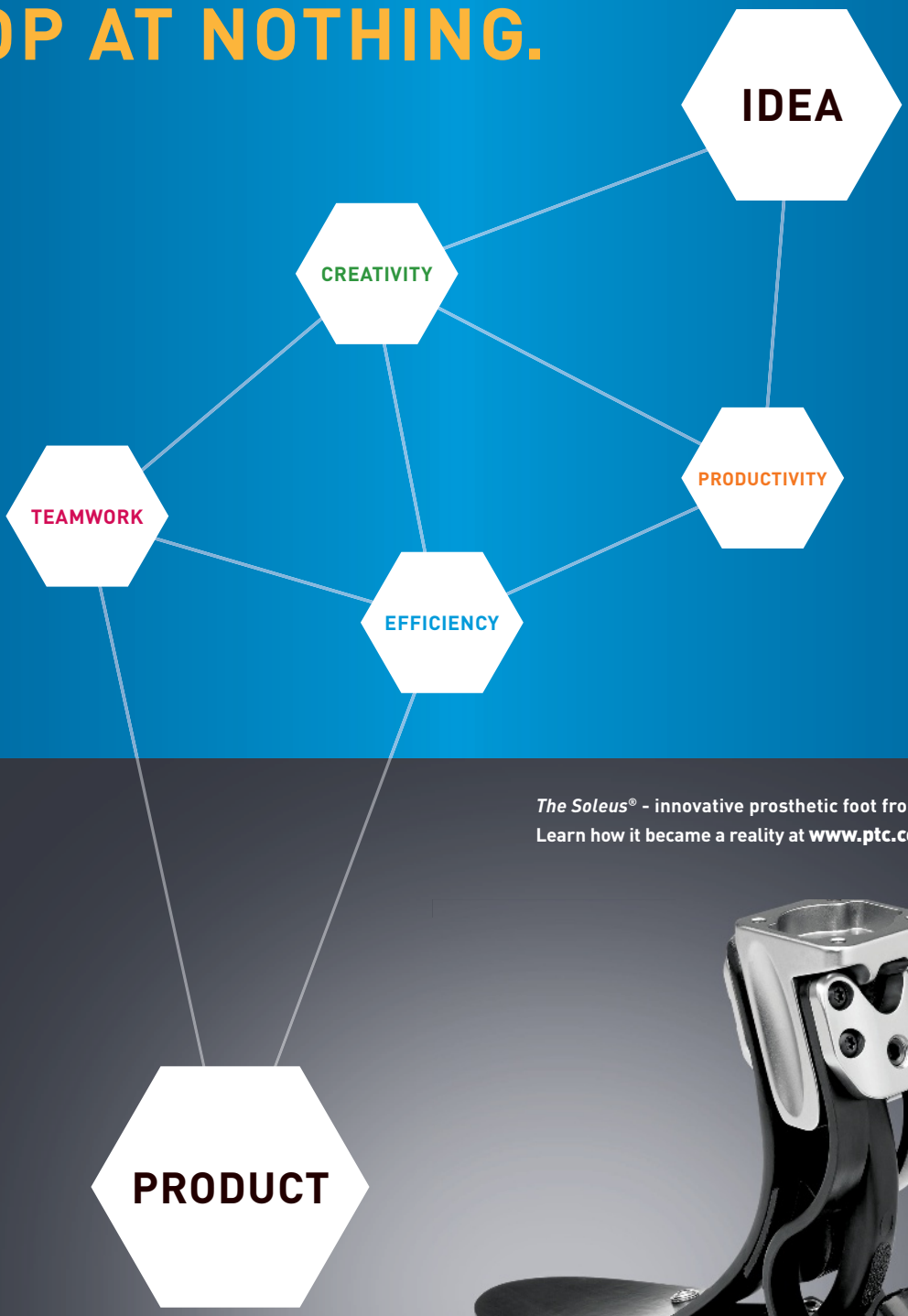
# Mobile Engineering

## Apps for portable productivity

P.27


SYSTEM-LEVEL MODELING P.54
REVIEW: THE LATEST SSDs P.56
REVIEW: KEYSHOT 3.3 P.58

# START WITH PTC Creo®
# STOP AT NOTHING.




*The Soleus*® - innovative prosthetic foot from College Park.
Learn how it became a reality at **www.ptc.com/go/college**



Ideas are your product team's most valuable asset. Unleashing those ideas into real products that set your company apart is where PTC Creo comes in. As the world's most scalable and easy-to-use suite of design software, PTC Creo maximizes every aspect of the design process. From creativity to productivity, teamwork to efficiency. All of which helps deliver the **powerful product and service advantage you can expect from PTC.**

PTC Creo®

# Data Acquisition Modules and Data Loggers


### *8/16-Channel Thermocouple/Voltage Input USB Data Acquisition Module*

- 8 Differential or 16 Single-Ended Analog Inputs
- 24 Bit Resolution with Up to 1000 Samples/Sec
- User Programmable for Type J, K, T, E, R, S, B, N Thermocouple or Voltage Input

**OM-DAQ-USB-2401**
**$529**

*Visit omega.com/om-daq-usb-2400*

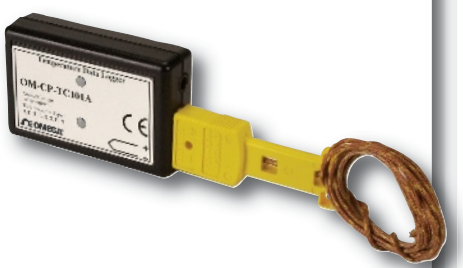
### *Four Channel Portable Data Loggers*

**OM-DAQLINK Series**
**Starts at**
**$365**


*Visit omega.com/om-daqlink*

### *Ambient Temperature and Thermocouple Data Logger Part of the NOMAD® Family*

**OM-CP-TC101A**
**Starts at**
**$149**




*Visit omega.com/om-cp-tc101a*

### *WiFi Wireless Temperature and Humidity Data Loggers*

**OM-EL-WIFI Series**
**Starts at**
**$150**


*Visit omega.com/om-el-wifi_series*

**1-888-82-66342®**
**1-888-TC-OMEGA**

Because of transmission frequency regulations, these wireless products may only be used in the United States, Canada and Europe.

**omega.com**

OMEGA®

by Jamie J. Gooch

# Design for Generation Mobile

When the screen on my daughter's hand-me-down laptop dimmed, flickered and finally died, I hooked it up to a secondary monitor that had been gathering dust in a closet. My take: Problem solved without a repair bill or a new laptop. Her take: "So I can only use my computer if I'm sitting at a desk?" It wasn't so much that she was complaining, it was just a foreign concept she was trying to comprehend.

She's not alone. More and more consumers expect mobility. Global smartphone shipments will exceed 1 billion units in 2013 and the installed base will exceed 2 billion, according to accounting and consulting firm Deloitte. Tablet shipments are expected to exceed 240 million units this year, beating the notebook PC shipment forecast for the first time, according to an NPD DisplaySearch.

**The mobile device is becoming the digital dashboard to the Internet of Things.**

That many smartphones and tablets have a ripple effect for product design engineers. Just as the personal computer boom opened up the market for printers, routers and other peripherals, so too is the mobile boom. But this time, there are no wires attached.

For example, there were enough watches and bracelets at the 2013 Consumer Electronics Show to fill a jewelry store, but most didn't operate independently. They owed their wow factor to how they interacted with smartphones by sending the wearer's vital signs to an app, or beaming a user's calendar meetings from their phone to their wrist.

About half of U.S. adults have a smart phone in their pocket, according to Pew Research, and they want to use them to control everything from their televisions to their thermostats to their cars. Pundits predicted for years that the computer would become the hub of the connected home, but it looks like that computer has a different form factor than they expected. The mobile device is becoming the digital dashboard to the Internet of Things.

## Meeting Demand

Designers charged with meeting the demand for connectivity have plenty of tools to get the job done. Design and simulation software is capable of helping to avoid heat displacement and interference issues in devices that traditionally haven't had to incorporate antennas, radios and screens. Workstations and servers have the processing power needed to develop and test new embedded software that can connect virtually everything to everything else. Sensors and components are shrinking to previously unheard of sizes, allowing design engineers to incorporate GPS in luggage, accelerometers in shoes and electronic noses in refrigerators.

The pace of technological innovation is both a blessing and a curse for engineering departments that find themselves transitioning from designing "dumb" products to "smart" ones that use embedded software to communicate via the Internet. They're tasked with learning new systems, requirements and technologies—and they need to know them yesterday. Hiring new engineers to fill in the gaps isn't always possible. Even if the economy were booming and companies were hiring more, they'd have a difficult time finding talent. There are two job openings for every unemployed science, technology, engineering and math (STEM) professional, according to a study by Change the Equation, a non-profit initiative to improve STEM education in the U.S.

While bringing in outside expertise is one answer, which we'll investigate in next month's special issue on engineering consultants and service providers, technology provides another potential solution.

## Collaboration is Key

Just like products communicating with each other in an Internet of Things makes each product more useful, design engineers who collaborate with engineers from other disciplines will improve themselves and the products they design. Communication is a no-brainer, but with tight production schedules and overflowing inboxes, it's easier said than done.

The good news is, design collaboration software in the form of product data management and product lifecycle management is not just for large enterprises anymore. Software developers have made their products easier to install, maintain and use by small- and medium-sized businesses. They're becoming increasingly important tools for all engineers, especially those who need to stay abreast of the rapid technological shifts a connected culture is bringing to their work.

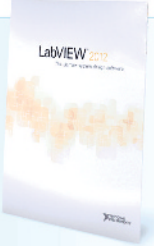
And, of course, many of them have mobile apps so engineers can stay connected to them on the go. DE

**Jamie Gooch** *is the managing editor of* Desktop Engineering. *Contact him at de-editors@deskeng.com.*

# Smarter Embedded Designs,
## Faster Deployment


The combination of NI LabVIEW system design software and reconfigurable I/O (RIO) hardware helps small design teams with varied expertise develop demanding embedded applications in less time. Using this graphical system design approach, you can take advantage of the same integrated platform to program embedded processors and FPGAs for faster application development in industries ranging from energy to transportation, manufacturing, and life sciences.

LabVIEW system design software offers ultimate flexibility through FPGA programming, simplifies code reuse, and helps you program the way you think–graphically.




**>> Accelerate your productivity at ni.com/embedded-platform**

800 453 6202



NATIONAL INSTRUMENTS

DE February 2013 VOLUME 18/ISSUE 6

## COVER STORY

# Engineering App Roundup

**27** In less than five years, the number of apps for mobile devices has gone from virtually nothing to more than 700,000, with no signs of slowing. We've collected more than 100 engineering-specific apps. While it's not an exhaustive list, it is representative of the types of tools available for engineering via mobile devices.

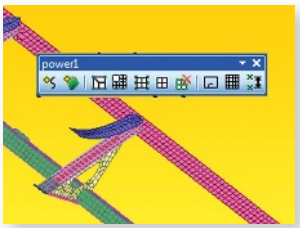
## PROTOTYPE


### 49 Large-Format 3D Printing
Airbus has announced plans to print an entire airplane by 2050. Is it possible? How far along the path are we?
By Mark Clarkson


**ON THE COVER**: Apps for mobile engineers enable design on the go and on the Web. *Images courtesy of iStockphoto and Big Stock and individual app developers.*

## SIMULATE


### 45 Where is my 21st Century FEA Preprocessor?
While the software is much improved over the technology levels of 30, or even 10 years ago, it seems to have been stuck in a groove for a while—refining many concepts, but with no fundamental paradigm shift.
By Tony Abbey


### 54 Modeling the System
Modelica is leveling the playing field for modeling engineering systems.
By Laurent Bernardin


## ENGINEERING COMPUTING

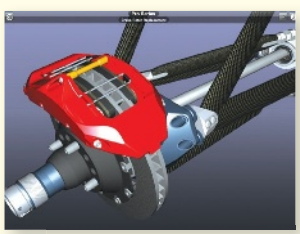

### 56 Review: The Latest SSDs
The disk performance bottleneck is being countered with solid-state drive technology, which removes storage concerns from the performance equation.
By Frank J. Ohlhorst


## DESIGN


### 58 Review: KeyShot 3.3
Multiple ingredients go into KeyShot 3.3's rendering optimization process that make it simple to use.
By Mark Clarkson


## FOCUS ON MOBILE COMPUTING


### 18 Engineering Meets the Mobile Fast Lane
Mobile offerings are finally starting to help streamline certain engineering workflows—while bolstering day-to-day productivity.
By Beth Stackpole

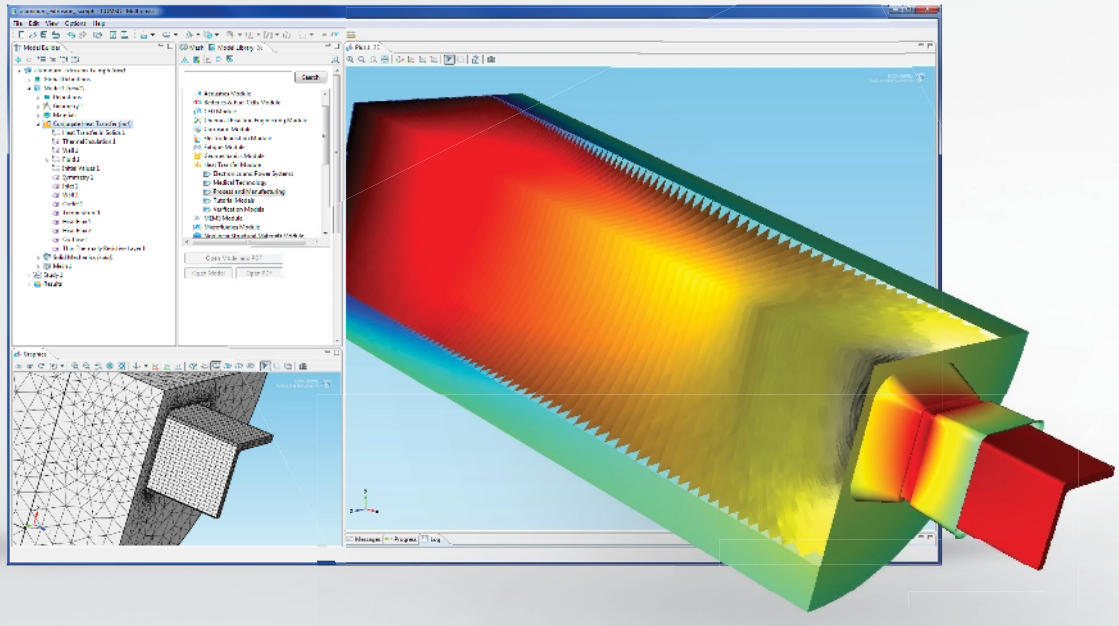




### 22 Mobile Engineering 2.0
A new generation of apps takes advantage of mobile devices' unique characteristics.
By Kenneth Wong

### 42 Review: Lenovo ThinkPad W530
Lenovo's new mobile workstation delivers incredible price and performance.
By David Cohn


COMSOL Version 4.3a
Now Available!
www.comsol.com/4.3a

METAL FORMING: Fluid-Structure Interaction (FSI) in the cast and mold of an aluminum extrusion process. The isosurfaces show the dynamic viscosity in the non-Newtonian aluminum flow.



# Verify and optimize your designs with COMSOL Multiphysics®

Multiphysics tools let you build simulations that accurately replicate the important characteristics of your designs. The key is the ability to include all physical effects that exist in the real world. Download a free product booklet at **www.comsol.com/booklet**

## Product Suite

COMSOL Multiphysics

**ELECTRICAL**
AC/DC Module
RF Module
MEMS Module
Plasma Module

**MECHANICAL**
Heat Transfer Module
Structural Mechanics Module
Nonlinear Structural Materials Module
Geomechanics Module
Fatigue Module
Acoustics Module

**FLUID**
CFD Module
Pipe Flow Module
Microfluidics Module
Subsurface Flow Module

**CHEMICAL**
Chemical Reaction Engineering Module
Batteries & Fuel Cells Module
Electrodeposition Module
Corrosion Module

**MULTIPURPOSE**
Optimization Module
Material Library
Particle Tracing Module

**INTERFACING**
LiveLink™ *for* MATLAB®
LiveLink™ *for* Excel®
CAD Import Module
ECAD Import Module
LiveLink™ *for* SolidWorks®
LiveLink™ *for* SpaceClaim®
LiveLink™ *for* Inventor®
LiveLink™ *for* AutoCAD®
LiveLink™ *for* Creo™ Parametric
LiveLink™ *for* Pro/ENGINEER®
LiveLink™ *for* Solid Edge®
File Import *for* CATIA® V5

COMSOL

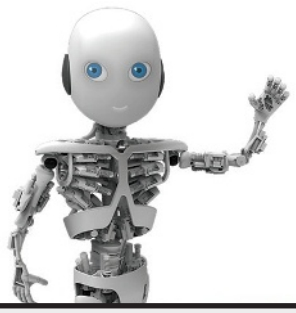
February 2013 VOLUME 18/ISSUE 6

## DEPARTMENTS


**2 Degrees of Freedom**
Desgn for generation mobile.
By Jamie J. Gooch

**8 Kenneth Wong's Virtual Desktop**
New features in Siemens PLM Software's NX 8.5, JT data format endorsed by ISO, beyond the headlines of the Stratasys-Objet merger.

**14 Engineering on the Edge**
Transforming robots, flexible screens, a new NASA spacesuit, a gravity-powered light and a crowd-sourced robot boy.


**16 Rapid Ready Tech**
3D Systems' acquisition of Geomagic, Mcor's Iris 3D printer, EOS' FORMIGA P 110, and a new material for 3D printing electronics.

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

**62 Editor's Picks**
Products that have grabbed the editors' attention.
By Anthony J. Lockwood



**63 Fast Apps**
Engineering case studies.

**63 Advertising Index**


# deskeng.com

**RAPID READY TECH BLOG**
Read all about making digital designs physical @ rapidreadytech.com.

**ENGINEERING ON THE EDGE BLOG**
See the future of engineering technology @ engineeringontheedge.com.

**VIRTUAL DESKTOP BLOG**
Read Kenneth Wong @ deskeng.com/virtual_desktop for a closer look at lifecycle components via articles, podcasts and video reports.

**NEWSLETTER REGISTRATION**
Newslink; Editor's Pick of the Week; Check It Out; Virtual Desktop; Focus on Analysis and Simulation; Focus on Engineering IT & Computing; Focus on MCAD; and Focus on Rapid Technologies.

**DE MOBILE BETA**
Check out our mobile app for Android and iOS by visiting wbxapp.com/de-mobile on your mobile device, or scan the QR code to the right.

***DE* ON TWITTER**
Follow us @ DEeditor

**LIKE *DE* ON FACEBOOK**
Visit *DE* @ deskeng.com/facebook


DE Desktop Engineering®

**EDITORIAL**
**Steve Robbins** | Editorial Director
**Jamie J. Gooch** | Managing Editor
**Kenneth Wong** | Senior Editor
**Anthony J. Lockwood** | Editor at Large
**Heather Pittinger** | Copy Editor

**CONTRIBUTING EDITORS**
Tony Abbey, Brian Albright, Mark Clarkson, David S. Cohn, Barbara Goode, Mike Hudspeth, John Newman, Susan Smith, Beth Stackpole, Peter Varhol, Pamela J. Waterman

**PUBLISHER**
**Thomas Conlon**

**ADVERTISING SALES**
603-563-1631 • Fax 603-563-8192

**Erich Herbert** | Sales Executive (x263)
**Jeanne DuVal** | Account Manager (x274)

**ART & PRODUCTION**
**Darlene Sweeney** | Director (x257)

**A LEVEL 5 COMMUNICATIONS PUBLICATION**
**Steve Robbins** | Chief Executive Officer
**Thomas Conlon** | President

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

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

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

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

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

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

Address all editorial correspondence to the Editor, Desktop Engineering. Opinions expressed by the authors are not necessarily those of *Desktop Engineering*. Unaccepted manuscripts will be returned if accompanied by a self-addressed envelope with sufficient first-class postage. Not responsible for lost manuscripts or photos.

*Find it at*
**mathworks.com/accelerate**
datasheet
video example
trial request

# MODEL PHYSICAL SYSTEMS

*in*

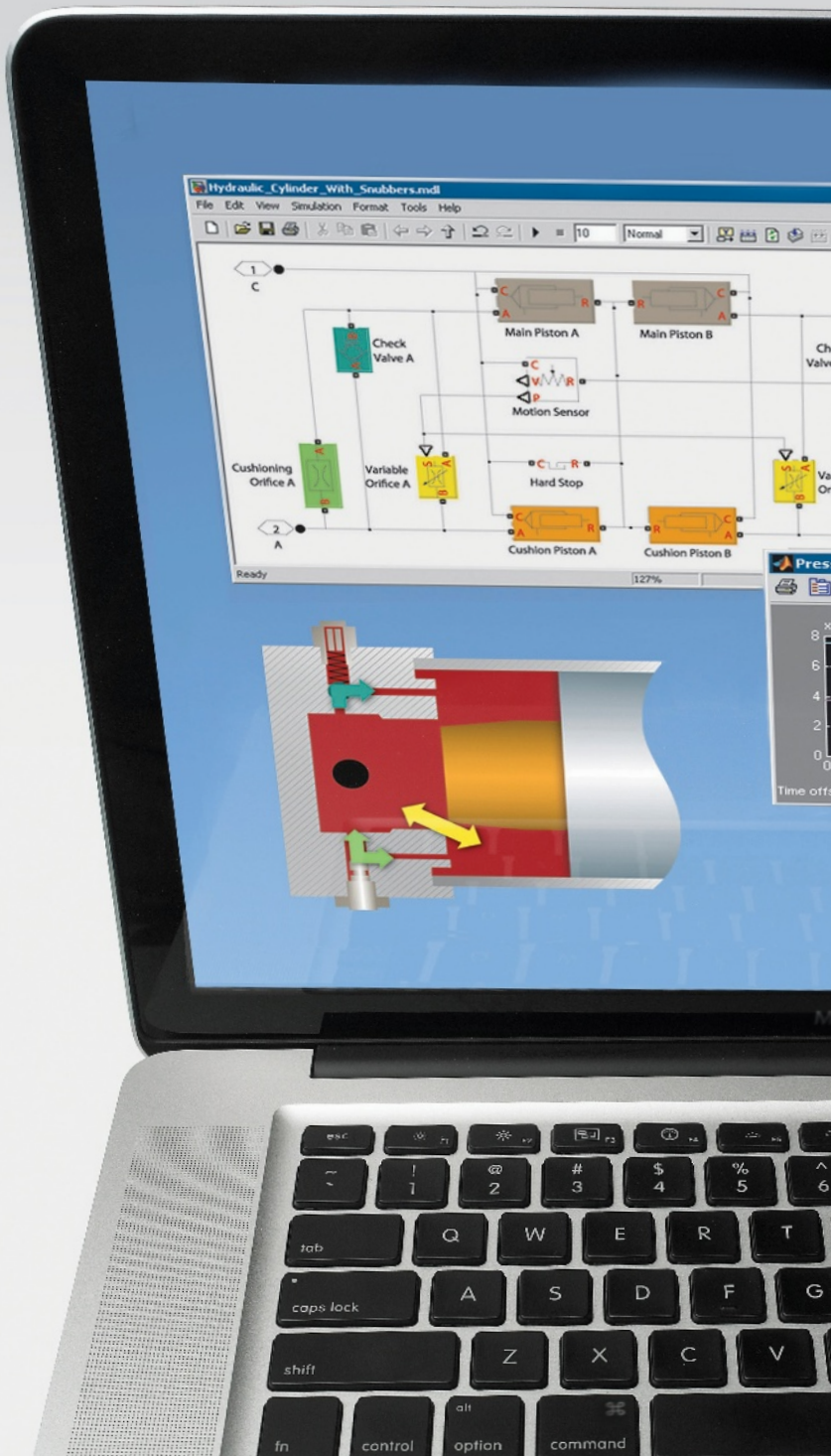
## Simulink

with **Simscape**™

- Electrical
- Mechanical
- Hydraulic
  *and more*

**Use SIMSCAPE with SIMULINK to model and simulate the plant and controller** of an embedded system. Assemble your model with a graphical interface, or import physical models from CAD systems. Use built-in components or create your own with the Simscape language.

MATLAB® & SIMULINK®

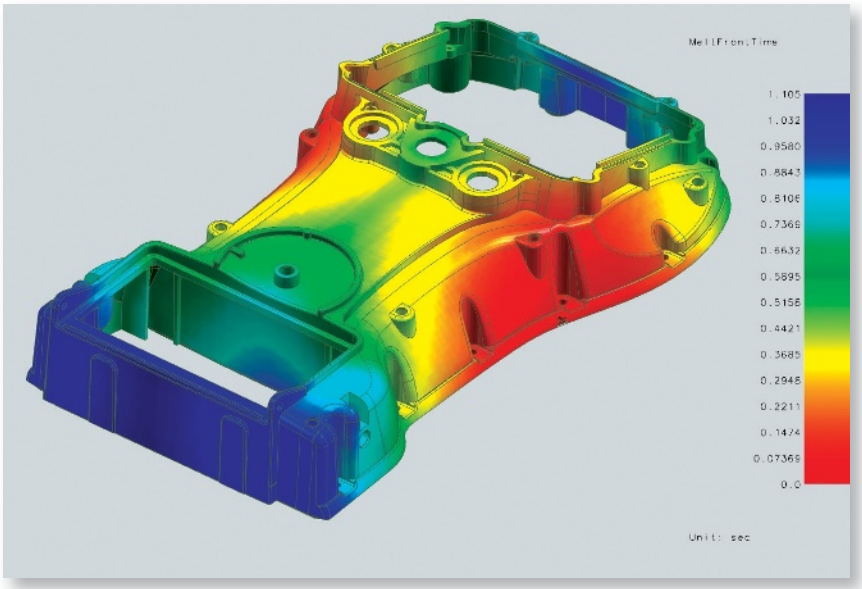



MathWorks®
*Accelerating the pace of engineering and science*

# NX 8.5 Plugs the Molding Gap with EasyFill Mold Analysis Integration

In 2008, when Autodesk got its hands on Moldflow in an acquisition, it gained a huge advantage over rival CAD developers. The ability to simulate the injection-molding process for molded plastic products brought design (CAD) and manufacturing (CAM) closer than before.

The simulation software is still available as a standalone program, rebranded as Autodesk Moldflow. But it's also tightly integrated with Autodesk's primary 3D mechanical design software, Autodesk Inventor, through a plug-in called Moldflow Adviser.




Moldex3D's plastic mold simulation technology is now available inside NX 8.5 as EasyFill Mold Analysis.

## EasyFill Added to NX

In November, Siemens PLM Software's NX program received a similar treatment with the integration of EasyFill Mold Analysis. The technology came from CoreTech System, makers of Moldex3D, a plastic simulation package.

"NX EasyFill Analysis enables designers to easily check potential manufacturing defects without leaving the NX design environment," according to the company. "It helps users tackle significant molding issues more efficiently to optimize gate number/locations, material selection or process conditions. Additionally, Moldex3D provides more advanced capabilities in its 'eDesignSYNC for NX' to support packing, cooling, fiber orientation and warpage predictions. It allows NX users to visualize more critical molding factors and evaluate the results, such as sink marks, overpacking or thermal displacement and part shrinkage."

## Free Trial Available

Though NX has a robust collection of stress analysis and simulation tools, EasyFill is the first-ever plastic mold simulation tool for the software, according to Robin Wei, Moldex3D's product manager.

"We delivered our [Moldex3D] solver and the API to Siemens developers," explains Wei. "So NX developers were able to integrate those solvers into their own API … It's free. It's a trial version, but [users] can use the basic features. If they want to use the more advanced features, however, they'll have to buy a license."

## Other Moldex3D Options

Through other plug-ins available from the company, you may also deploy Moldex3D with Dassault Systèmes' CATIA, SolidWorks, or PTC's Creo—all competing products of Siemens' NX.

Moldex3D also offers an on-demand solution, where you may use the processing power of remote servers to speed up the mold simulation process. Branded "Moldex3D Cloud Services Solution," the solution uses "the power of high-performance computing (HPC) capability for users to enable the plastic design verification and optimization on the cloud. Now, two solutions are available on market: Moldex3D Public Cloud Services is exclusively in North America and Moldex3D Private Cloud Solution is marketed worldwide," the company explains. The on-demand application is available for a free test drive.

*—K. Wong*

OUR NEW PLOTTERS PRINT

# LINES AS THIN AS

# .018 MM

That's less than 1/55th of the distance between here and here.


## THE NEW EPSON® SURECOLOR® T-SERIES

- Extreme plotting accuracy at resolutions up to 2880 x 1440 dpi
- Capable of producing a precise, color, D-sized plot in 25 seconds
- Advanced pigment ink technology for truly durable, full-color plots
- High-capacity ink cartridges up to 700 mL for low printing cost
- Space-saving design with easy access front-loading paper and ink

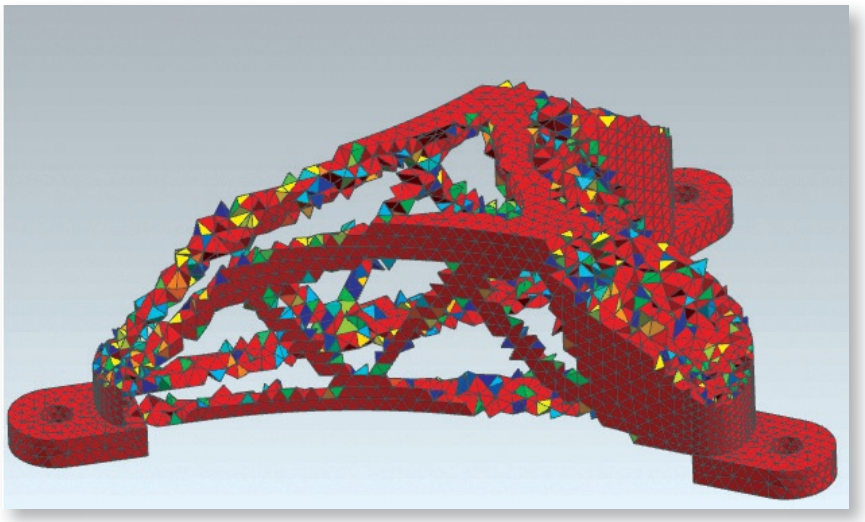
EPSON SureColor T3000 - 24" | $2,995
EPSON SureColor T5000 - 36" | $3,995
EPSON SureColor T7000 - 44" | $4,995

EPSON®
EXCEED YOUR VISION

Speeds are based upon print engine speed only. Total throughput times depend upon factors such as computer, file size, printer resolution, ink coverage, and networking. For the SC-T3000, top speed for a D-sized plot is 28 seconds.
Prices are MSRP, before rebates. Please check with an EPSON Professional Imaging Authorized Reseller for actual price as dealer prices may vary.

# A New Way to Lose Weight with NX 8.5

Like Jenny Craig and Weight Watchers, CAE software programs are now on a quest to help you lose weight. To be precise, they are introducing ways to help you shave off materials, or excess weight, from your design. (For more on weight reduction, see "The Twin Forces of Optimization & Inspiration" in the December 2012 issue.)



The optimal shape for a bracket, as proposed by NX 8.5's Topology Optimization.

## Topology Optimization

NX 8.5, the latest release of Siemens PLM Software's premiere design and engineering suite, joins the weight-reduction craze with the debut of Topology Optimization. In this process, you begin by defining a region in your design—a specific block of geometry, most likely a part—you'd like to optimize. The idea is to see whether you can redesign the part with less material, but still ensure it can withstand the anticipated loads and stresses.

The topology optimization tools are intended for designers, not specialists. Accordingly, NX 8.5 offers a guided approach to optimization. To identify where you can shave off materials, you must first understand the stress concentration. That calls for simulation.

## Similar to Simulation

Now, you can probably understand why optimization and simulation go hand in hand. The inputs required for optimization in NX are quite similar to those required for a simulation job: identifying fixed points, specifying loads, and so on. In fact, the optimization exercise is based primarily on a linear static analysis of loads and stresses on your part. The primary difference is, in optimization, you specify a target weight reduction—say, 30% of the current part's weight.

Once you have the inputs in place, the software can solve the optimization scenario, just like it would a simulation task.

In simple terms, the software is examining every element (or mesh) to see whether it's critical to counteract the load expected. If not, then that's a candidate for weight reduction. If you're running optimization on a complex part and need additional computing power (more than what's available in your desktop or laptop), you may tap into a high-performance computing (HPC) server. NX 8.5 allows distributed computing in its simulation functions. Keep in mind that you need a mesh model to optimize its weight or volume, so topology optimization works primarily on single parts. If your desire is to optimize an assembly (not a very likely scenario), you'll have to somehow reduce the entire assembly into a mesh model to study it.

## A Lighter Future

The optimized outcome resembles—for lack of a better term—a jagged blob. That's because the software doesn't make aesthetic judgment when it singles out areas to shave off materials. It's pure math, translated into geometry. It's up to you to examine the proposed topology, then fashion a part that can be manufactured and also appeal to your target consumers. You can export the proposed shape as STL into your design environment.

The process of topology optimization in NX is quite similar to the process employed by Altair Engineering's SolidThinking Inspire. (For a review and a video demo of Inspire, go to deskeng.com/virtual_desktop/?p=6219.) It suggests certain standard protocols may be emerging from the software-based optimization trend. It also points to a future where most designs will be lighter, produced with leaner, tighter topology.

*—K. Wong*

# A Winning Formula

## *Red Bull Racing and ANSYS*

**Victories by Red Bull Racing. Simulation by ANSYS.**

ANSYS®

**Realize Your Product Promise®**

Winning the Formula One World Constructors' Championship is a monumental accomplishment. Winning it three times in a row is practically unheard of. But for Red Bull Racing, it was just another day at the office.

Using ANSYS simulation technology, Red Bull Racing is creating virtual prototypes of its racecars, so engineers can quickly and inexpensively optimize everything from aerodynamics to brakes to exhaust systems. Red Bull Racing is delivering on its product promise by remaining dominant in one of the most competitive environments imaginable.

Not a bad day at the office.

Red Bull Racing | ANSYS

INNOVATION PARTNER

**Visit ANSYS.COM/RedBullRacing to learn how simulation software can help you realize your product promise**

by Kenneth Wong & Beth Stackpole

# Siemens PLM Software Walks the Walk with Openness Promise

For those who think Siemens PLM Software's talk about openness is just talk, it pays to consider its latest announcements. While they're seemingly unrelated, they go a long way in underscoring its commitment to the much-discussed strategy: In the course of a week, the product lifecycle management (PLM) veteran announced that its 15-year old JT data format has been accepted as what it claims is the first standard endorsed by the International Organization for Standardization (ISO) for viewing and sharing lightweight 3D product information. In a separate release, Siemens PLM Software announced 3DSync, a CAD editing tool based on Synchronous Technology, which it plans to offer to any CAD user as a way to increase productivity when dealing with imported CAD models from heterogeneous systems.

While 3DSync and the JT standard address different needs, they both play a role in helping organizations work more efficiently and collaborate more effectively when using different CAD systems. Heterogeneous CAD is a reality today, given the predominance of global design chains made up of partners and suppliers, comfortably entrenched in their own portfolio of preferred tools. CAD interoperability and the ability to modify 3D models created in another system has been a longstanding pain point for customers across industries, particularly those with complex and large supply chains.

"Clearly, JT and Parasolid and collaboration is part of our base story, and while it's serendipitous that the announcements happened in the same day, it's a proof point of a strategy we've been pursuing for years around multi-CAD environments and openness," says Bill Boswell, senior director of partner strategy for Siemens PLM Software.

**General Motors has used the JT file format for more than a decade as part of its PLM strategy for lightweight 3D visualization and collaboration.** ***Image courtesy of General Motors.***

## Commitment to Collaboration

JT, which many CAD vendors support and which has long served as a de facto open format for sharing and visualizing 3D product data across PLM systems in companies like General Motors, has now been adopted by the ISO as an international standard. Siemens PLM Software worked closely with ProSTEP iViP, a global consortium committed to advancing open standards, to complete the process of winning ISO acceptance for JT, as well as in publishing a key reference document (ISO PAS 14306).

Instead of continually having to clean up and rework native CAD models for sharing with engineering peers, JT provides a lightweight description of a design, including details like geometry, manufacturing information and metadata, but without the full design intent. Even though the spec was published in 2007 as an open format, the ISO blessing removes any lingering industry concerns that Siemens PLM Software might pull back on its commitment to open standards, according to Mike Zink, the company's senior product manager—and openness evangelist.

"Official ISO support for JT does not impact the technology or the capabilities of JT per se, but it does silence the naysayers who wanted to believe that Siemens could at any time wrest back JT and retake full control for their own purposes," agrees Ken Versprille, executive consultant at CIMdata. "Companies can now feel safe in adopting JT, and be assured that it can and will be supported in the future, whether by Siemens or others."

While lots of CAD and design tool companies support JT, there are other options being promoted around multi-CAD data exchange. The 3D PDF Consortium is promoting 3D PDF for 3D model exchange, while Siemens' competitor Dassault Systèmes has its own format, 3D XML, which is positioned as a universal lightweight XML-based format for quick and easy sharing of 3D data.

While Dassault prefers its own 3D XML to JT, it does support JT in a

number of its products, according to Fabien Fedida, Dassault's senior director, global offer strategy. However, Fedida says the ISO announcement supports JT as visualization standard, not as a format for data exchange—thus Dassault advises customers to continue to invest in STEP as a broader CAD interoperability standard.

"We've long recommended customers leverage STEP as the ultimate solution for 3D visualization and interoperability," he says. "STEP is just the better way to go when you consider the bigger picture. It handles visualization, interoperability and archiving. On the archiving front, this is mandated for aerospace companies, so… using STEP kills several birds with one stone, more efficiently, and more cost-effectively."

### Work with 3D Data

The other piece of the latest Siemens "openness" push is 3DSync, a new application designed to simplify the process of importing and modifying 3D data from multiple sources. The software is architected on Synchronous Technology, a key capability in NX and Solid Edge. The idea for 3DSync was rooted in feedback from customers, who continually cited the ability to easily work with imported CAD models as one of the core benefits of Synchronous Technology, according to John Fox, Siemens' vice president of marketing, mainstream engineering. In fact, based on industry research, Siemens found that 44% of imported CAD models had to be reworked because of translation errors during the import stage.

"There's always been a lot of complaints that once you import something, it becomes a dumb solid—but it's not like the solid is dumb, it's more that the CAD system is dumb," Fox says. Given Synchronous Technology's ability to increase productivity when working with imported CAD data, the company saw opportunity to parlay this strength to a broader market, Fox says. 3DSync will be available for testing at no charge through May 15, 2013.

*—B. Stackpole*

# The Stratasys-Objet Merger: Going Beyond the Headlines

The list of major players in rapid prototyping and 3D printing is not a very long one. In fact, if you try to count them with your fingers, you wouldn't need to use both hands. In that tightly packed corner, a new super pact was formed when 3D Systems acquired Z Corp. last year. Another one has emerged now that Stratasys and Objet have officially come together.

In a recorded interview available at deskeng.com/virtual_desktop/?p=6451, Jon Cobb, Stratasys' executive vice president of global product marketing, and Bruce Bradshaw, Objet's director of marketing, clarify the reasons behind the merger and addressed some questions on post-merger operations.

What drew Stratasys and Objet together, according to Cobb, was a mixture of similarities as well as complementary differences.

"The two companies are leaders in the industry, so obviously putting together the two premiere players make sense," he says. "In technology, Stratasys with its FDM [fused deposit modeling] technology, focuses on durable thermal plastic parts. Objet, with its jetting [technology], focuses on fine featured details, good surface finish, and dual materials." Objet's jetting technology also supplements the singular jetting process used by Solidscape, acquired by Stratasys in May 2011, Cobb pointed out.

### Room to Grow

"The fact that we have complementary technologies, and the fact that our distribution channels are so solid, there's room for all our resellers to continue to sell both product lines," Bradshaw says. "We will, over the next quarter or so, train—we're referring to it as cross-train—each reseller to learn about the other technologies."

Bruce Bradshaw

Jon Cobb

The merger, Cobb says, could offer both companies room for growth in aerospace and automotive industries, specifically in aerospace production. There may also be new markets they pursue. Both companies are just getting into that dental market [digitizing dental fixtures and producing them using 3D printers].

"Objet has had very good success" in the dental market, says Bradshaw, "but that industry itself is also changing … Digital dentistry as referred to today is changing that market rapidly. And Objet's technology is known as the leader in that space … Having the technology we have and the Stratasys name behind it is going to take us to the next level." Objet's penetration of the dental industry could also push Solidscape's participation further in the same market, he added.

The consolidated product lines will fall into three categories:

- The Idea series, comprising Mojo and uPrint 3D printers (for the concept exploration phase).
- The Design series, comprising most of Objet products (for testing design functions).
- The Production series, comprising the Fortus brand (for factory-scale production).

For more on this topic, read "Reading Between the Layers of the Stratasys-Objet Merger" at rapidreadytech.com/?p=2482.

*—K. Wong*

## MIT Invents Mini Transformable Robots

No, not that kind of transformer. The trio of Dr. Neil Gershenfeld, head of MIT's Center for Bits and Atoms, visiting scientist Dr. Ara Knaian and postdoctoral associate Kenneth Cheung has created miniature robots that can be reconfigured into different shapes.

The robots are called "milli-motein," and were inspired by a protein's ability to reshape itself into nearly any form.

To power their creation, the researchers invented a new type of tiny motor, called the electropermanent motor, that would ensure the robot held the shape when turned off. It uses a circle of permanent magnets, paired with electromagnets. When the robot needs to change shape, it taps into power to drive a small steel ring that has been placed around it. This system means the robots require very small amounts of power to operate.

**MORE** ➜ engineeringontheedge.com/?p=3306

## Flexible Phones Are on the Way

Imagine owning a phone that will never break if you drop it, with a screen that is nearly impossible to crack. Flexible cell phones offer all these advantages over current-generation models—and may soon become a common part of mobile electronics.

The devices will use OLED displays, and, according to Samsung, will be "foldable, rollable, wearable and more," and "will allow for a high degree of durability through their use of a plastic substrate that is thinner, lighter and more flexible" than conventional LCD technology.

Samsung showed off flexible screen concept devices during the 2013 Consumer Electronics Show keynote. Along with Samsung, LG, Philips, Sharp, Sony and Nokia are all developing the technology. The first flexible cell phones may hit the market this year.

**MORE** ➜ engineeringontheedge.com/?p=3315

## NASA Spacesuit Prototype Has Familiar Look

It's not clear whether it will take astronauts to "infinity and beyond," but NASA's Z-1 prototype spacesuit redesign will certainly draw comparisons to the gear donned by *Toy Story* character Buzz Lightyear, with its bubble top and green trim.

NASA has completed a round of reduced-gravity testing of the suit, which would replace the current Extravehicular Mobility Unit (EMU) spacesuit. The new suit has a hatchback, which should make it easier for wearers to put on and take off. It can also be attached directly to the exterior of a rover or space vehicle, which will allow astronauts to directly exit a craft rather than using an airlock.

**MORE** ➜ engineeringontheedge.com/?p=3482

## Light Powered by Gravity

There are billions of people in the world without reliable access to electricity; at night, those folks light their homes the old-fashioned way: with kerosene lamps. Unfortunately, the fuel is dangerous and expensive.

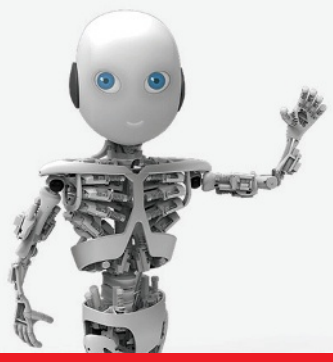
The GravityLight project hopes to mass-produce a gravity-based light that uses a descending weight to power an LED bulb. The light comes in a fabric bag that can be filled with rocks or dirt, and used as ballast to provide up to 30 minutes of light. GravityLight would be less expensive to purchase and maintain than solar options, which require costly hardware and rechargeable batteries for energy storage.

**MORE** ➜ engineeringontheedge.com/?p=3494

## Crowd-sourced Robot Boy Set to Debut

A team of researchers in Zurich turned to crowd funding to launch an ambitious robotics project—developing an advanced, humanoid service robot in just nine months.

The project is being spearheaded by the Artificial Intelligence Laboratory of the University of Zurich. Dubbed Roboy, the cuddly-looking robot will be constructed using a human-like, tendon-driven design (rather than having motors in its joints).



In addition to relying entirely on sponsorships and private donations, the robot will also be built with an open-source technology model. Keeping with that democratic spirit, the team let Roboy's Facebook friends vote on their favorite head design.

At press time, Roboy was set to be unveiled—possibly riding a bicycle—at the Robots on Tour event in March.

**MORE** ➜ engineeringontheedge.com/?p=3525

➜ For daily coverage on the future of engineering technology, visit EngineeringOnTheEdge.com

# ExSight Links CAE and CAD

CAE specialists previews ExSight from Dassault Systèmes' SIMULIA brand.

Over the last few years the R&D team at SIMULIA, the Dassault Systèmes brand for realistic simulation, has quietly been working on ExSight, a next-generation integrated CAE tool. They are now ready to make noise about it!

The first question that comes to mind is how ExSight fits with the existing SIMULIA workhorse, Abaqus. The Rhode Island-based team emphasized that Abaqus continues to be the flagship linear, nonlinear multiphysics solver, while ExSight represents a re-imagined modeling environment to access Abaqus and other solvers over time. With that in mind, it is important to explore this radically new and scalable user experience that drove a new architecture in ExSight, delivered on the Dassault Systèmes 3DEXPERIENCE Platform.

The first impression of the ExSight environment was an inviting, well thought out interface with many innovative interaction features.

## Three ExSight Areas Highlighted

1. **Composites.** The integration of 3D design (CATIA) capabilities with structural simulation (SIMULIA) was shown in ExSight. The design and simulation entities were displayed in a single view and manipulated on an aircraft fuselage model. The relationship between composite layups and plies and their position on the 3D model was easily checked. Updating the model automatically updates simulation entities, including re-meshing if required, so CAD and CAE model remain in synch.
2. **Batch meshing.** Large numbers of complex parts can be meshed without tying up the user. The computational burden can be distributed across processors, or launched on the cloud. Local meshing rules can be applied to each part. An expert has full control to set mesh density, element size, defeaturing options etc. and then distribute these best practices across the organization for less experienced users.
3. **High-performance visualization.** Sophisticated but intuitive visualization controls were shown, including interactive result contours embedded in surrounding geometry, 3D slice views etc.

High-performance is essential given the model sizes of many of SIMULIA's users. Remote graphics exploit multiple processors or cloud computing in the new architecture, supporting previously unattainable model sizes. Models with 250 million degrees of freedom can be manipulated in real time, leapfrogging previous technology. The goal is a billion in the near future. This is great timing as the data explosion, much talked about in CAE circles, is surely about to hit us soon.

Large nonlinear result files are not feasible for laptops etc.; ExSight ships only simplified polygon data over the network, keeping the full results file stored away from the user's machine—enabling full visualization on mobile devices.

## Collaboration Between Designer and Analyst

The Dassault Systèmes 3DEXPERIENCE Platform enables collaboration with a synchronized and managed architecture linking CAD and CAE. A complex assembly was shown as a CAD model on a designer's screen and simultaneously as a CAE model on an engineering analyst's screen. Since they were both accessing the same data, not just screen sharing, design changes flagged by the designer using a paintbrush, highlighter and chat box were instantly seen by the analyst. With the intent clear, the analyst accepts the new geometry, automatically re-meshes and re-analyzes the updated design. The 3DEXPERIENCE Platform handles all of the interactions behind the scenes.

## Conclusion

The heritage of CATIA and SolidWorks products give Dassault Systèmes a strong understanding of CAD users expectations. SIMULIA has a proven CAE pedigree with Abaqus. With the Dassault Systèmes 3DEXPERIENCE Platform, these technologies come together in the new ExSight environment, which promises to become a highly productive and innovative next-generation realistic simulation toolset. The performance with large models is astounding for both pre-processing and results visualization. DE

**INFO → Dassault Systèmes , SIMULIA:** www.3ds.com/simulia

## Mcor Technologies Announces Iris

Mcor Technologies' newest 3D printer, Iris, offers full-color prints, rather than blocks of solid colors.

The Iris uses the same process as Mcor's earlier printer, the Matrix 300—which, is what the ASTM calls sheet lamination. Unlike other printers, which use metal or plastic to build objects, Mcor printers use standard printer paper.

The build size is 9.39x6.89x5.9 in. Layer thickness is 0.004 in. for standard A4 paper. Color resolution is where the Iris really stands out, with 5,760x1,440x508 dpi. Mcor's new 3D printer accepts the usual STL, OBJ and VRML file formats.

Mcor Technologies is offering the Iris for just under $16,000 as part of its Free D plan. The plan also includes machine use, free materials and service.

**MORE** ➜ rapidreadytech.com/?p=2957

## Carbomorph Expands Printed Electronics for 3D Printing

Researchers at the UK's University of Warwick have come up with a material they are calling "carbomorph" that is designed to be used in 3D printers. The team made the material by combining carbon black filler with polymorph modeling plastic, which is a commercial version of polycaprolactone (PCL). According to the research team, the result can be run through any 3D printer that uses a material extrusion process.

PCL is biodegradable and has a low melting point, which makes it ideal for additive manufacturing (AM). Objects built using carbomorph look like plastic parts, but have the added bonus of being conductive.

The research was published in a paper named "A Simple, Low-cost Conductive Composite Material for 3D Printing of Electronic Sensors" in the open-access, online journal PLOS One.

"One of the goals of the project was to try and develop a material that was as simple as possible to make so that a hobbyist could produce it if they wanted," says Dr. Simon Leigh, who led the research team. "It's the idea of empowering people by giving them the tools to decide how they interact with the technology around them."

The research team has tested carbomorph by printing out a game controller, flex sensors in a glove, and heat sensors in a coffee mug. Creative individuals and businesses will, no doubt, come up with many other potential applications for the new material. For those without a lab, Leigh and his colleagues are investigating methods of providing carbomorph for sale.

**MORE** ➜ rapidreadytech.com/?p=3030

## EOS Introduces FORMIGA P 110

EOS has put sintering technology to use on plastic, using a 30-watt, carbon dioxide laser. The company recently released the FOMIGA P 110, which is an updated version of the P 100.

According to the company, the P 110 has been developed to build small print runs, and parts or products with a complex internal geometry, such as medical devices. Among the new features of the new system are a four-channel heating and use of a single-point pyrometer. EOS also says the FORMIGA P 110 has improved stability and reproducibility.

On the technical side, EOS' new additive manufacturing (AM) system has a build envelope of 7.9x9.8x13 in., with a build speed of up to 0.79 in. per hour. The P 110 offers a layer thickness of 0.0024 in., 0.0039 in. or 0.0047 in., depending on material (either polyamide or polystyrene).

**MORE** ➜ rapidreadytech.com/?p=3017

## 3D Systems Acquires Geomagic, Rapidform

3D Systems has signed a definitive agreement to acquire Geomagic, a provider of 3D authoring solutions including design, sculpt and scan software tools that are used to create 3D content and inspect products throughout the entire design and manufacturing process.

The company also recently acquired Rapidform, a provider of 3D scan-to-CAD and inspection software tools, which it described as securing the cornerstone of its fifth growth initiative: to create a seamless, digital scan, design and print platform for the benefit of its customers. The Geomagic acquisition would further that goal.

The company says the combination of Geomagic's sculpting, modeling, scanning and inspecting software tools with 3D Systems' portfolio strengthens its 3D authoring platform, and positions the company for accelerated growth in the 3D content-to-print space.

Geomagic recently made headlines with its announcement of Freeform 2013 3D modeling software and Spark. Freeform 2013 allows users to virtually sculpt new designs. Spark leverages the SpaceClaim platform to offer new tools for 3D scan, design and inspection.

**MORE** ➜ rapidreadytech.com/?p=3186

➜ For more coverage of rapid technologies, visit RapidReadyTech.com

# Hybrid Cloud: The Best of Local and the Cloud


The cloud may be all the rage, but it can't touch the speed of today's workstation.

**BY DOUG BARNEY**

If you listen to some cloud vendors, software in the ether can do everything a local machine can, and do it cheaper and better. For some applications, batch-oriented programs for instance, that may be true.

Workstations are different. Serious workstation applications where users create, test and modify their ideas in rapid succession are best served with high-performance local processing.

Moore's Law tells us that processor power will essentially double every 18-24 months—so your next workstation may be at least two to three times faster than the one you've got today.

## Performance and User Experience

Talk to anyone you know who uses interactive applications in the cloud, and you'll discover the experience can be maddening. Now imagine running a demanding engineering application purely from the cloud: probably not a very satisfying way to work.

The cloud has two things going against it in the performance department. Most services are based on shared, virtualized servers in huge server farms, not high-performance local central processors and GPUs. And the cloud will never be as fast as local computing because the network is the gating factor.

Moore's Law doesn't apply to the network, which makes far smaller performance gains. Even with faster connections, such as gigabit or 10 gigabit Ethernet connections, performance is only fully optimized if all portions of the network are upgraded the same way. After all, a network is only as fast as its slowest point.

## Where the Cloud Makes Sense

While the cloud struggles to support highly interactive applications, there are many things it does well. Some engineering tasks are optimized by cloud services that augment your workstation.

For instance, some smart engineers develop on their workstation, and then send the final system or assembly to the cloud, cluster or data center. Sounds great. Simulation is one area where the cloud may shine. Autodesk, a pioneer in bringing simulation to the cloud, refers to its services as a way to "extend design beyond the desktop." Clearly, Autodesk360 Simulation software is an adjunct, not a replacement, for desktop workstations.

When coupled with a powerful workstation capable of running simulations you can maximize the value of your cloud investment in the same way Hollywood brings new feature length animation to market. In Hollywood, artist and animators create and test locally in a highly interactive and very creative loop—once they agree on the outcome they enter a phase known as production rendering—using all their local and cloud contracted resources to deliver the next blockbuster animation faster than ever before.

They meld local with the cloud and the result is innovation and creativity at speeds never thought possible.

## Another Consideration: Cloud-onomics

Local processing is a fixed, well understood cost. Cloud services are a variable cost with prices you can't ultimately control. Hidden in the cloud costs are fees for boosting the network for performance and reliability, more pipes so there is no single point of failure, and perhaps WAN accelerators and optimizers.

So what is really more cost-effective, local computing or the cloud? For problems that are fairly quickly done, the network costs could be more than internal processing. Where the network economics start to make sense for cloud are large problems that can take multiple hours, days, or more of data processing.

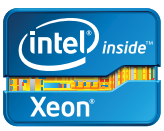
It still makes sense to keep most applications and computing local—using the cloud to augment your demands. More importantly, as Hollywood has figured out, employ the cloud when is it is more likely you will get the results you are looking for. Be educated in your use. Start with coarse grain models to validate your hypothesis, then and only then launch a large-scale fine grained model to the cloud. You will like the results much better.

## What to Do

Be smart about the cloud. Create, test and modify ideas locally. Be educated about how to get the most from the cloud and remain within your budget. Learn from others. Look to Hollywood. Can your workflows mimic theirs? Probably.

Next month we'll talk about getting the most from your software. DE

**Doug Barney** *is a computer journalist with nearly 30 years of experience.*




**INFO → Intel Corp:** intel.com/go/workstation

# Engineering Meets the *Mobile Fast Lane*

Mobile offerings are finally starting to help streamline certain engineering workflows—while bolstering day-to-day productivity.

**BY BETH STACKPOLE**

John, a structural engineer for an automotive original equipment manufacturer (OEM), is awakened by the alarm on his iPhone at 6 a.m. After a quick check of his email, he fires off a response to an overnight inquiry about a particular attribute on a part that was sent to him by a partner in Asia working on a 24/7 global design cycle.

Downstairs, coffee in hand, John grabs his tablet to do a collaborative online review of the 3D part model with the Asian-based team. The partners come up with a workaround, make the desired changes, and push the iterative design to the next level before John even hops in the shower—and prior to the Asian team taking off for the day.


**With ForceEffect Motion, engineers can apply simulation capabilities to develop and test mechanical systems with moving parts on their mobile devices. *Image courtesy of Autodesk.***

Elsewhere, Carol, a designer, is on the train, en route to her job at an industrial equipment manufacturer. Trying to get a jump on an already busy day at work, she leverages her iPad to access 2D drawings and customer requirement documents from the product data management (PDM) repository on the corporate server, in preparation for her part in the afternoon's big design review meeting. Taking advantage of on-the-go Internet access, she also manages to engage with a couple of members on a social networking site focused on her specific CAD tool, to get some pointers on how to use the tool to tackle a particularly thorny design tolerance issue.

Meanwhile, Carol's colleague, Bob, the engineering manager on the project, has been out for days at a client site. Now, he's slowly making his way back to the office to facilitate the design review meeting, although he's been stuck at the airport for the last few hours grounded by weather delays. Regardless, Bob has been able to put the unexpected layover to good use, polishing up the final details for the meeting. Juggling his tablet, a cell phone and a portfolio of mobile apps, Bob adds a couple of new milestones to the shared project timeline, uses an online mobile app to ensure the proper conference room is booked, and even places a lunch order online for the engineering team's favorite take-out.

Around the globe, organizations of all sizes and across all industry segments—along with engineers like the fictional John, Carol and Bob—are frantically integrating mobile devices and mobile apps into their daily workflows. A recent forecast by International Data Corp. projects the worldwide mobile worker population to reach 1.3 billion, representing 37.2% of the total workforce, by 2015. Symantec's 2012 State of Mobility Survey also reveals a tipping point in mobility adoption: It found that 71% of enterprises are, at a minimum, discussing the deployment of

custom mobile applications—and one-third are currently implementing or have already implemented custom mobile applications.

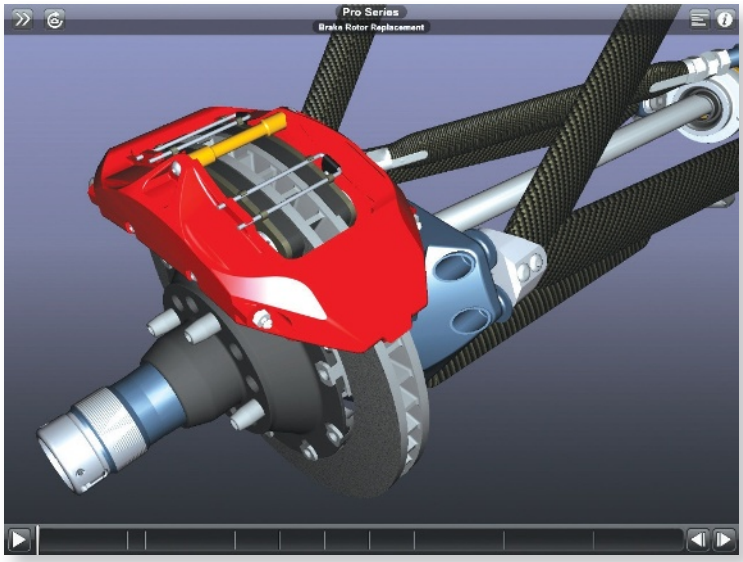
Experts say engineering departments are not necessarily at the forefront of this rapidly evolving paradigm shift, primarily because of the still-limited number of high-functionality engineering-specific apps, which are in part impeded by the much smaller real estate of mobile devices. Nevertheless, that's starting to change thanks to a bevy of next-generation mobile apps starting to hit the market. These new design tool apps maximize the smaller footprints; they also leverage features like video, accelerometers and global positioning capabilities to advance functionality and help facilitate more productive engineering workflows. (For a look at the new generation of mobile apps, see "Mobile Engineering 2.0 on page 22.)

"The lines are starting to blur between what a tablet is and what a laptop is," says Prabakar Murugappan, director, mechanical design, DLS, at Autodesk. "We're starting to see considerable interest and usage gradually growing in terms of mobile tools in all different facets of the design process."

## Mobilizing Key Workflows

Autodesk has been particularly aggressive about staying in front of the mobile design tool curve. The company has introduced an array of mobile apps—from ForceEffect for simulating early design concepts to AutoCAD WS, an app for viewing, editing and sharing AutoCAD files that the firm says now has more than 10 million downloads. Mobile apps like these and others go further than their predecessors in streamlining day-to-day tasks associated with the engineering workflow, from early concepting, to design collaboration, all the way through supplier sourcing and on-site inspection. Based on interviews with engineers and design tool vendors, here are five core workflows that can be improved, if not transformed, with the addition of mobile apps.

**1. Early design and concept.** What engineer hasn't, at one point or another, grabbed a sheet of paper or the proverbial "napkin" to sketch out an idea or rough up a design point to later showcase to a colleague or customer? Experts agree that the tablet (and even smartphone) is a perfect form factor to replace paper, which can get lost, and the gesture-based user interface now common among mobile apps provides a natural way to interact with the device for common drawing and light




**Autodesk Inventor Publisher Mobile Viewer lets teams interactively view animated 3D assembly instructions created with the Inventor Publisher desktop software.** ***Image courtesy of Autodesk.***

concept and editing work.

Beyond mobile sketch tools like SketchUp or Autodesk SketchBook, additional "point cloud" technology like the Autodesk 123Catch mobile app lets users capture a photo of an existing product or a particular part-in-progress that needs to be refined, and turn that component into a 3D model that can then be further refined using mobile technology when on-site with a customer or out in the field.

"Just think about being at a meeting with a client and breaking out your iPad to start drawing," explains Doug Cochrane, CTO at IMSI/Design. "It's a great way to show off ideas or sketch on top of a design for design iteration."

**2. Collaborative design.** At this point in time, given the current app offerings, collaborative design might be the sweet spot for the case for mobile use. Many of the early mobile design tool apps were all about capabilities like viewing and 3D markup, to facilitate design collaboration when engineers are on the go and not tied to their workstations. The newer generation of apps enhances the workflow by exploiting capabilities like video and video chat to push mobile collaboration to the next level.

Consider the scenario where there is an international team of engineers, planners and architects deployed on a project, in constant need to exchange everything from 3D parts models and building plans to requirements documents and project timelines. Typically, email has been the preferred communications vehicle—although not necessarily the most effective, given time zone differences and the sheer quantity of messages exchanged on every design project. That's according to Kal Houhou, regional BIM implementer, North American region for SmithGroupJJR, who says those involved in a typical project could see anywhere from between 150 to 200 related emails a day. "By sending emails back and forth, you end up with a lot of email from everywhere on different subjects—and no matter how organized you are, the flow is too large," Houhou says.

Using a combination of Autodesk PLM 360, a cloud-based product lifecycle management (PLM) solution, and a variety of mobile apps, SmithGroupJJR architects and mechanical engineers have transformed the way they collaborate on projects. Tablets are used to take pictures of work in progress, which are then digitized and marked up using AutoCAD WS. "Having something portable is a no-brainer for this kind of collaboration," Houhou says. "There are just some places where you can't take a laptop."

The ability to orchestrate mobile printing can also facilitate collaboration, notes Andrew Vecci, director of marketing at Océ, which offers Océ Publisher Mobile, for printing to a wide-format Océ system from a smart phone or tablet. Being able to submit print jobs and have documents accessible virtually can remove some of the burden of advanced planning prior to going off-site to a remote office or manufacturing location as part of the engineering process, he explains. "Employees no longer have to worry that they have all the documents they need stored on a jump drive or printed in hard copy before they go out into the field, or put a job on hold when they retrieve critical design data," Vecci says.

**3. Design costing.** For garnering access to standard parts, the mobile paradigm can be highly efficient. From a tablet or smart phone, engineers can easily frequent any number of online catalogs and communities—like Dassault Systèmes' 3DVIA Mobile, for example—and have immediate online access no matter where they are to thousands of high-quality, downloadable 3D CAD part models (many of them free) so they don't need to recreate the wheel for each design.

Using the video functions on a mobile device can also help facilitate the costing process when collaborating with suppliers, IMSI/Design's Cochrane says, describing a scenario where an engineer could pull up a part on his or her device and work with the supplier on making real-time changes right from the production floor, knowing instantly whether the revised design is manufacturable.

In addition to performing field observations using CAD drawings, TurboSite also allows for the presentation of 2D/3D designs to clients, to depict how the actual products work in the field. *Image courtesy of IMSI/Design.*

With TurboSite, users can analyze product specifications, add annotations and red marks, and attach pictures and video to document pertinent design information. A report can be automatically generated for team collaboration, record tracking and archiving purposes. *Image courtesy of IMSI/Design .*

**4. On-site field inspection.** Video and video chat capabilities can be a powerful tool in aiding in on-site field inspection and the subsequent reporting. In lieu of taking copious handwritten notes, and then manually re-entering them into a document to distribute to colleagues in email, it's much more efficient to capture conditions in video, which can be shared and discussed in real-time on the shop floor or at the customer site using the device's chat capabilities.

"No one in the world designs anything and doesn't inspect the end result," Cochrane says. "But to inspect it, you usually have to go off-site—and then there's the pain point of having to record and document information … using multiple pieces of software and compiling and recompiling notes. With a tablet, you can gather information in the field, organize it, hit a button, and export a report."

**5. Client presentations.** A mobile device's ability to support a near real-time collaboration process also helps facilitate client interaction, and streamlines the iterative design cycle. Whether it's through video chat, an augmented reality scenario where you virtually depict a product or building layout on the fly, or simply making a design tweak while at a client site and having them instantly see and sign off on changes, design teams can cut hours, even weeks, out of the design cycle.

"You can let clients see design iterations in real time," Cochrane explains. Traditionally, an engineer might get input from the client on-site, go back to the office, boot up the CAD package, make modifications, and then email the revised design for further input—a process that could take weeks, depending on the number of iterations.

While mobile tools are definitely making inroads into many facets of the engineering workflow, most pundits agree that full-blown design and 3D CAD modeling will remain on the desktop for the foreseeable future. Yet Autodesk's Murugappan doesn't see it that way, particularly with the advent of newer tablet technology and in conjunction with developments around cloud-based software.

"I don't see any limitations for using mobile devices anywhere, even for hard-core CAD," he says. "The key thing to keep in mind is not just looking at today's tablets, but at the evolution of the technology. With cloud and mobile combined together, any limitations go away." DE

**Beth Stackpole** *is a contributing editor to DE. You can reach her at beth@deskeng.com.*

**INFO**
- **Autodesk:** Autodesk.com
- **Dassault Systèmes:** 3DVia.com
- **IMSI/Design:** IMSIDesign.com
- **International Data Corp.:** idc.com
- **Océ:** Oce.com
- **SmithGroupJJR:** SmithGroupJJR.com
- **Symantec:** Symantec.com
- **Trimble:** SketchUp.com

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

# Mobile Engineering 2.0

A new generation of apps takes advantage of mobile devices' unique characteristics.

**BY KENNETH WONG**

Coming home from a trade show in early 2011, I found myself on a flight with no movie. With more than two hours to kill before landing in San Francisco, I decided to play with my iPad, acquired just a month before.

Like all new iPad owners, I had downloaded nearly every free app that seemed marginally useful. I soon realized the vast majority of the engineering and design apps I'd installed allowed me to do exactly the same thing: View a 3D model in a lightweight format and add notes to it.

Early mobile apps for engineers and designers, which hit the market about six months after the birth of the iPad, were largely attempts to duplicate the desktop experience on the tablet. (Developers have made, and continue to make, design and engineering apps for smartphones, but the tablet with its larger screen is often deemed a better platform for these apps.) Many developers did a handsome job providing tablet users with a way to remotely access cloud-hosted 3D models, inspect them, annotate them and share them with others.


**The next generation of eDrawings mobile from SolidWorks will incorporate an augmented reality setup. As shown here in the prototype app, you'll be able to project your design into the camera feed in real time.**

The ability to bypass the cumbersome desktop and comparatively heavy laptops to perform routine design reviews and collaboration was appealing in itself. However, these apps hardly introduced anything new to the tried-and-true operations made possible by traditional computers. Few, if any, took advantage of the features inherent to the new devices—location awareness and built-in camera, for example.

At the end of 2012, the iPad was 2 years old, but the platform had reached its fourth incarnation. Similarly, mobile apps now enter a new phase, marked by the incorporation of the device's unique advantages. For example:

- With Autodesk 123D Catch, you can transform a series of digital photos of the same subject (say, a building or a sculpture) into a 3D model, built with polygons, skinned with a realistic texture.
- With IMSI/Design's TurboSite, your physical location, as fixed and tracked by the device in real time, is part of the navigation mechanism. (Think of navigating a factory's 2D site plan as you might in Google Maps.)
- A new version of SolidWorks eDrawings mobile—still in development at press time—allows you to overlay your CAD model on top of the camera's view, creating an augmented reality (AR) window on the iPad.

Finally, the apps are catching up with the device's innovation.

## Combining Real and Virtual Worlds

In September 2012, even though SolidWorks World was still four months away, Rich Chin, the man who helped bring the runaway hit SolidWorks Sustainability to market, already had something up his sleeve he was ready to preview. Taking advantage of the press crew assembled in Waltham, MA, for the SolidWorks 2013 launch, he


# COMPOSITES MANUFACTURING 2013

**MARCH 19-21, 2013**

Long Beach Convention Center | Long Beach, California

## BY MANUFACTURERS. FOR MANUFACTURERS.

**Composites Manufacturing 2013** offers three days of expert conference sessions and demonstrations of the industry's latest materials and manufacturing technologies.Learn how they are changing the aerospace, automotive, sporting goods, and wind/alternative energy industry. Find the information and technologies you need to lower costs, enhance overall product quality, and serve new growth markets.

**Register today! sme.org/composites**

SUPPORTING PARTNERS: AWEA American Wind Energy Association; ABARIS Training; High-Performance Composites

MEDIA PARTNERS: Composites Technology; Wind Systems

PRODUCED BY: SME Society of Manufacturing Engineers COMPOSITES

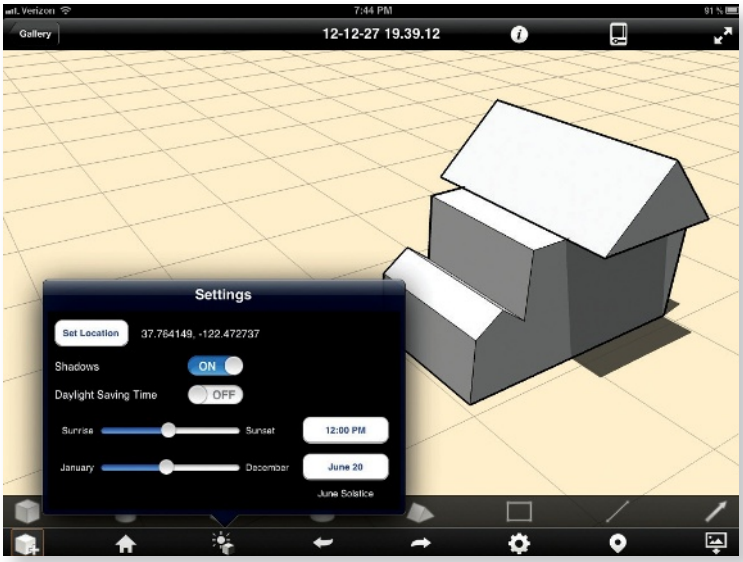
CO-LOCATED WITH AERODEF MANUFACTURING

decided to unveil a prototype AR app for the iPad (as mentioned above). The function is expected to become part of the next release of eDrawings Standard and Professional for the iPad.

"The idea is to expand the engineer's workspace beyond the LCD screen, into augmented reality," says Chin, director of product innovation. "We were looking at AR and how it was going to provide value to engineers. The first platform we tried it on didn't work out. Then the iPad came out, and it turned out to be a fantastic platform for this."

As demonstrated with the prototype, Chin envisioned the app to provide a button, which could beam a digital model into the real world—in other words, project the CAD model onto the camera view. This treatment will be available whenever you open a document recognized by eDrawings.

"When we render the virtual model, we'll do it in full-scale and match the perspective exactly with the camera perspective," Chin says. "It will feel like that model is sitting there."




**Autodesk FormIt mobile app lets you place, combine and edit primitive shapes to create geometry using fingertips. The geo-location option and sun angle simulation provides you with a way to examine precise shadow casting during a specific time of the year.**

## New Ways to Sketch and Draw

For years, design software developers have written programming code based on the mouse-and-keyboard input paradigm. But the emergence of touch-sensitive devices—and consumers' increasing reliance on them—now call for a new way to sketch in 2D and model in 3D, using fingertips as the primary input mechanism.

**Orange Juice Studios' Cado mobile app uses its patent-pending OMouse input system. The user can confirm or cancel the command by pressing either of the floating buttons that ergonomically trail the offset cursor. The keypad and sidebar tools are also presented to afford the user the option to draw using coordinate points or angle and length combinations.**

Such attempts could be seen in 123D Sculpt, an Autodesk mobile app already in Apple's app store, and Autodesk FormIt, a mobile app that premiered at Autodesk University 2012.

With 123D Sculpt, you can use fingertips to poke and pinch a block of geometry to reshape it organically, as you might do with a block of clay in real life. The mobile app, available for free, uses the same technology found in Autodesk Mudbox, a digital sculpting and painting program with a price tag beginning at $795.

FormIt allows you to use fingertips to drop, place, modify and reposition primitive shapes. A tap brings up a context-sensitive menu, which lets you add dividing lines to subdivide the primitive shape and create additional geometry through direct-edit style dragging. Though not ideal for precision modeling, it's a robust tool for creating basic shapes. The daylight simulator, which shows shadow casting based on sun angle calculation throughout the year, makes this a valuable tool for testing out architectural projects.

"When you're away from your desk, if you have an idea, you want to have an easy way to generate that and explore it," observes Amar Hanspal, Autodesk's senior

vice president of platform solutions. "[Touch-based modeling] is something you'll see more and more of in Autodesk apps—not just pinch to zoom and swipe to pan."

Recognizing the market for its bread-and-butter software AutoCAD on mobile devices, Autodesk came up with a cloud-powered mobile sketching app, called AutoCAD WS. The app successfully transformed many operations typically performed with mouse and keyboard (dimensioning, drawing lines and circles, resizing parameters, and so on) to fingertip operations. Still, that wasn't good enough for Az (Attaz), an architect in London, and Vim (Vimal), a mechanical engineer in South Africa. Together, they founded Orange Juice Studios and set out to create a new sketching app called Cado, still in development at press time. (The third party to this development team is a mysterious talented developer, who prefers to be known only as The Hat.)

Central to Cado is the use of forefinger and thumb to draw objects (lines and arcs) and adjust their precise dimensions. The input system is called OMouse, currently patent-pending, and it "solves the conundrum of drawing accurately with your fingers," Vim says. While many mobile software developers consider the lightweight device more suitable for editing existing drawings than creating something from scratch, Az and Vim say they believe Cado can be a "full-fledged CAD program." Cado is set to hit the market in the second quarter of 2013.

### The Cloud Catch

Even though the digital camera has been part of smartphones and mobile devices for years, few mobile engineering and design apps incorporated it into their functions. All that changed with Autodesk's 123D Catch mobile app. Launched in May 2012, the mobile version of 123D Catch is based on Autodesk's web-hosted application by the same name, previewed in Autodesk Labs in mid-2011.

Using a mix of triangulation algorithms and cloud-hosted processing, the application can stitch together a 3D mesh model of a scene based on a collection of user-submitted 2D digital photos. The resulting scene can be exported to design software as point clouds or a STL file.

Those who need to capture as-built conditions of plants, buildings and mechanical structures in highly detailed formats will continue to use laser scanners, dig-

itizers and other professional devices. But for average consumers, designers and artists who need to quickly digitize a 3D object, the ability to create a mesh model from a collection of 2D digital photos offers convenience and efficiency. Furthermore, the entire process can be done on any mobile device equipped with a camera, which bypasses the need for more expensive field equipment.

The strength of the 123D Catch mobile app rests with its reliance on cloud-hosted computing. Analyzing the pixels in 2D images, calculating the possible physical location of each point in 3D space, and assembling a coherent scene in meshes requires far more computing resources than a mobile device can provide. Offloading the process to cloud-hosted servers reduces the wait and makes the scene building effortless.

### Moving Targets in the Field Tracked with GPS

IMSI/Design, makers of TurboCAD and DoubleCAD XT, has begun looking at mobile computing as the next revolution in design and engineering software. The company released its first mobile app, TurboViewer, in early 2012. Even then, the company envisioned its mobile app not solely as a piece of software, but as a platform.

The latest addition to IMSI/Design's mobile app lineup is TurboSite, available for trial for free. The most significant feature of the app is its location-based navigation, called GeoMarks. The patent-pending system relies on the device's built-in GPS to identify the user's real-time location. When GPS processing is not available (for example, when Wi-Fi networks are out of range), the system uses triangulation based on user input. The mix of the two methods enables TurboSite to pinpoint your exact location as you travel in the field or navigate a project site. It also allows you to capture a certain object (a mechanical installation in a plant, for example) as a series of photos or video footage, then geo-tag its exact location on the site plan. This approach allows you and your collaborators to navigate building plans and plant plans loaded on mobile tablets as if you were navigating Google Maps, with a real-time tracker showing your position in relation to other critical landmarks.

Autodesk's rival Bentley Systems, well-known for its MicroStation CAD software, has also been watching the mobile craze closely. With a comprehensive suite of products targeting plants, architecture and civil engineering, the company saw the emergence of mobile tablets as a blessing for field workers. With the acquisition of Pointools in late 2011, Bentley began considering supporting point-cloud viewing in its desktop software and mobile apps. Candidates for point-cloud incorporation in Bentley's mobile app lineup includes Bentley Navigator Pano, designed for field workers to navigate through virtual plant structures using CAD data. The incorporation of point-cloud support in such an app would allow a worker to conduct a walkthrough of a plant using laser-scanned site data, commonly saved as point clouds.

### A New Way to Interact with Digital Design Data

For content creation, powerful workstations are still expected to be the primary hardware choice for designers and engineers. But for remote access to design data, revision, collaboration and field work, mobile devices offer clear advantages—and are likely to become the preferred hardware over time.

"I think many customers will do their core design and engineering work on laptops and desktops," predicts Autodesk's Hanspal. "That includes people who use Autodesk Inventor (for mechanical design), Autodesk Revit (for architecture), or Civil 3D (for civil engineering). The cloud-hosted products complement these desktop software; they're not meant as replacements … In a single company, you'll see people using different software products as well as hardware platforms. Someone uses a desktop in the design office, but the same person may use a tablet in the field."

With smaller, lighter form factors and the built-in location awareness, mobile devices offer navigation potential that desktops and laptops don't. Furthermore, the high-res camera functions as the device's eye—a virtual window for viewing, capturing and transmitting field conditions. The design and engineering apps that manage to integrate these hardware-specific benefits are bound to outshine the rest. (To learn how engineers and designers might employ different mobile apps in their daily routines, read Beth Stackpole's article "Engineering Meets The Mobile Fast Lane" on page 18.) DE

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

**INFO** ➜ **Autodesk:** Autodesk.com

➜ **Bentley Systems:** Bentley.com

➜ **IMSI/Design:** IMSIDesign.com

➜ **Orange Juice Studios:** OrangeJuiceStudios.com

➜ **SolidWorks:** SolidWorks.com

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

# Engineering App Roundup


In less than five years, the number of apps for mobile devices has gone from virtually nothing to more than 700,000, with no signs of slowing. In March of last year, Apple announced more than 25 billion apps had been downloaded since it launched its app store in 2008, a milestone Google reached about six months later.

That's a lot of apps. While most of them involve flinging birds at pigs or sending words to friends, there are plenty of apps targeted toward engineers. On the following pages are more than 100 of them, divided into categories that cover design, computing, data management, simulation and test and measurement. While it's not an exhaustive list, it's representative of the types of tools available for engineering via mobile devices.

As tablet and smartphone sales continue to surge, more and more developers are rolling out mobile versions of their software. In fact, today's mobile business apps market is expected to more than double to reach $53 billion by 2017, according to research from Strategy Analytics.

To keep you abreast of the latest and greatest engineering apps, *Desktop Engineering* is launching mobileengineer.com, a site dedicated to keeping you abreast of the latest mobile engineering apps and trends.

Check out the site, let us know what your favorite apps are, and how you use them. Be sure to let us know of any we may have missed in our roundup. DE

| Company | App | iOS | Android | Windows | Phone | Tablet | Cost |
|---|---|---|---|---|---|---|---|
| **DESIGN AND COLLABORATION** | | | | | | | |
| 3DS SolidWorks | eDrawings Pro | ● | | | ● | ● | $9.99 |
| Autodesk | AutoCAD WS | ● | ● | | ● | ● | Free |
| Autodesk | Autodesk ForceEffect | ● | ● | | ● | ● | Free |
| Autodesk | Autodesk ForceEffect Motion | ● | ● | | ● | ● | Free |
| Autodesk | Autodesk 360 Infrastructure Modeler for Mobile | ● | | | ● | ● | Free |
| Autodesk | Autodesk 360 Mobile | ● | ● | | ● | ● | Free |
| Autodesk | 123D Catch | ● | | | ● | ● | Free |
| Autodesk | 123D Make Intro | ● | | | ● | ● | Free |
| Autodesk | SketchBook Mobile | ● | ● | | ● | ● | $1.99 |
| Autodesk | SketchBook MobileX | ● | ● | | ● | ● | Free |
| Autodesk | SketchBook Express for iPad/ SketchBook Express for Tablets | ● | ● | | | ● | Free |
| Autodesk | SketchBook Pro for iPad/SketchBook Pro for Tablets | ● | ● | | | ● | $4.99 |
| Autodesk | 123D Sculpt | ● | | | | ● | Free |
| Autodesk | Buzzsaw Mobile | ● | ● | | ● | ● | Free |
| Autodesk | Inventor Publisher Mobile Viewer | ● | ● | | ● | ● | Free |
| Autodesk | Bluestreak Mobile | ● | | | ● | ● | Free |
| Autodesk | Autodesk FormIT | ● | | | | ● | Free |
| Bentley Systems | ProjectWise Explorer Mobile | ● | ● | | ● | ● | Free |

| Description |
| --- |
| |
| Professional 2D and 3D CAD collaboration app for the iPad, iPhone and iPod Touch that can view native SolidWorks files, eDrawings files and DraftSight files. |
| View and edit DWG files wherever you are. |
| Simulate design concepts in the field or in the office. |
| Develop functional moving mechanical systems on mobile devices. |
| View early design infrastructure concepts and project alternatives right from your iPad. |
| View and collaborating on files in the field. |
| Take photos with your iPhone or iPad and automatically turn them into 3D models. |
| Turn 3D models into 2D build plans with animated assembly instructions. |
| A professional-grade paint and drawing package that can be used to capture napkin-sketch ideas on the go. |
| A paint and drawing application designed for android devices with screen sizes of 7” and under, iPod Touches and iPhones. |
| Use professional-grade tools to create doodles, quick concept sketches or designs on the go. |
| A professional-grade paint and drawing application designed for Android tablets with screen sizes of 7” and above, and iPads. |
| Sculpt and paint realistic 3D shapes. |
| Lets Buzzsaw users securely access Architecture, Engineering, and Construction (AEC) project designs and documents from anywhere. |
| Allows you to interactively view animated, interactive 3D assembly instructions created with Autodesk Inventor Publisher software. |
| Lets users of Project Bluestreak from Autodesk Labs easily collaborate with their Architecture, Engineering and Construction (AEC) project teams from anywhere. |
| Conceptualize, analyze, and share early building design ideas and forms. |
| Create secure work packages from documents stored in ProjectWise by adding a variety of file types, send packages to the iPad for use at a remote location, and export return package to ProjectWise Explorer on your desktop to synchronize for review. |

| Company | App | iOS | Android | Windows | Phone | Tablet | Cost |
|---|---|---|---|---|---|---|---|
| Bentley Systems | Navigator Pano Review | ● | | | | ● | Free |
| CADENAS PARTsolutions | 3D CAD Models Engineering | ● | ● | | ● | ● | Free |
| Cadfaster, Inc. | CadFaster | ● | | | | ● | Free |
| Dassault Systemes | 3DVIA Mobile HD | ● | | | | ● | $4.99 |
| Geometric | Glovius Lite | ● | ● | | ● | ● | Free |
| Geometric Limited | Glovius | ● | ● | | ● | ● | $0.99 |
| GrabCAD | GrabCAD | ● | | | | ● | Free |
| IMSI Design LLC | TurtboViewer | ● | ● | | ● | ● | Free |
| IMSI Design LLC | TurboSite Reader | ● | | | | ● | Free |
| IMSI/Design | TurboSite | ● | | | | ● | $499.99 |
| IMSI/Design | TurboReview | ● | | | ● | ● | $49.99 |
| IMSI/Design | TurboViewer Pro | ● | ● | | ● | ● | $19.99-$29.99 |
| Krueger Systems, Inc. | iCircuit | ● | | | ● | ● | $2.99-$9.99 |
| Lattice Technology Co., Ltd. | iXVL View | ● | | | ● | ● | Free |
| Luxology, LLC | LuxPreview | ● | | | | ● | Fee |
| Luxology, LLC | LuxFolio Stereoscopic Portfolio | ● | | | | ● | $2.99 |
| Luxology, LLC | LuxGallery | ● | | | ● | ● | Free |
| MEA Mobile | Compression Spring Design | ● | | | | ● | $1.99 |
| ModuleWorks | STLView | ● | ● | | ● | ● | Free |

| Description |
| --- |
| Navigate, view, and mark up 3D models for design review and coordination as well as safety inspections. |
| Provides engineers and purchasers in the mechanical engineering, automotive and building industry direct access to thousands of parts from more than 300 certified catalogs of leading global manufacturers. |
| View, share, mark-up and co-view your 3D CAD models with anyone, anywhere. Provides access to all CAD models stored in your CadFaster 3D model box, which includes 100MB of free storage. |
| Turn your iPad into a powerful viewing and demonstration application. |
| 3D viewer for your iPad and iPhone. |
| With Glovius, showcase your 3D models on the go. Interact with your 3D models using the intuitive touch interface. Pinch to zoom, single finger drag to rotate, two finger drag to pan and two finger rotate to roll the model. Double tap to reset the model. |
| A place where 150,000+ mechanical engineers and designers share and discover 3D content. |
| Lightning-Fast 2D/3D DWG Viewer Free TurboViewer is a lightning-fast drawing viewer with powerful capabilities... the first mobile native DWG™ viewer that supports both 2D and 3D... and one of Macworld/iWorld's Top 5 Apps for 2012. |
| Free TurboSite Reader lets anyone view TAP (TurboApp file format), DWG, DWF, DXF, PDF, and 3D PDF (U3D) documents. This free app may be shared with everyone on your design team. |
| Designed as the ultimate field and site survey app, TurboSite reinvents the way every architect, engineer, and contractor will approach site visits and documentation. |
| Review, Markup, Measure, and Translate 2D/3D CAD Drawings. |
| TurboViewer Pro is a lightning-fast drawing viewer that claims to be the first mobile native DWG viewer that supports both 2D and 3D. |
| For designing and experimenting with analog and digital circuits. |
| Enables manufacturing companies to make product data and associated interactive 3D models available on Apple iOS devices. |
| View modo's preview render live by connecting to a computer on your wireless network. |
| Turns your iPad into a customized portfolio for presenting stereoscopic (and standard) imagery. |
| Brings the Luxology Image Gallery to your iPhone or iPad. |
| Provides a simplified method to design compression springs or verifying stock spring offerings with slightly different parameters. |
| Preview any STL geometry used during the design process. |

# From This Day, Forward

**BY DAVID REIS, *STRATASYS CEO***

3D technology is all around us. It's changing how we design and manufacture products, make movies, heal our bodies and interact with the world. Work that used to take place on a page or screen now reaches into space. And faster than ever before, 3D technology is transforming our world.

To see the impact of 3D, look to the realm of design. Designers led the way in embracing 3D CAD and then 3D printing, incorporating more and more physical models into their iterations and thinking with their heads and their hands. And they've reaped the benefits: design problems surface sooner and solutions are less costly. Inspiration happens faster. Ultimately, products are better and consumers are happier. Black & Decker makes a safer tree trimmer and Lamborghini makes a faster car because reviews and trials are more frequently executed on models very much resembling a final product.

Now, 3D printing applications are expanding from design into production, and freeing manufacturers to build without traditional restrictions. DDM stands for direct digital manufacturing, a way to produce a finished product, part or tool straight from a computer design. More importantly, DDM means the rewards of faster, leaner, smarter methods are coming to the production floor. When we at Stratasys (and publications like *The Economist*, *Forbes* and *The New York Times*) call 3D printing "the next industrial revolution," we're not exaggerating.

**A few examples of the Stratasys 3D Printer line.**

A hundred years ago, the assembly line changed the world with mass production. It brought luxuries to the middle class, good wages to workers

## WHATEVER YOUR GAME, 3D PRINTING IS GOING TO CHANGE IT.

3D printing means virtual inventories and low-volume production, which for manufacturers is the next big step.

This rover includes about 70 FDM parts, including housings, vents and fixtures.

and economies of scale to investors. Today, companies like BMW already know that DDM is mass production's heir apparent. One factory-floor fixture, a nameplate-application device, offers an elegant example. Liberated from tooling constraints, BMW engineers reduced the device's weight by half and replaced its blocky stock-metal handles with ergonomic grips — a great relief to workers who might lift the fixture hundreds of times per shift.

Today, NASA can shape a complex, human-supporting vehicle suitable for Martian terrain, despite the fact that its parts are too complex to machine, too rapidly iterated to outsource and too customized for traditional tooling.

In a 3D world, we leave behind injection molding, casting and machining, gaining economy without the scale. 3D printing leads us beyond mass production and into mass customization. It's how a researcher at a Delaware hospital creates a durable ABS-plastic exoskeleton customized to perfectly fit one child, Emma, allowing her to play, explore and hug for the first time. Then that researcher can make a 3D-printed exoskeleton to fit a different child. And another. And a dozen more. Now 15 children with rare disorders can raise their hands because of mass customization.

Ideas born today — your ideas — are freer to solve problems faster than ever before. Now, two innovators who helped spark this revolution have fused to lead the charge together, and more great changes are at hand.

Welcome to the new Stratasys, leader of the next industrial revolution.

A pediatric engineering research lab has developed and 3D-printed custom devices for their smallest patients.

They look like shoes. They feel like shoes. But they're actually prototypes. Printed layer by layer on a 3D printer. Every day, 3D printing rewrites another rule of how things are made. 3D printers are at work in product design studios, engineering departments and manufacturing plants. In schools and hospitals and dental labs. Wherever speed, efficiency, and accuracy matter. It is the next industrial revolution. And Stratasys is here to lead it. Come explore the game-changing possibilities of a 3D World at Stratasys.com.

3D printing means prototypes like these, that help product designers put their best foot forward.

Stratasys
FOR A 3D WORLD™

Learn more at **StratasysForA3DWorld.com**

| Company | App | iOS | Android | Windows | Phone | Tablet | Cost |
|---|---|---|---|---|---|---|---|
| Nemetschek Vectorworks, Inc. | Vectorworks Nomad | ● | | | ● | ● | Free with membership |
| Novatek | iCAD Free | ● | | | | ● | Free |
| PTC | Creo View Mobile | ● | | | ● | ● | Free |
| Robert McNeel & Associates | iRhino 3D | ● | | | ● | ● | $3.99 |
| Sculpteo | Sculpteo | ● | | | ● | ● | Free |
| Siemens PLM Software | Solid Edge Mobile Viewer | ● | | | | ● | Free |
| Tech Soft 3D | HOOPS Viewer | ● | | | ● | ● | Free |
| Titansan Engineering Inc. | vueCAD | ● | | | ● | ● | Free |
| TouchAware Limited | iDesign | ● | | | ● | ● | $4.99 |
| ZWCAD Software Co., Ltd. | GstarCAD MC | ● | | | ● | ● | Free |
| ZWCAD Software Co., Ltd. | ZWCAD Touch | ● | | | ● | ● | Free |
| **ENGINEERING COMPUTING AND PRINTING** | | | | | | | |
| HP | HP Designjet ePrint & Share | ● | ● | | ● | ● | Free |
| HP | HP Support Center | ● | ● | | ● | ● | Free |
| Intel Corporation | Intel Desktop Boards Decoder | ● | ● | | ● | ● | Free |
| Intel Corporation | Intel Technology Provider | ● | ● | | ● | ● | Free |
| Intel Corporation | Intel Solid-State Drives Decoder | ● | ● | | ● | ● | Free |
| Intel Corporation | Intel Boxed CPU Decoder | ● | | | ● | ● | Free |
| Maide, Inc. | CADremote | ● | | | ● | | Free |
| Océ | Océ Publisher Mobile | ● | ● | | ● | ● | Free |

| | Description |
|---|---|
| | Access your Vectorworks documents with your mobile device. |
| | View and share CAD and 3D models on the go. |
| | Instantly visualize 3D Creo View models on your iPad or iPhone. |
| | View native Rhino 3DM files on your iPad, iPhone and iPod Touch. |
| | Browse 3D designs. |
| | Interactively view 3D models created in Solid Edge design software. |
| | 3D viewer based on the HOOPS Visualize Software Development Kit. |
| | Professional CAD viewer for 3D visualization and markup that uses no file translations. |
| | Precision 2D vector drawing and design for the iPad, iPhone and iPod Touch. |
| | View and edit CAD drawings ( DWG, OCF and DXF files) directly on your mobile device. |
| | Open and save DWG files directly, for high compatibility and seamless interaction with ZWCAD on a desktop PC. |
| | |
| | Print large-format document from virtually anywhere using your mobile device. |
| | Get support for HP enterprise and commercial printers, commercial laptops, commercial desktops, workstations and servers. |
| | A quick reference guide for all Intel desktop boards. |
| | Find an Intel Platinum Partner at your fingertips and on the go. |
| | Enables you to quickly look up the latest product information and advantages of using Intel Solid-State Drives. |
| | Quickly identify detailed processor features, search and compare processors by brand or socket. |
| | Turns your iPhone into a portable 3D mouse. |
| | Print PDF, DWF PLT, JPG and TIFF documents to Oce plotters. |

| Company | App | iOS | Android | Windows | Phone | Tablet | Cost |
|---|---|---|---|---|---|---|---|
| RealVNC Ltd. | VNC Viewer | ● | | | ● | ● | $9.99 |
| **PRODUCT LIFECYCLE MANAGEMENT AND DATA MANAGEMENT** | | | | | | | |
| Mechworks | DBTablet | ● | ● | | ● | ● | Free |
| mobilePDM | mobilePDM | ● | | | ● | ● | Free |
| PTC | Windchill Mobile | ● | | | ● | ● | Free |
| Siemens PLM Software | Teamcenter Mobility Free/Pro | ● | | | | ● | Free-$19.99 |
| **SIMULATION AND ANALYSIS** | | | | | | | |
| CD-adapco | CD-adapco | ● | | | | ● | Free |
| CEI | Reveal for IOS | ● | | | ● | ● | Free |
| Maplesoft | Maple Player | ● | | | | ● | Free |
| MathWorks | MATLAB Mobile | ● | ● | | ● | ● | Free |
| Nei Software | Nei Stratus | ● | | | ● | ● | Free |
| Orlovsoft | Timik Mobile | | | ● | ● | | $3-$5 per year |
| **TEST AND MEASUREMENT TOOLS AND CALCULATORS** | | | | | | | |
| Ageio | Grafikal | ● | | | ● | ● | $1.99 |
| Agilent Technologies | Engineering Calc | ● | | | ● | ● | Free |
| Agilent Technologies | GC Calculator | ● | | | ● | ● | Free |
| Agilent Technologies | LC Calculator | ● | | | ● | ● | Free |
| Agilent Technologies | MicroWave Calculator | ● | | | ● | ● | Free |
| Agilent Technologies | PCBCalc | ● | | | ● | ● | Free |
| Agilent Technologies | Power Supplies Catalog | ● | | | ● | ● | Free |
| Agilent Technologies | Tips and Tricks - Agilent Oscilloscopes | ● | | | ● | ● | Free |

| | Description |
|---|---|
| | Control a computer from your iPhone, iPad or iPod touch. |
| | |
| | A subset of DBWorks PDM. |
| | Eables mobile workforces to connect securely to mobilePDM's online data repository and to SolidWorks Enterprise PDM Software. |
| | Access PTC Windchill directly from your iPad or iPhone for up-to-date visibility on product and process information. |
| | Stay connected to Teamcenter with instant access to product information. |
| | |
| | Delivers STAR-CCM+ information, new features on the latest version, the ability to check Power-on-Demand usage and more. |
| | Review and share 3D results from FEA, CFD, electromagnetics, crash, and other CAE applications that were post-processed using EnSight. |
| | Explore mathematical concepts and solve advanced problems with these interactive calculators based on Maple technology. |
| | A lightweight desktop on your iOS device that connects to a MATLAB session running on MathWorks Cloud or your computer. |
| | Experience mobile Nastran FEA technology. |
| | Do fast beam analysis, getting all diagrams of internal factors and all point values. |
| | |
| | An advanced graphical calculator for both engineers and ordinary people. |
| | Easily determine the resistor and capacitor values based on their color codes, or vice versa. |
| | Fast and easy GC pressure and flow calculations at your fingertips. |
| | Quickly calculates flow rate and back pressure under a variety of conditions and column dimensions. |
| | Helps calculate errors in your microwave measurements. |
| | Computes the characteristic impedance and sizes of typical printed circuit board trace geometries. |
| | Find which model of Agilent power supply has the right voltage and current rating for your needs. |
| | Supplements manuals for the Agilent 2000/3000 X-series and provides tips and trick for basic usage of the scope for beginners, along with more detailed tips and tricks for advanced users. |

| Company | App | iOS | Android | Windows | Phone | Tablet | Cost |
|---|---|---|---|---|---|---|---|
| Agilent Technologies | PMPS Catalog | ● | | | ● | ● | Free |
| Agilent Technologies | 34972A DAQ | ● | | | ● | ● | Free |
| CAS DataLoggers | DT-Remote | ● | ● | | ● | | $10 |
| Diffraction Limited Design LLC | Vibration | ● | | | ● | ● | $4.99 |
| DTU Mechanical Engineering | TopOpt | ● | | | ● | ● | Free |
| elias THEODORAKI | Engineering Calculator | ● | | | ● | ● | $2.99 |
| InnovMetric Software | PolyWorks \| Talisman | ● | | | ● | ● | Free |
| James Rockliff | Electronics Toolkit Pro | | ● | | ● | ● | $1.09 |
| MEA Mobile | AC Impedance Simulator | ● | | | | ● | $1.99 |
| MEA Mobile | Ray Tools: AC Input Operational Amplifier Simulator | ● | | | | ● | $1.99 |
| MEA Mobile | Gear Design | ● | | | | ● | $1.99 |
| MEA Mobile | 555 Timer | ● | | | | ● | $1.99 |
| MEA Mobile | Ray Tools: Inverting Operational Amplifier Simulator | ● | | | | ● | $1.99 |
| MEA Mobile | Ray Tools: Non Inverting Operational Amplifier Simulator | ● | | | | ● | $1.99 |
| MEA Mobile | Ray Tools: Output Driver Devices Simulator | ● | | | | ● | $1.99 |
| MEA Mobile | Ray Tools: Sensor Input Devices Simulator | ● | | | | ● | $1.99 |
| MEA Mobile | Ohm's Law | | | ● | ● | | $0.99 |
| National Instruments | Data Dashboard Mobile for LabVIEW | ● | | | ● | | Free |
| National Instruments | NI DAQ Device Pinouts | ● | ● | | ● | ● | Free |

| | Description |
|---|---|
| | Simplifies your search for suitable Agilent Power Meters and Sensors models. |
| | Provides a means to control and monitor Agilent's 34972A. |
| | Incorporates multiple dataTaker-based systems letting users choose how they view their data. |
| | A spectrum analyzer using the built-in accelerometers inside the iPod Touch and iPhone. |
| | Perform structural optimization by the topology optimization method. |
| | A scientific calculator extended to allow inline unit combinations to your calculations. |
| | Brings a PolyWorks 3D measurement session to a mobile device while performing measurements on the shop floor. |
| | Provides a useful interface for calculating unknown quantities in the fields of electronics and electrical engineering. |
| | Solve Ohms law for AC. |
| | Pass AC above a cutoff frequency and block DC input signals in this simplified high pass filter. |
| | Adjust the variables of gears to see the relative size of the gear train. |
| | This program can be used to design four different timer circuits, a Pulse timer (monostable), an Oscillator (astable), a Delay OFF timer and a Delay ON timer. |
| | Adjust the variables of an inverting operational amplifier and see what happens to the gain or output voltage. |
| | Adjust the variables of an AC Input inverting operational amplifier and see what happens to the gain or output voltage. |
| | Simplify your calculations with four types of output devices, a relay driver circuit, an LED driver, an AC speaker circuit and an MOSFET motor driver circuit. |
| | Simplify calculations with four types of input devices. |
| | Solve for E, I or R and calculate power. |
| | Create custom and portable views of your National Instruments LabVIEW applications. |
| | Access device pinouts for NI data acquisition hardware. |

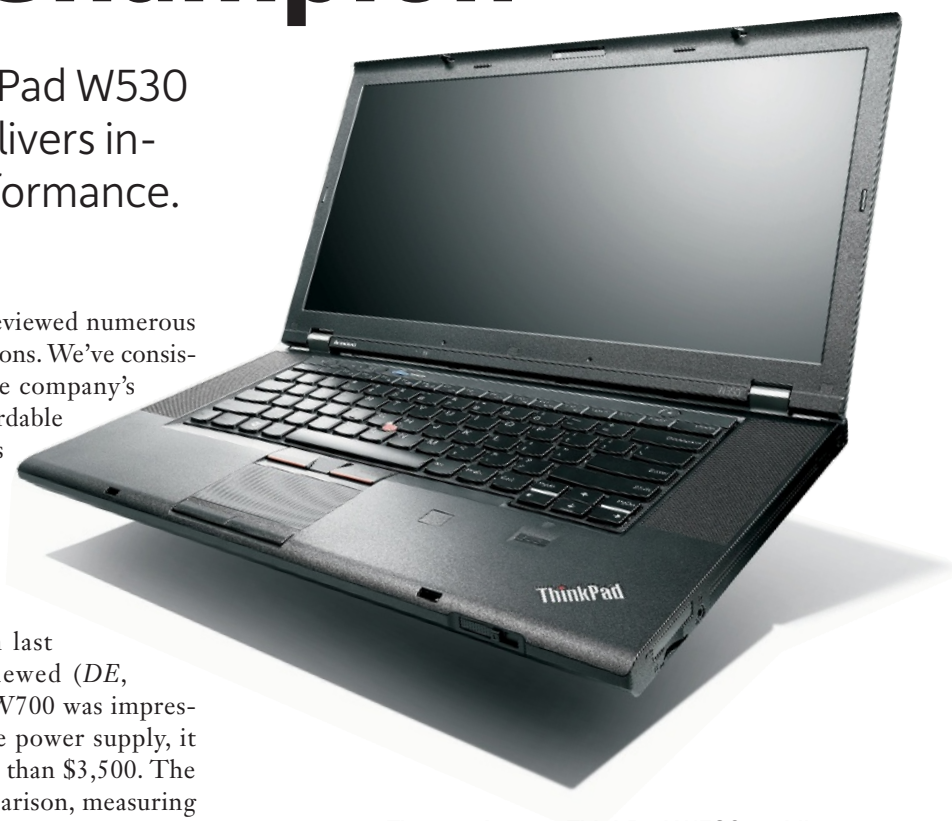
| Company | App | iOS | Android | Windows | Phone | Tablet | Cost |
|---|---|---|---|---|---|---|---|
| National Instruments | LabVIEW Intro | ● | | | | ● | Free |
| National Instruments | NI cDAQ-9191 Data Display | ● | ● | | ● | ● | Free |
| National Instruments | Multisim Circuit Explorer | ● | | | | ● | $0.99 |
| National Instruments | NI SRManager | ● | | | ● | ● | Free |
| NFX Development | Oscilloscope Pro | | ● | | ● | ● | $7.99 |
| ONYX Apps | Oscilloscope | ● | | | ● | ● | $14.99 |
| PASCO scientific | SPARKvue | ● | ● | | ● | ● | Free-$9.99 |
| Simple Solutions Droid | Solid Mechanics | ● | ● | | ● | ● | $1.45 |
| Soaring Kite Software | iBeams | ● | | | | ● | Free |
| Thomas Gruber | Electronics Engineering Toolkit Pro | ● | | | ● | ● | $3.99 |
| Titansan Engineering Inc. | MobiGage Laser | ● | | | ● | ● | Free |
| **TRAINING AND REFERENCE** | | | | | | | |
| Dassault Systemes | 3DS Academy | ● | | | | ● | Free |
| Dassault Systemes | 3DS Events | ● | ● | | ● | ● | Free |
| Digital Cheetah Solutions, Inc. | AutoCAD Iref | ● | | | | ● | Free |
| GTC Mobile | NVIDIA | ● | ● | | ● | ● | Free |
| Infinite Skills Inc. | Learn SolidWorks 2012 Quickly and Easily | ● | | | ● | ● | $9.99 |
| Multieducator Inc. | Martin's Engineering Tools of the Trade | ● | | | ● | | Free |
| Multieducator Inc. | Mechanical Engineering | ● | | | ● | ● | $5.99 |
| Wolfram Alpha LLC | WolframAlpha | ● | ● | | ● | ● | $3.99 |

| | Description |
|---|---|
| | An intuitive and fun beginner's guide to LabView graphical programming concepts. |
| | A 1-slot NI CompactDAQ chassis with Wi-Fi communication that is combined with an NI C Series measurement module to create a portable data acquisition device. |
| | Explore and understand common electronic circuits. |
| | View and bookmark your NI Serve Requests. |
| | A simple signal vs. amplitude analyzer that supports USB and microphone inputs. |
| | Designed to plot audio signals, monitor equipment, analyze events, and test circuits. |
| | Brings real-time sensor-based data collection to your iPhone, iPod touch or iPad. |
| | Calculate the engineering stresses and strains for a wide variety of standard loading conditions. |
| | Displays various beam and load configurations along with the corresponding reaction, shear, moment, and deflection diagrams. |
| | A collection of useful calculators, simulators, component references, circuit and application examples. |
| | A metrology application for inspection of manufactured parts and assemblies using Leica AT401 Laser Trackers. |
| | |
| | Allows community members to browse through and organize learning materials. |
| | The official mobile application for the Dassault Systemes events. |
| | Comprehensive companion reference for AutoCAD. |
| | A personalized conference scheduler for the GPU Technology Conference (GTC) series of worldwide events, which advance global awareness of GPU computing and visualization. |
| | Get hands-on CAD modeling in Learning Solidworks 2012. |
| | Contains over 200 formulas and conversions needed by industrial professionals. |
| | Contains over 300 mechanical engineering formulas, more than 300 additional conversion formulas and 70 area formulas. |
| | Uses its collection of algorithms and data to compute answers and generate reports for you. |

# Mobile Champion

## The new Lenovo ThinkPad W530 mobile workstation delivers incredible price and performance.

**BY DAVID COHN**




**The new Lenovo ThinkPad W530 mobile workstation is an elegant, portable and capable performer.**

Over the past few years, we've reviewed numerous Lenovo ThinkStation workstations. We've consistently been impressed with the company's ability to deliver performance at an affordable price. But it's been more than four years since we last looked at one of the company's mobile workstations. We were, therefore, excited when the Lenovo ThinkPad W530 arrived.

The 15.6-in. ThinkPad W530 represents a significant change from last Lenovo mobile workstation we reviewed (*DE*, January 2009). While that ThinkPad W700 was impressive, at more than 9 lbs., plus its large power supply, it was big and bulky—and also cost more than $3,500. The new ThinkPad W530 is svelte in comparison, measuring 9.65x14.68x1.40 in., and tipping the scales at just 6.3 lbs. (plus 1.3 lbs. for its 170-watt power supply). The matte black carbon fiber case has a nice sculpted form, with the nine-cell lithium-ion battery adding an extra inch to the total depth of the system.

Lenovo offers the W530 with a choice of third-generation processors. Our evaluation unit came equipped with a top-of-the-line Intel Core i7-3920XM quad-core 2.90GHz mobile extreme CPU. This 32nm "Ivy Bridge" processor has a maximum turbo speed of 3.8GHz, includes 8MB of SmartCache, supports PCIe 3.0, and has a thermal design power (TDP) rating of 55 watts.

Although the CPU included integrated Intel HD Graphics 4000, the W530 comes standard with either an NVIDIA Quadro K1000M or the K2000M professional mobile workstation graphics board we received. Both are based on NVIDIA's latest Optimus technology for optimized graphics performance and long battery life and include 2GB of DDR3 graphics memory. The more powerful K2000M features 384 compute unified device architecture (CUDA) cores and a 28.8GB/second memory bandwidth. Our evaluation unit also came equipped with 16GB of DDR3 system memory, installed as four 4GB 1,600MHz dual in-line memory modules (DIMMs), although the ThinkPad W530 can support a total of 32GM of memory using 8GB DIMMs.

### Impressively Equipped

A single slide latch near the right-front edge of the case releases the lid to reveal a full HD 1920x1080-pixel LED backlit antiglare display and an 84-key keyboard flanked on either side by speakers. The keyboard is perhaps the nicest we've ever seen in a mobile workstation, with key spacing comparable to a desktop keyboard and well-shaped keys. Our only complaint was the lack of a separate numeric keypad.

A red TrackPoint pointing stick is nestled above the B key, with three dedicated buttons located below the spacebar. Centered below this is a touch pad with its own pair of buttons. In addition to standard one-finger movements and a dedicated scroll zone along the right edge, the touch pad also supports gestures such as a two-finger spread or pinch to zoom in and out within documents, and a two-

finger vertical swipe to scroll.

To the right of the touch pad, the optional color sensor included in our system works in conjunction with the supplied X-Rite software to measure and adjust the accuracy of the display. An optional fingerprint reader, located to the right of the sensor, enables you to enroll your fingerprint to control access to the system.

A round power button is located to the upper right of the keyboard, while four buttons to the upper left mute the speakers, adjust volume, and mute the microphone. A fifth button activates a special Lenovo SimpleTap app, which lets you access the computer's settings and launch frequently used applications and websites. This button also accesses the Rescue and Recovery workspace, for rescuing files or restoring the drive to its factory default settings.

Expansion options are very well organized. The right side of the case provides a security lock, RJ-45 network

## Portable Workstations Compared

| | | **Lenovo W530** mobile workstation (2.90GHz Intel Core i7-3920XM quad-core CPU, NVIDIA Quadro K2000M, 16GB RAM) | **Eurocom P150HM Racer** mobile workstation (2.70GHz Intel Core i7-2960XM quad-core CPU, NVIDIA Quadro 5010M, 16GB RAM) | **HP EliteBook 8560w** mobile workstation (2.30GHz Intel Core i7-2820QM quad-core CPU, NVIDIA Quadro 2000M, 16GB RAM) |
|---|---|---|---|---|
| Price as tested | | $2,592 | $4,933 | $4,063 |
| Date tested | | 12/29/12 | 5/1/12 | 5/1/12 |
| Operating System | | Windows 7 | Windows 7 | Windows 7 |
| SPECview 11 | higher | | | |
| catia-03 | | 34.82 | 49.74 | 27.49 |
| ensight-04 | | 18.40 | 41.07 | 18.46 |
| lightwave-01 | | 62.75 | 60.13 | 48.21 |
| maya-03 | | 62.04 | 93.79 | 58.12 |
| proe-5 | | 15.58 | 10.97 | 9.77 |
| sw-02 | | 39.48 | 53.57 | 35.85 |
| tcvis-02 | | 30.63 | 45.65 | 23.12 |
| snx-01 | | 25.14 | 42.48 | 19.85 |
| SPECapc SolidWorks | lower | | | |
| Score | seconds | 97.97 | 123.33 | 131.17 |
| Graphics | seconds | 34.46 | 42.36 | 44.76 |
| CPU | seconds | 25.91 | 38.78 | 39.37 |
| I/O | seconds | 37.60 | 42.19 | 47.04 |
| SPECapc SolidWorks 2007 | higher | | | |
| Score | ratio | 4.98 | 3.67 | 3.67 |
| Graphics | ratio | 5.49 | 4.21 | 4.37 |
| CPU | ratio | 4.73 | 3.16 | 3.11 |
| I/O | ratio | 3.76 | 3.35 | 3.01 |
| Autodesk Render Test | lower | | | |
| Time | seconds | 62.00 | 76.66 | 89.83 |
| Battery Test | higher | | | |
| Time | hours;min | 6:09 | 1:50 | 2:37 |

Numbers in blue indicate best recorded results. Numbers in red indicate worst recorded results.

jack, a Serial Ultrabay (which in our evaluation unit contained a DVD read/write drive), a combo audio jack (for headphones or external speakers), a media card reader slot, and an ExpressCard slot. The left side houses a mini DisplayPort connector, VGA port, two USB 3.0 ports, a USB 2.0 port, a mini 1394a FireWire port, a switch for the wireless LAN/Bluetooth radio, and a SmartCard slot.

The only connections on the rear are the power jack and an always-on USB port, for charging devices even when the computer is in sleep or hibernation modes. The bottom provides access to a SIM card slot, battery, docking station connector, memory upgrade slot, and hard drive. Our evaluation unit came with a 500GB, 7,200rpm Toshiba hard drive. Other drive options include a 1TB, 5,400rpm drive, solid-state drives (SSDs), and a micro SSD that can be installed in the system's PCIe mini card slot to work in tandem with the primary hard drive.

Status indicators located below the display show hard drive activity and indicate whether the wireless LAN/Bluetooth module is turned on, while indicators on the outside of the case display the sleep, battery and color calibration status. An integrated camera with 720p resolution is centered above the display, and a small ThinkLight to its right can be toggled on to illuminate the keyboard in low-light situations. Lenovo also offers an optional backlit keyboard. The camera, keyboard light, volume and most other settings can be accessed using function key combinations.

## Excellent Performance

As we've come to expect, Lenovo once again proved that it knows how to combine and configure quality components for optimum performance. The ThinkPad W530 turned in excellent graphics performance, as measured by the SPECviewperf benchmark.

When we turned our attention to the SPECapc SolidWorks benchmark, however, which is more of a real-world test (and breaks out graphics, CPU and I/O performance separately from the overall score), the Lenovo ThinkPad W530 delivered the best performance we've ever recorded for a mobile workstation—results that rivaled those of current entry-level workstations.

On the AutoCAD rendering test, which is multithreaded and, therefore, clearly shows the benefits of multiple CPU cores, the Lenovo ThinkPad W530 also outperformed any previous mobile workstation. It took just 62 seconds to complete the rendered image—equal to or better than the most recent single-socket workstations we've reviewed.

In the past, such computing performance in a mobile workstation would have come at the expense of battery life. But here, too, the ThinkPad W530 astounded. Thanks to the NVIDIA Optimus technology and some very intuitive Lenovo power management software, our evaluation unit ran for more than six hours in our battery rundown test—nearly double the battery life of the next best Windows-based mobile workstation we've ever tested.

While a one-year warranty is standard, our evaluation unit came with an extended three-year warranty. Other options include up to five years of coverage, as well as accidental damage protection and battery warranties. Windows Professional 64-bit was pre-installed. Windows 8 and Windows XP are also available. Lenovo also offers a host of options and accessories, including docking stations and additional batteries.

Prices start at $1,143 for a system with 8GB of memory, a 320GB hard drive, a 1600x900 display, and the NVIDIA Quadro K1000M graphics card. Yet as equipped, our evaluation unit priced out at just $2,593. That makes the Lenovo ThinkPad W530 not just the most powerful mobile workstation we've ever tested, but also the most affordable. If you're in the market for a mobile workstation, the Lenovo ThinkPad W530 delivers a price/performance package that is second to none. DE

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

**INFO ➜ Lenovo:** Lenovo.com/thinkstation

***Lenovo ThinkPad W530***

- **Price:** $2,593 as tested ($1,143 base price)
- **Size:** 9.65x14.68x1.40-in. (DxWxH) notebook
- **Weight:** 6.3 lbs. as tested, plus 1.3-lb. power supply.
- **CPU:** 2.90GHz Intel Core i7-3920XM quad-core with 8MB cache
- **Memory:** 16GB DDR3 at 1,600MHz
- **Graphics:** NVIDIA Quadro K2000M (2GB DDR3, 384 CUDA cores)
- **Hard Disk:** 500GB 7,200rpm
- **Optical:** DVD+/-RW
- **Audio:** Dolby Home Theater 4.0 with combo audio jack
- **Network:** integrated Gigabit Ethernet with RJ45 port, wireless b/g/n LAN, Bluetooth
- **Other:** two USB 3.0, two USB 2.0, one mini IEEE 1394a FireWire, mini DisplayPort, 15-pin VGA, 720p webcam, 4-in-1 SD card reader, Express Card slot, SmartCard slot, color sensor
- **Keyboard:** integrated 104-key keyboard
- **Pointing device:** UltraNav with Fingerprint Reader
- **Warranty:** three years

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

# Where is my 21st Century FEA Preprocessor?

While the software is much improved over the technology levels of 30, or even 10 years ago, it seems to have been stuck in a groove for a while—refining many concepts, but with no fundamental paradigm shift.

**BY TONY ABBEY**

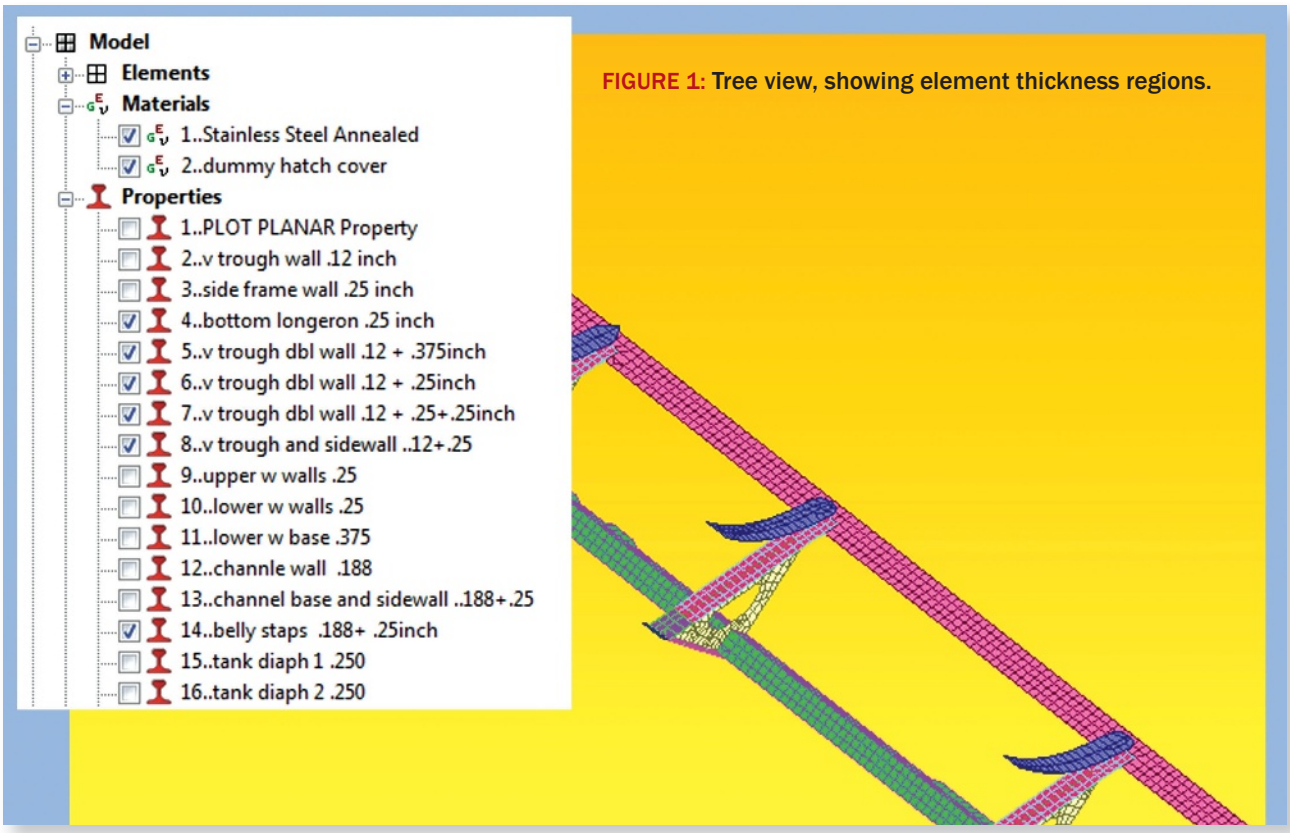



FIGURE 1: Tree view, showing element thickness regions.

I have worked in finite element analysis (FEA) for many years as an end user, and for FEA vendors in support, training and product definition roles. The preprocessor tools that I use now require experience and ingenuity to get the highest levels of productivity. While I enjoy driving my favorite tools, I do sometimes reflect, "Why am I following the same meshing and set-up process I did 35 years ago?"

I have helped design pre- and post-processing interfaces from a clean sheet. It is fascinating to define what a user needs to achieve, how to achieve it and how to facilitate that action in an intuitive and direct way. I had many preconceptions that blocked this, assuming data had to be constructed a particular way—based on arcane batch input methods, or being sidetracked by conventional wisdom. A cleaner, elegant and user-friendlier interface needed much thought.

The user also has preconceptions, and we often avoid that time when we have to "learn another pre/post." We know it will be tedious, learning new usage paradigms and

"tricks" to get up to speed. A good objective is a product so compelling in its simplicity and power that the user reaction would be "I want that, now."

What follow are some of the items that might prompt that reaction from me—and some that won't.

## New Technology

We've considered improvement in traditional technologies, but how about new technologies? Structural meshing is ripe for new technology, perhaps as a crossover from computational fluid dynamics methods. Graphical user interface (GUI) technology seems to be another fruitful area—let's briefly review two methods.

### Radial Menus

The advantage of the radial menu (as seen in Fig. 3) is that direction of selection becomes a key recognition factor. Mouse action becomes familiar and fast, with little movement and big target areas. The technology allows logical grouping of rings of operations in a radial direction. Hovering can allow a preview of underlying forms, avoided by faster movement for experienced users. Long lists of items are best left to traditional linear menus, but combinations of radial and linear can exist.

I worked on early 3D analogs to this type of menu, including virtual storage rooms, filing cabinets and toolboxes. The objective was the same: to give the user a familiar "route" to the data or process.

I would love to see a 3D toolbox, but maybe that's the latent plumber in me.

### Touchscreen and Gesture Technology

The iPad and iPhone convinces me of the importance of gesture technology through touchscreen. I can imagine a touchscreen with gesture control for fast zoom, pan, drag and drop, etc., in a CAE GUI. The graphic objects in a tree view are probably too small at present, so a new object paradigm is required—although resizing on a small iPhone shows that readability and control is workable.

Another new area is gesture and hand/finger recognition off-screen, typically a few inches away. This opens up wider possibilities beyond touchscreen.

Hopefully these approaches, together with new 3D virtual toolboxes, will provide the immersive experience that will improve productivity in preprocessing.

—T. Abbey

### Meshing Issues

Meshing is core technology, and issues with it were discussed in last month's article. (See "Meshing for FEA" on page 24 of the January issue of *Desktop Engineering*.) Geometry can require labor-intensive investigation and correction before a mesh is achievable. Meshing on poor geometry needs strong free meshing tools or CAD level geometry functionality—and preferably both.

CAD functionality should work with native formats, or at least rapidly parameterize "dumb" geometry. Rapid defeaturing should overcome associativity problems. Direct geometry modeling, rather than feature-based modeling, seems preferable here.

Often, mesh is non-congruent across adjacent geometry; different geometry types or creation methods give incompatible mathematics. It can be very hit-or-miss to get a smooth mesh that has no out-of-limit elements. Many years of research have gone into this elusive technology.

Controls on the interior of a solid mesh are weak because of a few controllable features. Automatic geometric slicing or sophisticated element propagation may be ways to improve this. Solid brick or hex-meshing is still very desirable; however, this remains the Holy Grail. If achievable, it would improve the accuracy of most solid models and reduce element count.

### Workflow Issues

Teaching conversion courses to engineers changing preprocessors always brings resistance to change. The ergonomics, consistency and common sense of the graphical user interface (GUI) design reflect how fast the new product is accepted and learned.

A traditional workflow, reflecting the top-level finite element model creation process, is as follows:

- CAD import
- Geometry operations
- Meshing
- Material properties
- Physical properties
- Loads
- Boundary conditions
- Analysis definition

A menu cascade from top level is a linear approach. However, complex tasks such as multiple components, contact surfaces, non-linear material tables, etc., also exist. Completing top-level operations in sequence is not often feasible because users want to follow their own path through the process.

A key requirement is a series of consistent approaches across all vital operations, to which a user can rapidly adapt. I used to believe in a single approach, but modern GUI methods and working practices require more versatility, as shown shortly.

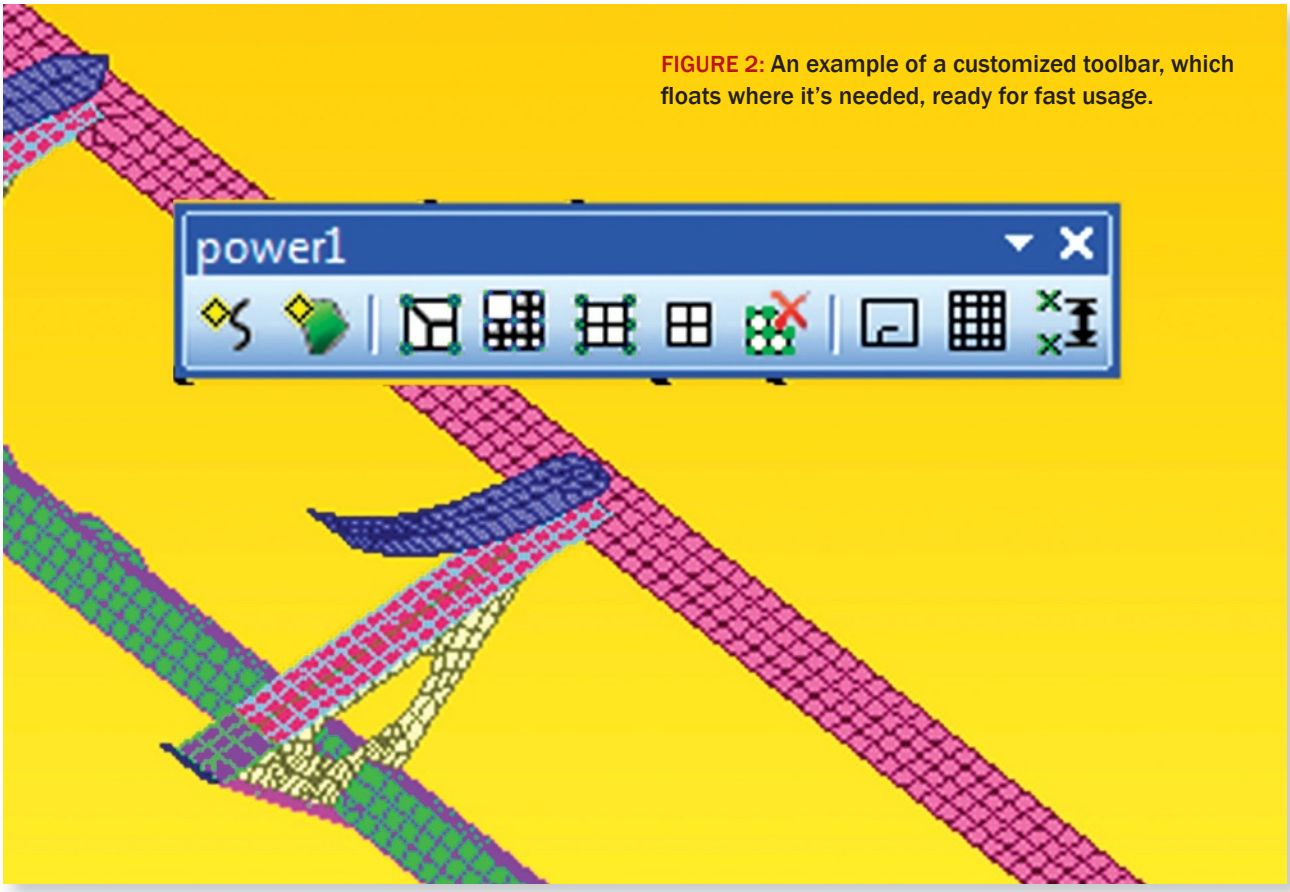



FIGURE 2: An example of a customized toolbar, which floats where it's needed, ready for fast usage.

## Right Tools for the Job

At every stage, it is important that the user is presented with the right view, menu, and actions with which to proceed. This is just like a plumber wanting to be on a job with good access, a clear, well-lit view of the problem and the right tools ready to use.

When applying a pressure to an area, for instance, I need the following:

- An uncluttered view, with easy options to rotate pan and zoom.
- Quick coloring, transparency, hiding of objects.
- All constructs available to create the pressure.
- Parent load case update or modification tools in hand—not back up a menu or two.
- Straightforward locating of surface, with ambiguity or hiding of surfaces easily resolved.
- Intuitive entity filters, to avoid intense frustration as the workflow is interrupted with "Why can't I pick this?"
- Simple and efficient input of pressure value.

The instance of the pressure applied to the surface available for validation and editing in a variety of ways.

All forms should pop up close to where I am operating for minimum mouse movement. This seems trivial, but many mouse movements are made during model build. Reduction of total travel by, say, 20% provides a huge ergonomic savings.

It seems like a straightforward list, but how quickly and effectively can you complete it in a complicated model with many geometric components, associated objects, partly meshed, etc.? We may be like the plumber on a nasty job—cramped, stressed and frustrated by the wrong tools or parts. (On the other hand, at least we are dry!)

## The Tree View

The tree view is an essential requirement. Fig. 1 shows elements arranged in sets by their shell thickness. The set visibility can be switched with a checkbox. Right mouse-clicking on a set opens up context sensitive editing, copying, etc.

A tree view enables a great overview of the model, including "tangible" objects such as elements. It can also showcase complex intangible objects, such as analysis setup, output requests, etc. A good tree view will even enable a very rapid drilldown into local detail, such as thickness value.

## Menu Evolution

The design of a menu is vital. There are many approaches to this, from simple forms allowing focus on the essential

FIGURE 3: A radial menu could improve an interface by allowing a logical grouping of rings of operations.

tasks, to busy forms with every option crammed in. The latter may actually be more useful to experienced users because it provides a fast, pragmatic way of getting the job done.

This highlights one aspect of form design: evolving complexity based on user skill, either user-defined or software-evaluated. Working methods can be assessed, such as a preference for command line inputs, rather than menu picking. Each engineer thinks and acts differently in a preprocessing task. This could govern the way the user's GUI evolves over usage. More sophisticated interfaces (see "New Technology" on the previous page) will benefit from such a natural migration.

Training challenges occur if no one works to a "standard" approach. A young engineer's approach to software or a toddler's use of an iPad is often an aggressive "cause and effect"-driven approach. However, I remember early training classes that were a repetitive slog through endless menus, with little appreciation of the GUI or the background engineering. The unstructured approach may be one way to avoid this, and give a richer, more immersive experience.

## Typical Menu Issues

Menu issues can crop up, often related to ambiguous or unclear objectives and actions of forms. A preprocessor needs a house style that defines a consistent layout and set of actions. Typical don'ts include forms that are:

- busy and confusing;
- sparse with wasted space;
- physically long, requiring excessive scrolling or disrupting the understanding of the scope;
- inconsistent or with counterintuitive exit actions;
- riddled with excessive levels or depth;
- using difficult data cross-reference;
- using ryptic, solver jargon or verbose text; and/or
- using decorative icons.

## Power Menus: Toolbars and Macros

The ability to construct custom menu bars incorporating standard and user-defined functions is key to powerful and productive preprocessors. It relies on simplicity to be attractive to most users. Use of Microsoft Office Visual Basic for Applications (VBA) type applications is one way to achieve this.

Fig. 2 shows a toolbar for interactive mesh manipulation. It includes simple macros that have been recorded and embedded with user-defined icons. The toolbar floats where it is needed, cutting down mouse travel.

## Entity Picking

Powerful preprocessors have sophisticated and rich entity picking tools. In addition to direct picking, they have picking by reference or inference. Lists of entities can be manipulated to facilitate indirect picking. Usage of this type of tool requires experience. It may be a ripe area for simplification by new virtual methods.

## Looking Ahead

There are a lot of new technologies bubbling out there that, when harnessed together, could provide significant breakthroughs in the important areas of preprocessor functionality and ease of use. To be fair, it will take a lot of development to understand how a modern user can get the best out of these, with some false starts being inevitable.

Still, I think the reward is worth the effort, to create that compelling product to which we will all say "I want!" DE

**Tony Abbey** *is a consultant analyst with his own company, FETraining. He also works as training manager for NAFEMS, responsible for developing and implementing training classes, including a wide range of e-learning classes. Send e-mail about this article to DE-Editors@deskeng.com.*

**INFO** ➜ **FETraining:** FETraining.com

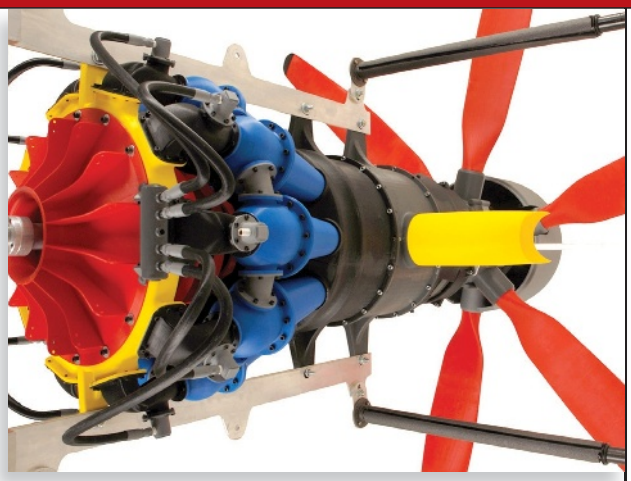
➜ **NAFEMS:** NAFEMS.org/e-learning

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

# Large-Format 3D Printing

Airbus has announced plans to print an entire airplane by 2050. Is it possible? How far along the path are we?

**BY MARK CLARKSON**



Turboprop prototype printed by Stratasys via FDM.

The granddaddy of 3D printing is stereolithography (SLA), invented way back in 1986. A UV laser scans across the surface of a vat of liquid photopolymer. Where it touches, the liquid transforms into a solid. As work progresses, the part drops deeper into the polymer on an elevator, with the laser drawing one thin layer at a time on the surface. The finished part emerges—a fraction of a millimeter at a time.

SLA is by no means the only method of 3D printing, of course. Selective laser sintering (SLS) works in a similar fashion, but its fluid is a fine powder of metal, plastic, glass or ceramic. Lasers fuse the powder in thin layers at its surface, once again creating the part layer by layer. Binder-based 3D printing uses something like a traditional printhead to deposit binder on the powder's surface. Fused deposition modeling (FDM) extrudes a thick liquid from its printer head to build up the final part.

There are many other forms of 3D printing. What they all have in common is that they are additive. Additive manufacturing (AM) skips the molds and tools—and the piles of shavings.

But what about their size? Could we print cars and planes?

"The reason most of the systems have been relatively small," says Wohlers Associates' Terry Wohlers, "is that most products that you buy are made up of parts that would fit in a 200mm to 300mm build environment. Manufacturers are going after that sweet spot; they want to sell to a lot of different companies. But we're going to have bigger systems. There's no question about it."

In fact, Airbus recently announced plans to print an entire passenger jet by around 2050. That's way beyond today's capabilities but, since 3D printing is itself less than 30 years old, you can't say it's impossible.

### Today's State of the Art

"Printing a fully assembled car in one go is still a fairy tale," admits Stijn De Rijck, marketing manager of Belgium's Materialise. "But yes, there are cars that have 3D printed components in them."

Materialise has produced parts for the Pininfarina Sintesi and

## Daimler Wants Large-Scale AM

The Fraunhofer Institute of Laser Technology has partnered with Concept Laser to produce a large-scale additive manufacturing (AM) system at the behest of Daimler. The X line 1000R is being touted as one of the largest AM systems ever built. It has a build envelope of 23.6x15.7x19.7 in., and the build bed rotates to help reduce build times. The new system has a layer thickness of 20 to 100 µ.

"This really was uncharted territory for us," admits Frank Herzog, managing director of Concept Laser. "The development of a machine concept of these dimensions in close collaboration with Daimler AG and the Fraunhofer ILT clearly illustrates our claim to be the technology leader in the field of laser melting."

The X line 1000R uses Concept Laser's LaserCusing process, which, according to the company, produces metal AM-created objects with greater durability and density than other laser sintering processes. Potential materials include high-grade steel alloys, tool steels, aluminum or titanium alloys, nickel-based super alloys and cobalt-chromium alloys.

Daimler approached Concept Laser and the Fraunhofer Institute to design an AM system that could replace sand and die-casting processes. The lack of waste associated with AM means long-term savings for Daimler, as opposed to more traditional methods of manufacturing.

Size wasn't the only goal. Daimler also insisted on a system that was significantly faster than Concept Laser's other machines. According to Concept Laser, this was achieved by fine-tuning temperature control inside the reaction chamber and the powder bed. The first X line 1000R has already been delivered to Daimler.

*— John Newman*

Designed as a virtual racecar for a video game, The Citroen GT was brought to reality with the help of Materialise's Mammoth SLA machines. The instrument panel and door panel interiors are printed in epoxy and given a high-quality finish with copper plating. *Image courtesy of Laurent Nivalle, Citroen Centre de Création.*

The instrument panel of the Sintesi concept car of Pininfarina was 3D printed in its full width on a Materialise Mammoth SLA machine in a translucent PP-like epoxy (Poly 1500). *Image courtesy of Laurent Nivalle, Citroen Centre de Création.*

Fabrisonic's SonicLayer 7200 uses a combination of ultrasonic welding and machining to build metal parts as large as 72x72x36 in.

the Citroën GT, and the entire body shell of the Areion racecar, a competitor in the 2012 Formula Student Challenge. The Areion's body includes integrated clips and connection points, sidepods with complex internal cooling channels, and a custom sharkskin texture—all printed on Materialise's Mammoth SLA machines with a build envelope of 2100x700x800mm.

When Materialise was founded in 1990, says De Rijck, "we soon discovered that the automotive industry would benefit significantly from huge models, to test their new designs of bumpers, dashboards, door trims, etc." Materialise currently has 12

## Printing Houses ... on the Moon

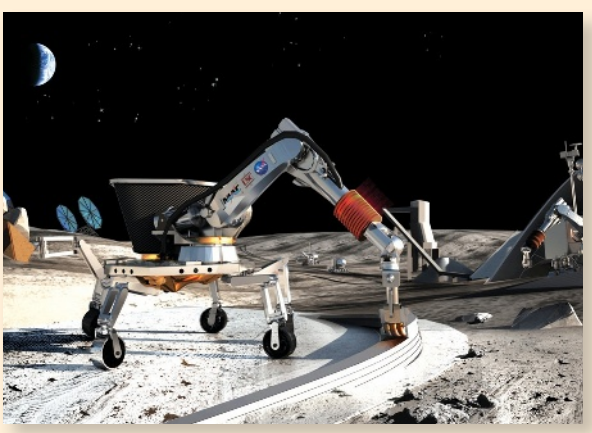
Berok Khoshnevis is developing a method, called contour crafting, designed to print really large 3D structures—from concrete garden paths to industrial-sized ceramic molds to entire two-story houses, which he claims could be built in a day. So far, he's built full-sized walls, but not entire houses.

Like all 3D printing, contour crafting builds layer by layer. The business end is a computer-controlled nozzle and trowels. The nozzle deposits a paste, such as concrete, and the trowels smooth it out, layer by layer.

The process is fast, efficient and, because it requires virtually no manual labor, cheap. It's also mobile. The current gantry system disassembles into three pieces, fits on a small flatbed truck, and can be assembled and operated by two people.

"You can have exotic, freeform, curved designs," says Khoshnevis. "Anything you can turn into paste you can build a structure with—thermal plastics, ceramics, plaster, concrete."

Even molten rock: At press time, Khoshnevis was working with the NASA Office of the Chief Technologist's Innovative Advanced Concepts (NIAC) program to develop a way of printing infrastructures on the moon.



NASA is looking into using contour crafting with moon rock material to build up a lunar settlement. *Rendering courtesy of Behnaz Farahi and Connor Wingfield.*

**Sciaky's largest EBDM chamber boasts an envelope of 29x4x4 ft., and can produce parts from high-value materials such as titanium.**

Mammoth machines running. Each can build a full dashboard or a bumper in less than five days.

Advances in materials are as important as size, says De Rijck, noting that today's SLA "combine good mechanical properties with a really good finish. We have materials available that cope with the high standards in aerospace, automotive and electronics. Strength is always a combination of design and material, and since 3D printing allows for an extremely high degree of design freedom, you can solve design challenges you were not able to solve before.

Another option for printing large parts is polymer jetting (polyjet), similar to inkjet printing. Stratasys' recent acquisition of Objet adds polyjet printing to the company's product offerings. The new Objet1000, for example, uses polyjet printing to make 3D parts as big as 1000x800x500mm.

"It builds it up in 16 micron layers—about 1/3 of a hair," says Objet's director of marketing, Bruce Bradshaw. "The surface finish is good enough to use as-is."

The Objet1000 prints in 107 different materials, and it can print two materials at once. You can print different parts of the same assembly in different materials, or you can mix the materials together, either by blending them (such as "black+white=gray") or layering them in stripes, polka dots or whatever pattern is appropriate. This isn't just for mixing colors; you can create whole new material properties.

"Typically, if it's a high-temperature material, it's brittle; if it's tough, it's not high-temperature," says Bradshaw. "By blending two materials, we can take the best of both of those properties and get a material that [withstands up to] 95° C and is very tough. It's the only technology in the world that allows you to do that."

Stratasys also offers fused deposition modeling (FDM) with its Fortus 3D line of printers. FDM is a controlled extrusion process, where a high-tech glue gun lays down very fine lines of molten thermoplastic, about 0.010-in. thick. Fortus printers can create parts up to 3x2x3 ft. from a range of thermoplastics including acrylonitrile butadiene styrene (ABS), polycarbonate and high-strength engineering thermoplastics such as ULTEM (polyetherimide), a preferred material in aerospace.

In addition to vents and panels inside airplanes, "a lot of the heating and cooling ducts in the belly of the airplane are FDM parts, because of their crazy-shaped geometries," says Jeff DeGrange, Stratasys' vice president of direct digital manufacturing.

What's the alternative to FDM? "You've got to invest in a hard metal tool and send it to an injection molding machine or a vacuum forming machine," says DeGrange, an AM veteran whose career includes being a senior manager at Boeing.

Granted, in terms of speed, AM technology can't compete with injection molding. But for low- to mid-volume produc-

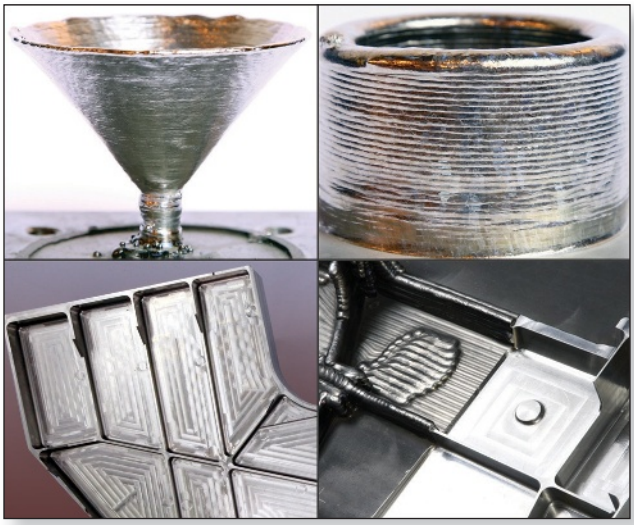
tion, says DeGrange, AM wins hands down: "It takes away the high cost of investing in metal tooling."

He offers the example of a business jet manufacturer that builds 500 airplanes over 10 years, but because they're doing it for 50 different airlines, they have a high product mix.

"Each of those customers are going to want something different. Now I've got to buy 50 different tools? Store those tools over the lifetime of the airplane, which will be decades?" he says. With AM, there's no tooling to buy, store and update. "Your warehouse is your computer. If you have to update a given model airplane, you download your file, you send it to your machine, and you build it in hours or days—not weeks or months."

What if you need large metal parts? Fabrisonic has developed the Sonic Welding AM process that can create large metal parts—nearly 6 ft. cubed. Its solid-state welding process builds up parts out of thin strips of metal such as aluminum, steel or titanium, typically between 0.005 and 0.010 in. thick. The metal tape is laid under a rolling ultrasonic horn, which produces high-frequency vibrations—inducing a solid-state, metallurgical bond at the interface.

According to Fabrisonic CEO Mark Norfolk, all the machines are basically "large computer numerically controlled (CNC) vertical machining centers with our welding head on them. At every layer, we can machine away internal voids and shapes to create complicated internal geometry, as well as finish the outside of the part.



**EBDM takes place in a vacuum, with an electron beam melting metal wire.**

"A lot of our work is mixed materials, where you want copper in one place, aluminum in another, and maybe a steel mounting bracket," he continues. "Typically, if you melt aluminum and steel together, you get something that's very brittle, almost like glass. Since we don't actually melt it, we can join aluminum and steel and have a very nice metallurgical bond."

The resulting parts have material properties very near that of the raw materials, Norfolk says.

Another company producing large metal parts is Sciaky, which has provided advanced welding systems for the aerospace and defense industry since 1939. Over the past few years, Sciaky has expanded its core competency from manufacturing world-class electron beam (EB) welding systems to producing large-scale, high-value parts for defense and aerospace applications, using its exclusive direct manufacturing (DM) technology.

Sciaky's DM produces near-net shape parts made of high-value metals like titanium, tantalum and Inconel. A fully articulated, moving electron beam welding gun deposits metal, layer by layer, onto a substrate plate (of the same material), until the part is complete and ready for finish machining. Deposition rates typically range from 7 to 20 lbs. per hour, depending upon part geometry and the material selected.

The DM process takes place in an EB vacuum chamber, which provides a pure environment. The contaminants are typically 0.1 part per million (ppm), compared to arc and laser welding, where there might be 500 ppm. Sciaky owns one of the largest EB chambers in the world, which has a standard envelope of 19x4x4 ft.—well-suited to producing large parts and structures.

Picture a large, internal wing structure with lots of ribs and

other fiddly bits. The final structure might be mostly empty space—but, if you're going to machine it, you've got to start with a billet that encompasses the entire final structure.

If you have to order a huge billet of titanium for a large wing structure, it can take up to a year to obtain, says Kenn Lachenberg, application engineering manager at Sciaky. Then, with conventional methods of manufacturing this large structure, you're machining a good portion of that material away. The aerospace industry references this as the "buy-to-fly" ratio.

With a not-unrealistic buy-to-fly ratio of 5:1, you're buying a ton of expensive material to get a 400-lb. finished part … and a 1,600-lb. pile of shavings. That's bad if you're working with aluminum. If you're building titanium parts, it's practically obscene.

Any weldable alloy is a good candidate for Sciaky's DM, but high-value materials and big structures really lend themselves to this process, adds Lachenberg. With DM, there's minimal waste, which adds up to huge savings.

AM such as EBDM doesn't require big blocks of starting material. You don't need a lot of tooling. You can start with a CAD file and build the geometry in a matter of weeks—and sometimes hours. You can change your CAD model and build a revision without changing dies and tooling.

In a nutshell, Lachenberg concludes, Sciaky's DM solution allows manufacturers to save time and money on the production of large-scale, high-value parts and prototypes over traditional manufacturing methods. **DE**

---

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

**INFO**

- **Formula Student Challenge:** FormulaStudent.com/aboutus/thechallenge
- **Center for Rapid Automated Fabrication Technologies:** CRAFT.USC.edu/Mission.html
- **Fabrisonic:** Fabrisonic.com
- **Materialise:** Materialise.com
- **Sciaky:** Sciaky.com
- **Stratasys:** Stratasys.com
- **Wohlers Associates:** WohlersAssociates.com

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

# Modeling the System

Modelica is leveling the playing field for modeling engineering systems.

**BY LAURENT BERNARDIN**

Soaring product complexities across many industries, including automotive (electric and hybrid vehicles), aerospace (unmanned aerial vehicles), and energy (smart grids, green power), are putting a tremendous strain on the engineering toolchain. As a result, system-level modeling stands out as an increasingly important approach to engineering design.

With system-level modeling, all the system components are simulated together in one environment. Complex and often competing requirements (such as engine performance vs. emissions, thermal battery requirements vs. energy used by the cooling system) and constraints (such as manufacturing cost and government regulations) need to be reconciled. System-level modeling makes it possible to optimize the overall design from the early stages of product development. This way, requirements are met, development timelines and costs are reduced, and products can be brought to market quickly in a competitive environment.

Modelica seems to be emerging as the standard for describing system-level models. Already pervasive in parts of Europe, we are seeing increasing penetration in other parts of the world, notably Japan and North America. A strong ecosystem is developing around the Modelica standard:

- Multiple tool vendors are providing software to aid in the construction of Modelica models.
- Library vendors are offering both free and commercial component libraries, extending the reach of the set of components that are part of the standard library.
- Consulting and training is readily available.

## The Mighty Mod

At its base, Modelica is a modeling language, supported by a standard library of components that cover many engineering domains like electrical, mechanical, thermal and fluids. Both the language and the standard library are developed and maintained under the auspices of the Modelica Association.

The most common way of interacting with Modelica is to use a tool to graphically build a model by selecting, connecting and configuring individual components taken from a library.

Fig. 1 shows a diagram for a double spring-mass-damper system, such as you would find in a suspension model. From left to right, we see a step input signal, connected to a force driver, followed by two sets of sliding masses connected to spring-damper components. Finally, the last spring-damper is connected to a fixed reference frame.

Each individual component contains the dynamic equations that describe its behavior. Fig. 2 shows the governing equations that are encoded into the sliding mass component.

The variables s(t), v(t) and a(t) represent displacement, velocity and acceleration of the component, and m denotes its mass. The variables f_a(t) and f_b(t) are the forces acting to the left and right of the mass, respectively.

It is important to note that the equations, and thus the component, make no assumptions on how it will be connected to surrounding components. In particular, there is no assumption on what directions the forces on either end of the mass will take. This is at the core of why Modelica is referred to as an acausal modeling language, as opposed to causal systems, where the direction of flow has to be modeled explicitly.

There are some advantage of acausal modeling: Subsystems can be more easily reused in different contexts, and model diagrams are typically much less complex, require fewer components and are easier to understand and modify because they more closely resemble the physical system being modeled.

The Modelica language has the capability to model using both causal and acausal paradigms—and indeed, mix the two in the same system model.

Looking back to Fig. 2, tools like MapleSim, Maplesoft's system-level modeling tool, allow you to extract such equations from any component or an entire subsystem, enabling symbolic

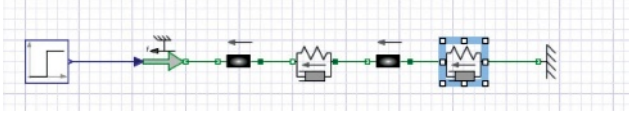


FIGURE. 1: Modelica diagram for a double spring mass damper system (above).

$$m\,a(t) = f\_a(t) + f\_b(t)$$

$$\frac{d}{dt}\,s(t) = v(t)$$

$$\frac{d}{dt}\,v(t) = a(t)$$

➜ FIGURE. 2: Sliding mass equations.

```
model DoubleSpringMassDamper
   Modelica.Mechanics.Translational.Components.Mass SM1(m=10, L=0);
   Modelica.Mechanics.Translational.Components.Fixed F3;
   Modelica.Mechanics.Translational.Sources.Force F4;
   Modelica.Blocks.Sources.Step S2(height=-1, offset=0, startTime=1);
   Modelica.Mechanics.Translational.Components.Mass SM2(m=2, L=0);
   Modelica.Mechanics.Translational.Components.SpringDamper SD2(c=3, d=0.02);
   Modelica.Mechanics.Translational.Components.SpringDamper SD1(c=1, d=2);
equation
   connect(SD1.flange_b, SM1.flange_a);
   connect(SM1.flange_b, SD2.flange_a);
   connect(SD2.flange_b, SM2.flange_a);
   connect(SM2.flange_b, F4.flange);
   connect(F4.f, S2.y);
   connect(F3.flange, SD1.flange_a);
end DoubleSpringMassDamper;
```

**FIGURE. 3:** Modelica code for double spring mass damper system.

analysis that is not possible with just black box component models. However, the graphical diagram fully abstracts all of the underlying mathematics—and diving into the equation level is completely optional if you are just looking for simulation results. In that case, the tool will automatically generate the entire set of equations for the system diagram (in general, these will be systems of hybrid differential algebraic equations) by combining the equations from each component together with equations derived from the connections between the components.

For example, a mechanical connection between one end of the sliding mass and a spring damper implies that the displacement of the connected extremities is identical, and that the forces applied cancel each other. The entire system of equations is then simplified symbolically, and C code is generated that will be compiled and executed within a differential equation solver to provide simulation results.

The symbolic simplification step is a crucial part of this process. Not only does this involve transforming the set of equations into a solvable set; it also reduces the size of the equations and uses optimization techniques to yield efficient simulation code, without loss of model fidelity. This code can be executed within the Modelica tool environment, or exported to other parts of the toolchain. Simulation results are available as data tables, plots or three-dimensional visualizations (see Fig. 4).

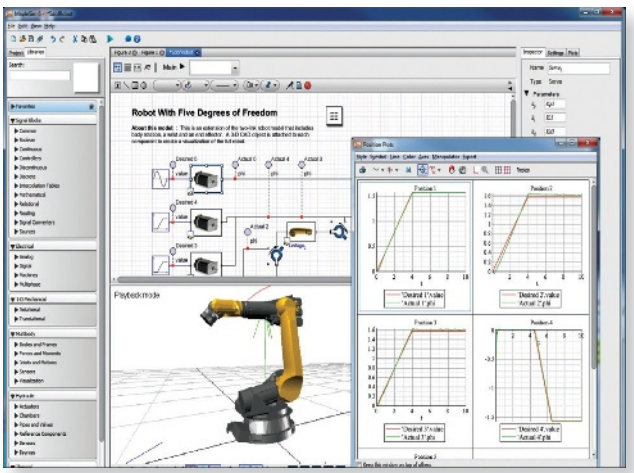



**FIGURE. 4:** Simulation results.

## Learning the Language

As easy as it is to interact with Modelica models at the graphical diagram level to get simulation results and perform analysis, drilling down to the language level provides access to the entire power of the Modelica modeling paradigm. Fig. 3 shows the Modelica code that underlies the system diagram from Fig. 1.

Within this code, declarations like Modelica.Blocks.Sources.Step refer to components within the Modelica Standard Library. The "connect" statements within the equation section describe how these components are to be interconnected. Typically, the Modelica code also includes annotations that specify the graphical presentation of the model diagram, including location and size of the components as well as routing of the connections, but we have omitted these annotations for space reasons.

Because both language and base library are standardized, Modelica models and component libraries are portable among different tools, preventing lock-in to a particular vendor.

That bring us to the real promise of the Modelica standard for engineering companies around the globe: to be part of a growing ecosystem of vendors and consultants, where engineering models can be easily shared and are never tied to a particular tool or vendor, and to leverage an increasing body of knowledge in the form of component libraries and engineering expertise to bring better products to market faster. DE

**Laurent Bernardin** *is vice president, research and development, for Maplesoft. Send e-mail about this article to DE-Editors@deskeng.com.*

**INFO** ➜ **Modelica Association:** Modelica.org

➜ **Maplesoft:** Maplesoft.com/products/maplesim

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

# A Look at the **Latest** SSDs

The disk performance bottleneck is being countered with solid-state drive technology, which removes storage concerns from the performance equation.

**BY FRANK J. OHLHORST**

Solid-state drives (SSDs) are exploding in popularity, and are starting to replace traditional hard drives en masse on high-performance systems. After all, what's not to like? SSDs are faster, use less energy and come in a small form factor that offers abundant storage.

Nevertheless, there are some caveats with SSDs—namely, cost and longevity.

Manufacturers are attempting to eliminate those perceived negatives by reducing manufacturing costs and improving the quality of the components used to build SSDs. What's more, manufacturers are also establishing rigorous quality assurance programs, and are increasing capacities to keep up with demand.

While there is no denying that SSDs can outperform traditional hard drives, there is a question as to how much performance can be gained. The only way to determine that is to benchmark the drives and measure the performance increases offered. Does one brand or type of SSD outperforms another? Obtaining that knowledge can be crucial when it comes to upgrading a workstation or server to provide maximum performance.

According to Zsolt Kerekes, editor of StorageSearch.com, there are approximately 400 manufacturers actively designing and marketing SSD products and systems today. However, the majority of those vendors are focusing on enterprise and industrial solutions that are far different than the typical workstation or notebook storage device. With that in mind, the list of SSD vendors quickly shrinks, with some of the top vendors sporting well-known names such as Intel, Corsair, OCZ, Samsung and Kingston.

To see whether these replacement SSDs live up to their claims, I decided to put the latest 200GB models through their paces, using a methodology that most upgraders would follow. I started off with a workstation class system: an HP Z220 SFF, with an Intel Panther Point Chipset, Intel E3-1245V2 3.4Ghz Xeon (Sandy Bridge) processor, 8GB of DDR3-1600 ECC RAM, 250GB 7,200rpm hard drive, 16X DVD+-RW SuperMulti SATA optical drive and NVIDIA Quadro 600 graphics.

My test unit bordered on the high end of small form factor workstations, and featured what most professionals would want in a high-performance workstation—save for the factory hard drive, which was a traditional spindle-based 7,200rpm hard disk. As configured, the HP Z220

## Benchmarking Solid-State Drives vs. a Standard Hard Drive

| Drive | Boot Time | 1024K Write MB/Sec | 1024K Read MB/Sec | 4K Write MB/Sec | 4K Read MB/Sec | 8192K Write MB/Sec | 8192K Read MB/Sec |
|---|---|---|---|---|---|---|---|
| 7200 RPM Factory Hard Disk Drive | 67 Seconds | 106100 | 10449 | 54344 | 67962 | 98508 | 90687 |
| Corsair Neutron | 26 Seconds | 512525 | 555383 | 272531 | 64887 | 51225 | 555948 |
| Intel SSD DC S3700 | 25 Seconds | 523776 | 550323 | 202877 | 134568 | 526344 | 554109 |
| Kingston SSDNOW E100 | 36 Seconds | 479349 | 394182 | 169033 | 71691 | 488064 | 479349 |
| OCZ Vector | 26 Seconds | 535532 | 559240 | 301203 | 252918 | 533315 | 555383 |

Numbers in blue indicate best recorded results.

became a likely candidate to benefit from an upgrade to SSD technology.

I performed the upgrade process by duplicating the image of the existing hard drive onto the new SSD using a methodology often referred to as cloning. I performed the cloning task using Macrium Reflect (free edition) from Macrium Software.

## Building a Baseline

To fully expose the performance gains that SSDs can deliver, I first tested the system using Disk Benchmark v2.47 from ATTO Technology, a utility that measures drive performance by writing and reading various sized files to and from a hard disk drive.

I first ran ATTO's disk benchmarking program on the HP Z220 SFF using the unit as shipped with the 7,200rpm drive to determine throughput. I also measured boot times, from power-up to the appearance of the Windows 7 Logon Prompt. I then compiled those results into a chart, which offers a comparison between the base configuration and each of the test SSDs.

## A Closer Look

I tested and evaluated the latest SSDs with approximately 200GB of capacity from Intel, Kingston, Corsair and OCZ for performance and design. I was unable to include Samsung's latest drive, the SM843 Series, because at press time none were available for review.

Let's take a closer look at each of the other candidates:

• **Intel SSD DC S3700 Series 200GB:** Designed for low latency and high performance, the DC S3700 series of drives are 2.5-in., 6GB/s SATA drives that are based on 25nm NAND Flash memory. Intel has targeted these drives for data centers and other high-performance environments where reliability is a major concern. Intel claims that the DC S3700 series is designed for 2 million hours of mean time between failures (MTBF), and backs that claim up with a five-year warranty. With a manufacturer's suggested retail price (MSRP) of $470, the Intel DC S3700 series is pricey, especially when compared with low-end, basic consumer-level SSDs, which do not offer the warranty and performance of Intel's offering. Intel's SSD DC S3700 Series just started shipping in quantity in December, making these SSDs one of the latest to hit the market.

• **Kingston SSDNOW E100 Series 200GB:** Like other SSDs tested here, Kingston Technology Co. targets the SSDNOW E100 Series at the enterprise, which translates to higher prices, yet improved performance and reliability. The E100 uses a standard 2.5-in. body with SATA interface; like most other drives tested here, it comes in at just 7mm thick. Kingston offers the drives in three capacities: 100, 200 and 400GB. Each offers claimed burst speeds of up to 535MB/s sequential read and 500MB/s sequential write. Kingston does not publish MTBF rates, but does offer a three-year warranty on the drives. The 200GB SSDNow E100 SSD uses a SandForce SF-2500 controller and Toshiba 24nm eMLC NAND with a SATA 3.0 interface. While priced at $734 MSRP, it's heavily discounted by most sales outlets.

• **Corsair Neutron Series GTX 240GB:** Corsair touts the Neutron Series GTX as its flagship line of SSD products—and the company does have something to be proud of with these enterprise-class SSDs. The 2.5-in., 7mm thick drive offers a SATA 3 interface, and comes with a five-year warranty. Corsair uses 24nm Toshiba Toggle Model flash to create the 240GB of capacity, and a Link_A_Media Devices Controller. With a MTBF of 2 million hours and a street price of just $250 (the company does not publish MSRP), the Corsair Neutron Series GTX 240GB may be one of the best values for those looking for enterprise-level quality and performance at a reasonable price.

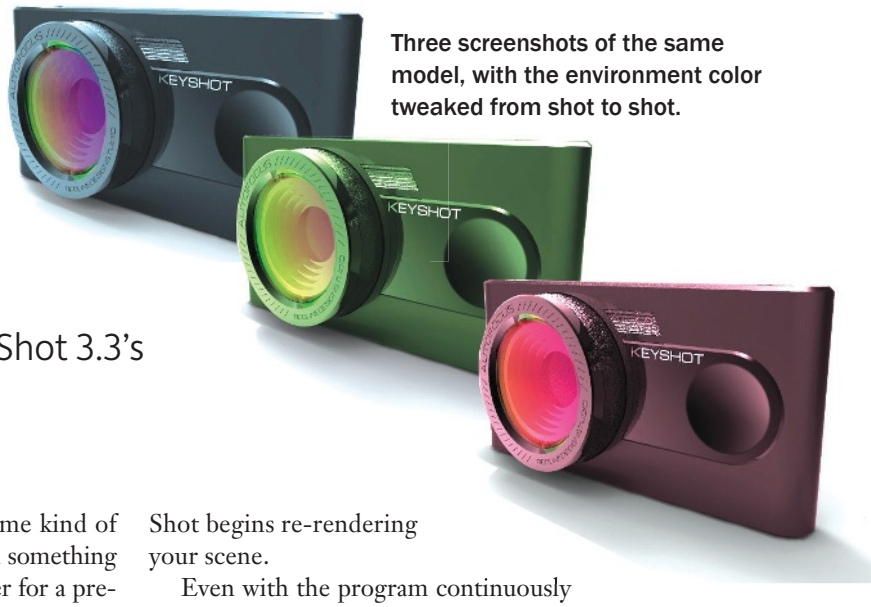
• **OCZ VECTOR Series SATA III 256GB:** The Vector is OCZ Technology Group's top-of-the-line SSD; it features SATA 3 connectivity and is backed by a five-year warranty. The drive features OCZ-branded NAND flash memory and an OCZ-made Barefoot 3 controller. The 7mm-thick, 2.5-in. drive is designed for workstations and laptops, where durability, speed and low power use are all a concern. Although the drive is not marketed as an enterprise (or data center)-level drive, the company does claim it can support sequential read speeds of 550MB/s and write speeds of 530MB/s—putting it in the same ballpark of other vendors' enterprise-class SSDs. Although the company does not offer an MTBF rating, OCZ claims that the drive is rated for 20GB/day of host writes for five years under typical client workloads. DE

**Frank Ohlhorst** *is chief analyst and freelance writer at Olhorst.net. Send e-mail about this article to DE-Editors@deskeng.com.*

**INFO**
- **ATTO Technology:** ATTOTech.com
- **Corsair:** Corsair.com
- **HP:** HP.com
- **Intel:** Intel.com
- **Kingston Technology Co.:** Kingston.com
- **Link_A_Media Devices:** Link-A-Media.com
- **Macrium Software:** Macrium.com
- **NVIDIA:** NVIDIA.com
- **OCZ Technology Group:** OCZTechnology.com
- **Samsung:** Samsung.com
- **SandForce:** SandForce.com
- **StorageSearch.com:** StorageSearch.com
- **Toshiba:** Toshiba.com

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

# Love Me, Render




Three screenshots of the same model, with the environment color tweaked from shot to shot.

Multiple ingredients go into KeyShot 3.3's rendering optimization process.

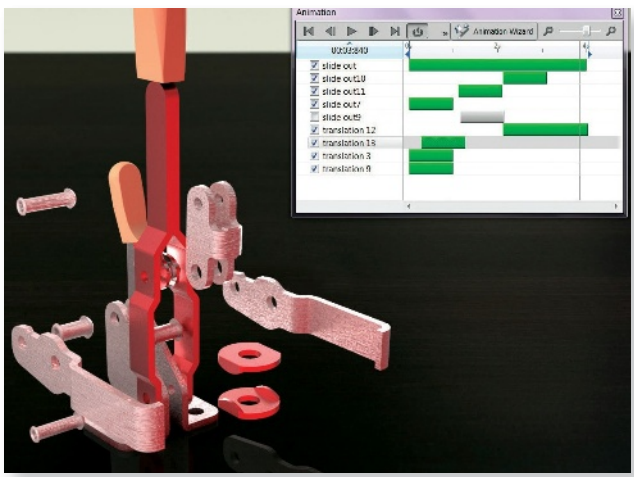
**BY MARK CLARKSON**

Almost every 3D CAD program offers some kind of rendered output, but sometimes you need something a little better looking—a really sexy render for a presentation, or a high-quality, high-resolution shot for a magazine advertisement, or a simple animation. There are plenty of rendering applications available; the good news is that, frankly, they'll all give you great-looking renders. The bad news is that they're not exactly straightforward and easy to learn.

With KeyShot, producing great renders is easy: Open a model, wait a few seconds, then click the screenshot button.

## Always on

As soon as you load or import a model, KeyShot begins rendering it onscreen. In fact, KeyShot is always rendering, no matter what you're doing in the program. Within seconds, you've got a pretty decent-looking render. Rotate the model, move the camera—make any change—and KeyShot begins re-rendering your scene.




An exploded view animation in progress. Each animation appears as a green bar in the timeline, and can be moved, duplicated, resized and deleted interactively, while the animation runs.

Even with the program continuously tracing rays, movement of (or around) your model is nice and smooth—although, of course, the model becomes blurry and low-resolution as the renderer is forced to start over from the beginning several times a second. As soon as you stop, the program, constantly rendering, begins to converge on a final image again. Within five or 10 seconds, it's looking pretty darned nice.

When you're happy with what you see, you can take a screenshot. If screen resolution isn't adequate, you can also do a "real" render at a higher resolution. That option is limited to 4.1 MP in the standard version of the program, but is unlimited in the Pro version. If you're interested, you can get under the hood a little bit, tweaking the number of ray bounces, shadow sharpness and such—but, thankfully, you'll probably never need to go there.

KeyShot is strictly CPU-powered. If you've got a Quadro card packed with GPU cores, that's a little disappointing, but on a moderately current computer, the program is still really, really fast.

## Importing Files

KeyShot is not a modeler; your 3D geometry will come from other programs. In addition to its own format, KeyShot will import a wide variety of 3D models, including SolidWorks, Solid Edge, IGES Pro/ENGINEER Wildfire, OBJ, STEP and Collada. I didn't try them all. I had generally good luck with OBJ files and SolidWorks parts and assemblies, but generally poor luck with Collada (DAE) files, which were often accused of containing no 3D geometry.

## Textures & Materials

It's unlikely that your imported models will come into KeyShot looking their best. You'll probably have to apply new materials to them. Fortunately, that's easy. You can drag-and-drop materials from the library of presets onto your various

parts, either within the rendered scene or in the scene's object tree. That part's material instantly changes onscreen. In fact, you get a preview of the material as soon as your mouse cursor touches a part, letting you confirm that you're applying the right texture to the right part. Release the button, and the material is actually applied.

KeyShot comes with more than 600 materials, ranging from composites to anodized metals to metal flake paint to glass and precious gems. You can modify any of the material presets to create your own.

KeyShot gives you 20 basic material types to start with (plastic, metal, glass, matte, etc.), each with its own appropriate controls for fine-tuning. Flat materials, for example, only have color; metals have color and roughness; liquids have color, transparency and refraction. You'll get nowhere near the amount of control over your materials as you do in, say 3ds Max, where you can create layered materials of almost unlimited complexity, but it's more than sufficient for most tasks.

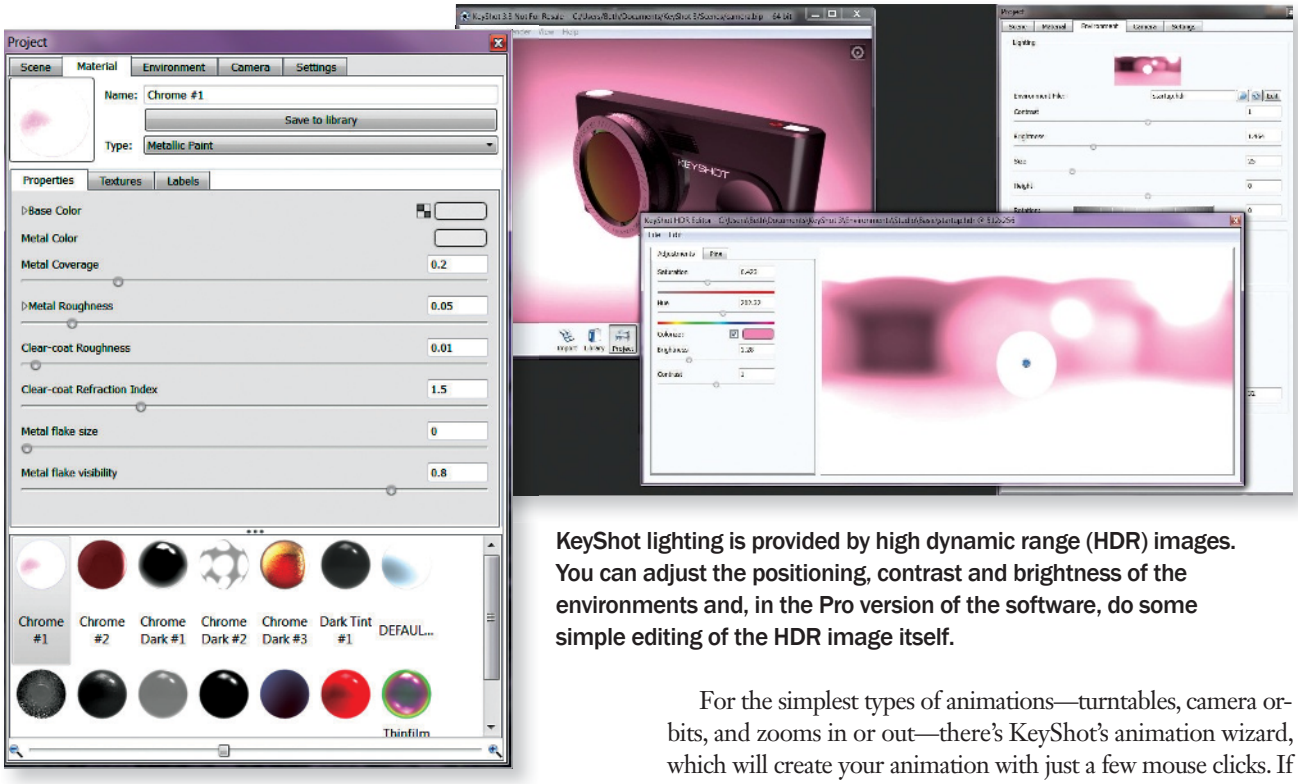
To help you optimize your pipeline, KeyShot lets you create texture templates that will automatically map imported texture X to KeyShot texture Y. You don't have to manually apply, say, the shiny black plastic material to all your shiny black plastic parts; KeyShot will recognize the name of the imported material and automatically apply the correct KeyShot material. If you can pull in models with standardized material names, this will save you a ton of time.

KeyShot applies materials on a per-part basis. If your imported model isn't broken up into different parts, there's nothing you can do about it in KeyShot. Everything's going to be the same material.

## Lighten up

Good renders need good lighting, and good lighting can sometimes be difficult to achieve. KeyShot's lighting comes from its high dynamic range (HDR) environment maps—spherical images of different environments ranging from the office to the desert. Drop in a photo studio environment and, voilà, photo studio lighting.

To change the lighting, you change the environment—by rotating or resizing it, by tweaking its brightness and contrast, or by replacing it with another environment altogether. KeyShot's Pro version allows you to do some editing to the HDR




**You can edit any of KeyShot's 600-plus predefined materials to create your own.**

**KeyShot lighting is provided by high dynamic range (HDR) images. You can adjust the positioning, contrast and brightness of the environments and, in the Pro version of the software, do some simple editing of the HDR image itself.**

image itself, changing the color cast, and pinning new light sources to the background.

If you really need them, you can create additional lights by importing simple objects (cubes, spheres, etc.) and applying luminous textures to them. You can also apply luminous textures to parts of your model—the headlights of a car, for example.

## Final Tweaks

For some final tweaks, you can add light bloom and vignetting, adjust the scene's overall brightness and gamma, and fine-tune camera perspective and focal length.

Depth of field really adds realism to renders. With KeyShot, click on any point on an object to focus the camera there, then adjust the scene camera's F-stop to achieve the desired depth of field effect.

KeyShot does not currently compute motion blur, but it has been promised for version 4, which is said to be ready sometime this year.

## Animation

When static renders don't suffice, there's KeyShot's optional animation add-on. You could call KeyShot's animation capabilities limited, but it's probably better to think of them as focused. KeyShot will animate simple translations and rotations. You can't do, say, character animation, but you don't do that anyway, do you? What you can do is produce animated exploded views, flip open a cell phone and fly models on- and off-screen.

For the simplest types of animations—turntables, camera orbits, and zooms in or out—there's KeyShot's animation wizard, which will create your animation with just a few mouse clicks. If you need something a bit more complex and controllable, you can add translation and rotation animations to the model, or to individual parts within your model. Right-click on the part in the model tree, and choose Add Translation or Add Rotation. Drag the sliders around, and set the duration of the animation—for example, rotate 120° on the X-axis over two seconds. You can select easing in and out to add smooth acceleration and deceleration to your animations. You don't have any control over the amount or duration of the ease, however, it's either on or off.

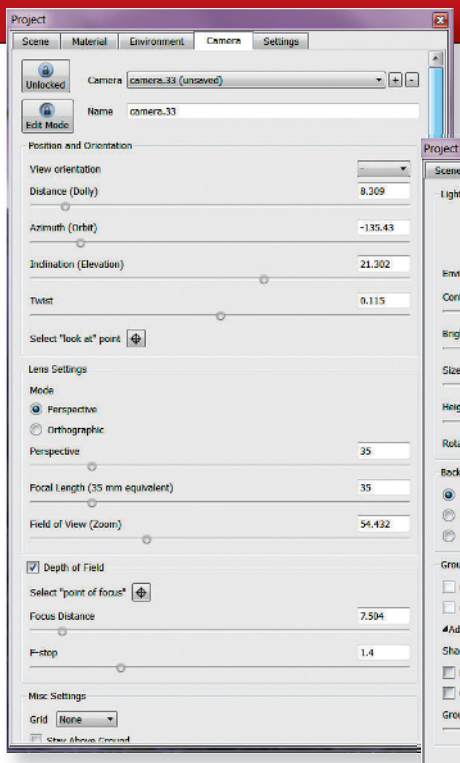
If you're doing an exploded view and need to move 20 different bolts 5 in. to the left, you can create the animation for one bolt, then select the other 19 and copy-and-paste the animation to them. Each bolt gets the same translation animation with a unique number appended to it: Translate01, Translate02, etc.

Open KeyShot's timeline editor, and you'll see all 20 animations there, represented by green bars. You can drag the bars

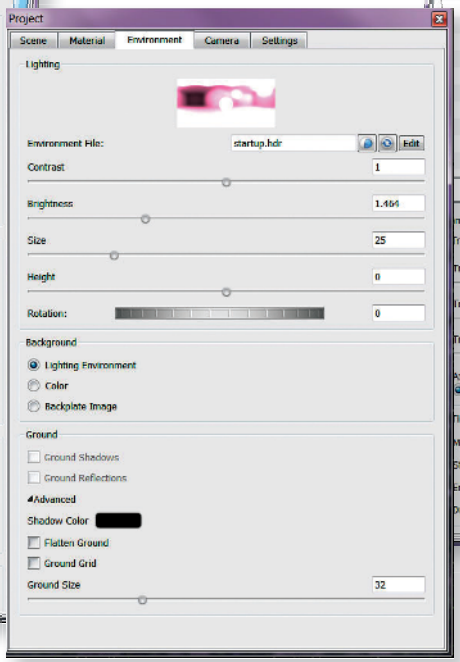
## KeyShotVR

If you'd like to share your renders with others, KeyShot's optional KeyShotVR add-on produces high-quality, ray-traced 3D output that you can embed in any web page, allowing viewers to spin and zoom your models interactively.

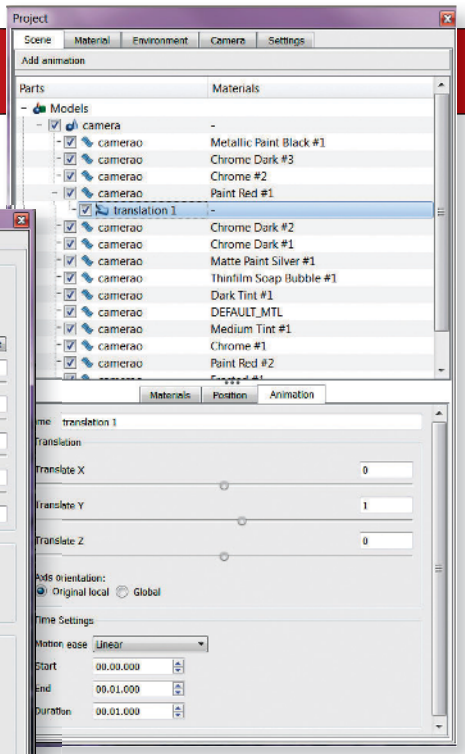
KeyShotVR starts by rendering out all the viewable angles of your model. Because everything is pre-rendered, KeyShotVR content doesn't require any special plug-ins to run. You can play with some examples at KeyShot.com/vr.




KeyShot's camera settings are easily tweaked via a handful of sliders.




Lighting in KeyShot is provided by HDR environments.




The Project Scene panel shows all objects in your model, along with the material currently assigned to them. To animate a part, right-click on it and choose Add Translation or Add Rotation.

forward and backward in time. Drag on either end of the bar to make it occupy either more or less time, slowing the animation down or speeding it up; as you drag, a pop-up gives you the current start and end times and the animation's duration.

You can select multiple animations—all the transmission bolts, for example—and move or retime them as a group. You can also create folders of animations. As you slide the folders forward and backward in time, their contents follow along. If you drag on the beginning or end of the folder, all the animations within that folder scale up or down accordingly. You can easily duplicate and mirror animations, allowing you to unexplode your exploded view with relative ease.

It's easy to end up with a timeline full of animations called Rotate01, Rotate02, Rotate03 and so forth. Clicking on an animation in the timeline will select its object in the scene's object tree, and you can rename each animation ("Main Bolt Slide Left," etc.). Still, I'd like to see an option to view animations by object.

The screen updates constantly as you work. You can even start the animation running and drag things around in the timeline as it goes, re-timing individual animations and seeing the results in something approaching real time. In fact, you can change materials, lighting—anything at all—and instantly see the results.

## The Bottom Line

Is KeyShot a good choice for you? Well, it's easy to learn and fast to render, and time is money.

But money is also money, and KeyShot is pretty expensive, ranging from $995 for the basic version (no animation, limited render size), to $2,495 for the full-blown Professional Version with animation, network rendering, HDR editing, unlimited render resolution and more. If you want the KeyShotVR add-on (see previous page), you're up to $3,495.

To decide for yourself whether KeyShot hits your personal time/money sweet spot, download the free trial edition at KeyShot.com/try. DE

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

**INFO → KeyShot:** KeyShot.com

***KeyShot 3.3***

**Price:** $995 - $3,496 with add-on

**Requirements:**

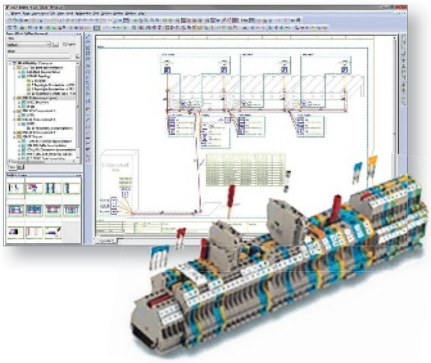
- INTEL Pentium 4 processor or AMD or better
- Windows XP 32/64 bit
- Windows 7 32/64 bit
- Windows 8 32/64 bit
- OpenGL 2.x or higher

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

# 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.



## Enhanced Electrical & Fluid Product Design Automation

*EPLAN Platform technology 2.2 features graphically supported navigation.*

EPLAN is a set of PC-based design automation solutions for electrical, fluid power, and process and instrumentation control systems. The applications are geared to make planning, managing, and documenting your work key priorities. They can interface with each other and with third-party design and enterprise systems.

Version 2.2 of its EPLAN Platform offers enhancements to make working with it easier as well as extensions to various features and functions. It also introduces a new module that, among its other features, provides the ability to document field cabling of a machine or plant directly in an EPLAN project.

**MORE** ➜ deskeng.com/articles/aabhcw.htm

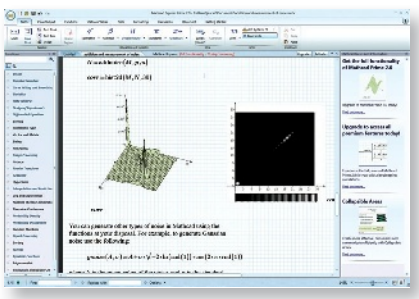
## Mobile App Platform Supports Component Manufacturers

*Platform enables manufacturers to create interactive product catalogs, configurators, and CAD models for iPad and Android tablets.*

CADENAS PARTsolutions, the developer of 3D part catalog management and sales configuration tools, has launched a mobile app platform for industrial component manufacturers. They say it's the first such product. I just know that it's first rate interesting.

The basic idea is to make a user-friendly app out of your product catalog. It can offer 3D CAD models, data sheets, company and product news, and more. But that isn't the half of it.

**MORE** ➜ deskeng.com/articles/aabhed.htm



## PTC Mathcad Express Released

*Complimentary engineering calculation application's license does not expire.*

PTC released a no-cost application called PTC Mathcad Express. As the "Express" tag implies, this tool is something of a spin-off of the company's high-power engineering calculation environment, PTC Mathcad Prime.

I weasel and say "something of" because PTC Mathcad Express is an unusual hybrid. It's both a trial unit of the full-featured PTC Mathcad Prime system and a stand-alone engineering calculation tool. No matter how you define it, downloading PTC Mathcad Express seems like a no-brainer. Here's why.

**MORE** ➜ deskeng.com/articles/aabhfj.htm

## 3D Printer Builds and Unpacks Models Continuously

*Could make short-run mold and modeling jobs faster and cost-effective.*

A German company by the name of Voxeljet Technology, which specializes in 3D printing technology and 3D print services for industrial applications, has announced the planned release of its VXC800, "the world's first continuous 3D printer." It sounds interesting for those of you making molds and models for metal casting.

The gist of the genius here is that the VXC800 uses a conveyor belt to continuously move your 3D model from the machine's front to back during the build process. This not only allows for larger builds, it means faster build times for more affordable print runs.

**MORE** ➜ deskeng.com/articles/aabhgf.htm

# PTC PLM Solution Fuels SRAM's Passion for Cycling Product Design

*Global Bike Component Supplier Design Teams Collaborate for Global Product Development with PTC.*

Multiple acquisitions coupled with strong corporate growth highlighted the need for SRAM, a manufacturer of high-end bicycle components, to review the company's long-standing approach to managing product data across its network of globally located employees, suppliers and customers. The company is using the PTC Product Lifecycle Management (PLM) olution to optimize product strategy and planning across the organization.

SRAM is passionate about cycling, just as passionate as its customers that cycle to work, down mountains or in road races. The bike components SRAM provides to manufacturers must utilize the latest technology available in the market in order to deliver to consumers a bike that's assembled for very specific requirements. SRAM has built a global company to address these requirements through a combination of strategic acquisitions and a next-generation product design strategy.

SRAM needed a PLM system that could represent the complete view of its products across its 16 locations in nine countries. Additionally, the company wanted a solution that would enable them to continuously improve the creation and management of SRAM product data in order to improve business processes that would speed time to market of new products.

"We will continue to seek and deploy design technology as we redefine and design bicycles and their components," said Michael Johnson, global PLM manager, SRAM. "To help us with this goal, we are using the PTC PLM Solution in our enterprise-wide, cross-functional, business process initiative that impacts all of SRAM, our suppliers and any of our customers who use our product-related data. PTC solutions give us a single, integrated, digital environment for data that helps us identify and manage new product opportunities much more quickly than previously."

The implemented PTC PLM solution defines parts (product specifications, bill of materials and qualification requirements) and manages them via a closed loop change process. It is able to effectively manage complex, cross-functional processes and coordinate the efforts of distributed teams to consistently and efficiently to create the best possible products.

"Global product development is not just about reducing costs, it's about driving business growth in new, expanded markets," said Brian Shepherd, executive vice president, PLM, PTC. "To capture these market opportunities, companies need to share information and standardize processes. With one source of truth for all product-related information, manufacturers can take advantage of fast and secure collaboration among global sites and value chain partners to deliver new products to market faster. Manufacturers like SRAM understand the business value that PLM can deliver against these objectives." DE

**INFO → PTC:** ptc.com

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

→ For the complete application stories visit deskeng.com/fastapps

## Advertising Index


ANSYS ..... 11
CD-adapco ..... 27
Composites Manufacturing 2013 ..... 23
COMSOL ..... 5
*DE* Reprints ..... 59
Epson ..... 9
Intel Corp. ..... 17
IronCAD, LLC ..... 25
Kubotek USA, Inc. ..... 59
Lenovo ..... 19
MathWorks ..... 7
National Instruments ..... 3
NVIDIA GPU Tech. Conference ..... CV3
Okino Computer Graphics, Inc. ..... 51
Omega Engineering ..... 1
Proto Labs ..... 59
PTC-Creo ..... CV2
SIMULIA ..... 15
Stratasys-3D Printers ..... 32-33
Stratasys-uPrint ..... CV4
Tormach LLC ..... 52
Traceparts ..... 53
Wohlers Associates ..... 59

by Tom Salomone

# Optimization in Design: The Foundation of Engineering 2.0

Suppose you could have all the simulation you wanted. Would it change the way you work? Would it change the decisions you make? Would your designs improve? With the technologies that are emerging, this may soon be the case.

There are plenty of options. Just look at the hardware choices. On the desktop with today's workstations, you can get 16 cores, and even double that by using hyper-threading. You can network desktop workstations to get a few hundred cores working on your simulations. You can set up simulations on high-performance computing (HPC) servers and run hundreds and even thousands of cores, or you can run simulations by purchasing Software-as-a-Service (SaaS) on a contract where your core allocation is only limited by the money you are willing to spend. You could even simply get your simulation done as a cloud offering and pay as you use it. All of those choices have different affordability models.

**Companies need to look for many new ways to use simulation.**

How will all this capability change the design process? We run simulation and analysis programs because we want to gain insights into the design that we would not get otherwise. In addition, we simulate to avoid the time and expense of actual physical testing. Simulation draws our attention to areas in the design that we need to change, to improve outcomes. We simulate to justify and test our design decisions, and to make sound engineering judgments. We can set up engineering design of experiments (DOE) and run various simulations to help us optimize our designs. In today's world, we often trust the software without comparing the results against test data from physical models to validate the analysis, something we should carefully consider.

## Simulation Has Taken Hold

There are many customer examples of simulation. Indy racecars are designed with complex simulations including airflow, tire wear and traction, and various changes are made to determine the impact on race time. Simulation is used before and even during the race to make key decisions, based upon predicting the final race time and position. Automotive companies simulate crash testing to predict safety outcomes. Plastic manufacturers simulate the mold design to make sure the final plastic product will emerge as intended and they will achieve the required product quality, and so on. Not only are these analyses being done, but new simulation use cases are rapidly emerging. For instance, in the race to have the perfect electric car, companies are using simulation to determine the impact of design changes on charging times, safety, size, charge duration and car performance.

The case can be made for simulation to emerge everywhere in design where critical decisions are being made, and also for the next level of decision-making with regard to reliability and product quality. Today's hardware is well equipped to make this happen. Application providers are also making it easier. Some analysis applications are included within CAD applications, such as SolidWorks. More sophisticated applications, such as ANSYS, are able to run massive problems on the desktop or in a workstation cluster to give users more control. HPC servers are more powerful than ever, and analysis is available at a cloud level, so users can quickly get multiple design decisions analyzed.

## New Paths Toward a Competitive Advantage

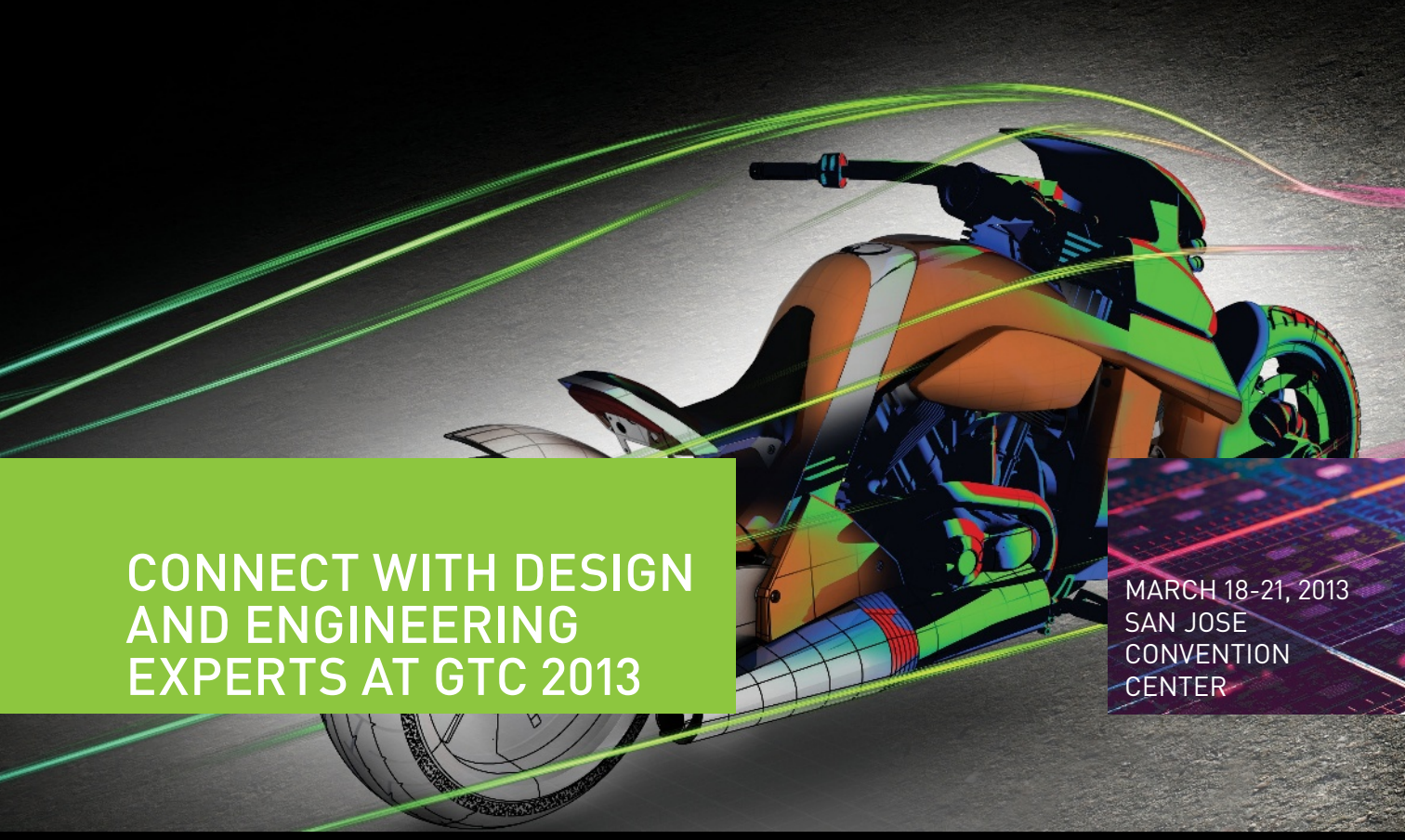
For many, simulation results must be tested and validated by real physical testing to ensure assumptions and analysis decisions are correct. Engineers, and often PhDs, will develop the details needed for correct analysis. For companies that invest in this data and process, it becomes a serious competitive advantage—one not likely to be released outside their company anytime soon.

With the availability of hardware and software to push analysis further, and the existing simulation capability to improve the design process (and hence, designs), companies can find new ways to gain and keep a competitive advantage. Companies need to look for new ways to use simulation. They may find these new ways in a metric that hadn't been considered thoroughly, or a manufacturing process impact and a way to improve the quality of a part.

Engineering itself is not standing still, but rapidly evolving. More product outcomes are becoming predictable through good engineering tools. The winners and losers of the next generation of products will be the ones that master this change.

Some of us are starting to call this the foundation of Engineering 2.0; that is, the engineering that will be the foundation for 21st-century competitive design. DE

**Tom Salomone**, *is HP's recently retired marketing manager for workstations. He is currently an industry consultant at Salomone Consulting. Contact him via de-editors@deskeng.com.*



# CONNECT WITH DESIGN AND ENGINEERING EXPERTS AT GTC 2013

MARCH 18-21, 2013
SAN JOSE
CONVENTION
CENTER

This year's NVIDIA GPU Technology Conference (GTC) is the place to be to network with the world's leading manufacturing companies. Come see how they're taking advantage of GPU-driven digital design to increase innovation, produce higher-quality, lower-failure designs, and get to market faster.

## Learn valuable insights:

- How design engineering companies are using advanced computer graphics at all stages of the product development life cycle—from concept to design and marketing
- How analytical simulations and photorealistic rendering can minimize physical prototypes
- How advances in desktop hardware, cloud solutions, and mobile platforms are speeding up the design lifecycle

## Who should attend:

- CTOs
- CMOs
- CIOs
- General Managers
- Senior Designers
- Senior Engineers
- CAD Group Managers
- Visualization Group Managers
- Simulation Group Managers

**GPU** TECHNOLOGY CONFERENCE

Learn more at **www.gputechconf.com/mfg**
Use promo code **GM10NMN** for 10% off registration.

DELL hp IBM Microsoft PNY SUPERMICRO DASSAULT SYSTEMES DE Desktop Engineering NVIDIA

## THE MOST AFFORDABLE, COMPLETE 3D PRINTING PACKAGE. JUST UN-BOX AND PRINT.

**ONLY $299/ MONTH**

Building 3D models at your desk is as easy as clicking "print." With the uPrint SE 3D Print Pack you get everything you need to start printing immediately. No hidden costs. Nothing more to consider. Just un-box and print. And, at just $299 per month, they're affordable for any organization.

**Find out more at www.uprint3dprinting.com/de.**

uPrint SE 3D Print Pack

Stratasys