Desktop Engineering®

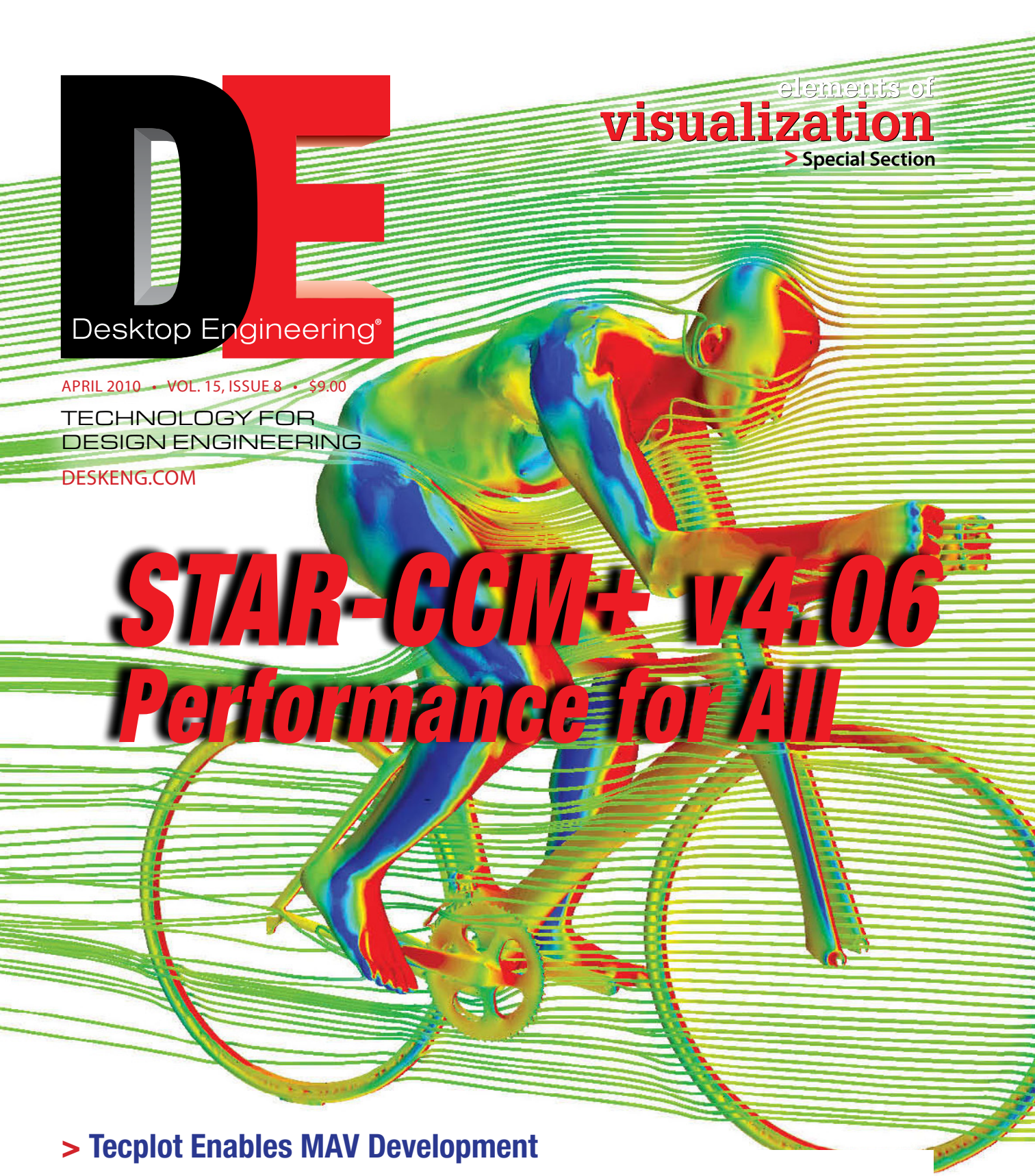
APRIL 2010 • VOL. 15, ISSUE 8 • $9.00

TECHNOLOGY FOR DESIGN ENGINEERING

DESKENG.COM

elements of visualization

> Special Section



STAR-CCM+ v4.06 Performance for All

> Tecplot Enables MAV Development

> Homebrew Aras PLM: Part 3

> Anark Core 3 Reviewed

> Lightning Strike Simulation

> Composite Materials in Space

Fulfill your design destiny.

ATI FIREPRO PROFESSIONAL GRAPHICS

hp

An HP Z Workstation with ATI FirePro™ 3D professional graphics can push your designs where they've never been before.

Get ready for a quantum leap in the way you work. For projects that go from ideas, thoughts, and visions to tangible designs — faster and more efficiently than ever. Get ready for the power of an HP Z Workstation with ATI FirePro 3D professional graphics. Tested and certified for 3D applications like SolidWorks®, it offers you exceptional performance and real-time display quality, solid reliability for extreme productivity, and a competitive edge that's within your budget.

For innovative designs, start with an innovative workstation.

Learn more at www.hp.com/go/ati

Image courtesy of Local Motors.

Where Do I Go for Data Loggers?
omega.com, of Course!

Your single source for process measurement and control products!

Portable Handheld Data Logger

OM-DAQPRO-5300
Starts at
$995

Visit omega.com/om-daqpro-5300
For Complete Product Details

Pressure and Temperature Data Logger

¼ NPT and Submersible Models
Part of the NOMAD® Family

OM-CP-PRTEMP1000
Starts at
$649

MADE IN USA

Visit omega.com/om-cp-prtemp1000
For Complete Product Details

Portable Data Logger

OM-SQ2010
Starts at
$1500

Visit omega.com/om-sq2010
For Complete Product Details

THE MINI NOMAD® Series Miniature RFID Data Loggers and Readers

***OM-84 Matchbook™ Series**
$90
5-Pack

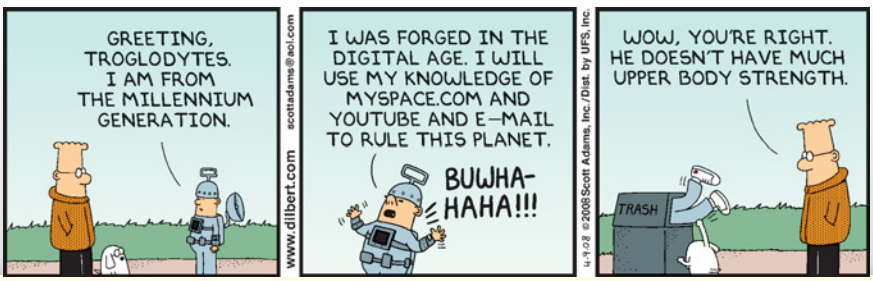
MADE IN USA

Visit omega.com/om-84
For Complete Product Details

FREE! New Horizons® in Data Acquisition Systems

Visit omega.com to order your FREE copy of The DILBERT BLUECAT® New Horizons in Data Acquisition Systems Version 23

Featuring 120 Classic DILBERT Cartoons!



For Sales and Service, Call TOLL FREE
1-800-327-4333SM
1-800-DAS-TEEE

Dilbert © United Feature Syndicate, Inc.

**PATENT PENDING*
COVERED BY U.S. AND INTERNATIONAL PATENTS AND PENDING APPLICATIONS

VISA MasterCard

Shop Online at
omega.com®
OMEGA®

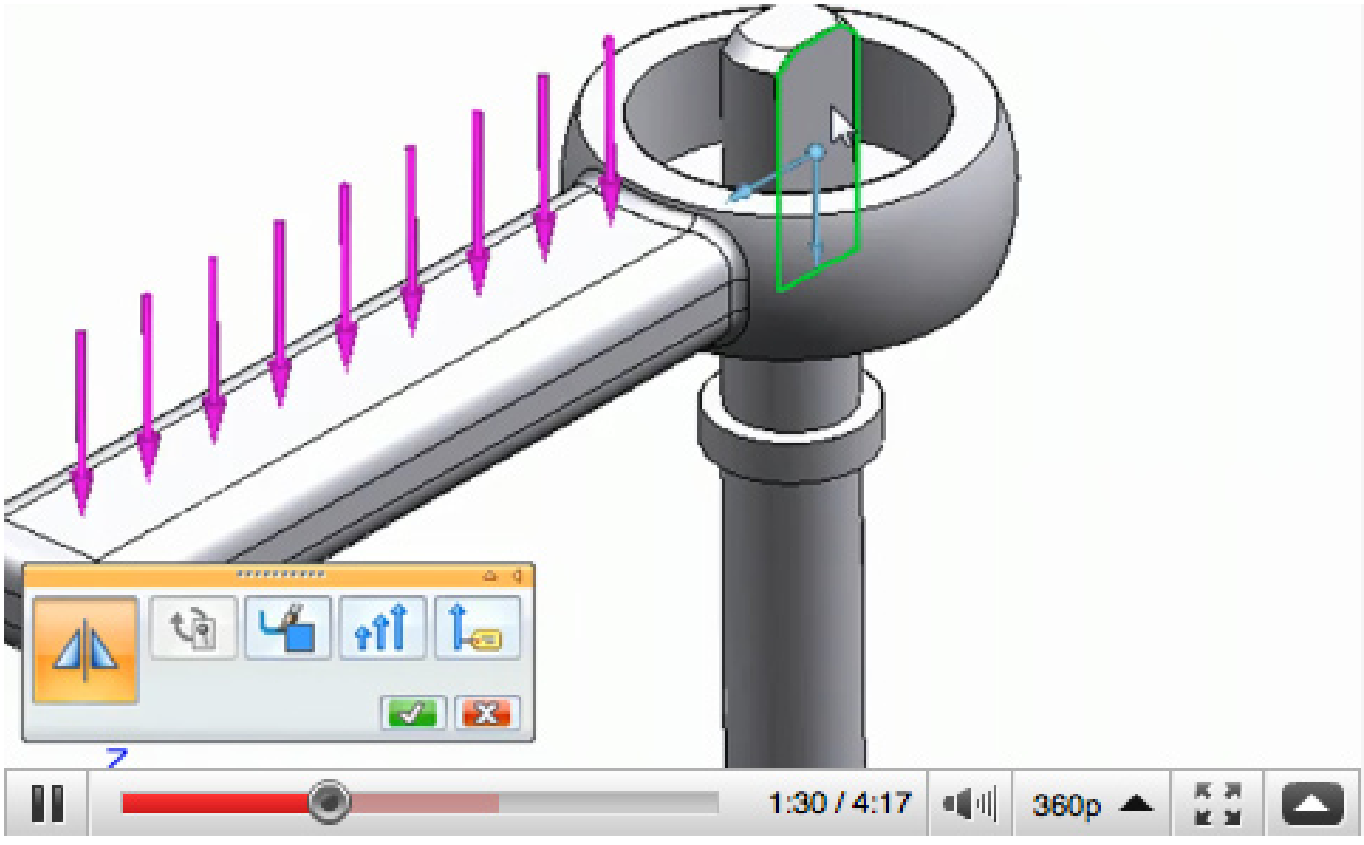
Stress Relief: Solid Edge with Synchronous Technology 2

KENNETH WONG
kennethwongsf@earthlink.net

In the last few days, I acquired a taste for destruction. I blame it on Solid Edge with Synchronous Technology 2 (SE with ST2).

After exploring part modeling, I ventured into the Simulation tab to see what kind of virtual mayhem I might cause. I'll tell you, there's nothing quite like watching a metal plate or a steel ring get twisted and deformed right before your eyes—in full color, in 3D, in slow motion, available for rewind (you can watch some of them in the video clip below).

Watch the video for more information. ■



REAL PARTS. REAL STORIES. JOE GIBBS RACING.

THIS COOLING DUCT WOULD HAVE TAKEN 33 DAYS TO DESIGN, TEST AND PRODUCE. WITH FORTUS, WE DID IT IN 3.

Nelson Cosgrove
Director of Engineering
Joe Gibbs Racing

Our engineers had just three days to correct an overheating brake rotor. We designed a new cooling duct in CAD, then used our versatile Fortus 3D Production System to help:

- Quickly produce and test a series of design iterations
- Test fitment of functional prototypes on the actual race car
- Produce a tooling buck for molding the final part
- Cut time and costs by 90% over traditional methods

With Fortus, we fixed the problem in time for the next race.

Watch the full story video and get a free sample part at:
WWW.FORTUS.COM/DE

STRATASYS®
Make It Real™

FORTUS™
3D PRODUCTION SYSTEMS

AfterCAD Unveils Interactive 3D Demo

Christopher Boothroyd, CEO of AfterCAD, was cutting it close, to say the least. As he headed out to the airport for San Francisco, he and his colleague Kenney Wong (not the same as this blogger) were still troubleshooting the interactive application he was planning to debut at Game Developers Conference.

The application, dubbed Immersion, is in Alpha code, not even Beta, so it's bound to be unpredictable. While he was demonstrating it to me on his laptop at JW Marriott hotel, his screen went dark. To his relief, the cause of the mishap turned out to be low battery, not the software.

Immersion, delivered in the form of a Facebook application, is made possible by a combination of technologies. There is no client-side application to install. It works in the web browser …

Watch the video for more information. ■

STRATASYS
Make It Real™

NOW THERE'S ROOM ON YOUR DESK AND IN YOUR BUDGET FOR BIGGER 3D PRINTING.

Modeling material available in nine colors with uPrint Plus.

Introducing the uPrint® Plus Personal 3D Printer. Turn big ideas into color 3D models right at your desk.

The uPrint Plus Personal 3D Printer gives you a 33% larger build envelope than the original uPrint Printer but in the same 25" x 26" footprint. uPrint Plus also gives you two layer resolutions and a choice of nine material colors. Both uPrint and uPrint Plus bring your ideas to life as durable plastic models you can use for proof of concept, functional testing, product mock-ups and much more.

Choose which uPrint is right for you at www.dimensionprinting.com/de3

STARTING AT
$19,900* USD

uPrint® plus
by dimension

*Manufacturer's worldwide list price. Additional options, shipping, applicable taxes/duties not included. ©2010 Stratasys, Inc.

Changing the World via Innovation & Quality Tools

STEVE ROBBINS
steverobbins@deskeng.com

There are a lot of designers and engineers out there working hard every day to make a difference. You know who they are. You work with them all the time on projects large and small. In fact, you're probably one of them.

We want to hear from more engineers and designers who have that innovative spark and the chops to use the right tools to develop products and processes that improve people's lives. If you've got one of those designs, or have seen your colleague work on that innovative process, we want to recognize them. We want to salute the men and women working on those projects, and we want to publicize their work and promote those innovations.

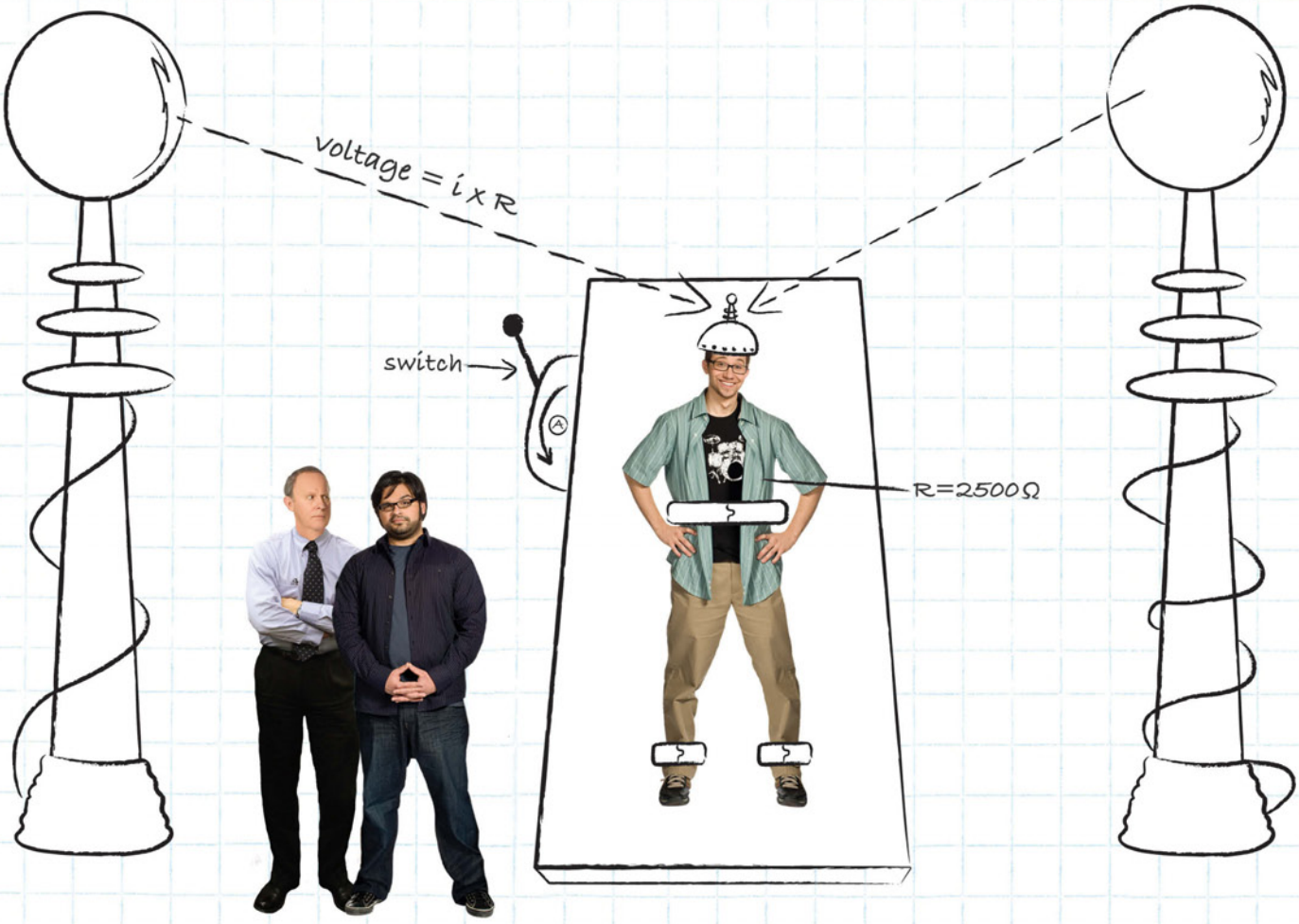
The second-annual Change the World Challenge is back and we at DE are hoping that you will help us find the winners.

This past December we recognized a total of 15 innovative projects we judged as truly world-changing. By world-changing we mean developments in technology and its use so the end result improves our world and the

> You are answering the needs of society everyday in numerous ways.

way we live in it. That requires engineers and designers who exert control over the way their products might have less impact on the environment than the old way of doing things. They might be developing solutions to greatly improve energy efficiency, designing a life-saving surgical tool, or figuring out a way to purify contaminated water for pennies.

Last year's winners included four designs ranging from a cutting-edge hearing aid to an innovative automotive power train. There were also four winning uses of simulation spanning from a wave-powered electrical generator to a hybrid locomotive. In the realm of HPC and computing IT, we picked three original projects, including a new cloud-ready tablet computer poised to hit the market, a robotic machine view development, and a battery-testing platform for electric vehicles. Finally, we chose four winners among rapid technologies all the way from a new treatment for



THE COMPLETE SEASON WILL BLOW YOUR MIND.
ALL EPISODES AND EXTRAS ARE ONLINE NOW.

3DUDES GONE 3D

SolidWorks® presents an online series about three PRODUCT DESIGNERS forced to work in an overflow trailer. Starring a USER COMMUNITY OVER ONE MILLION STRONG, a friendly NEIGHBORHOOD SOLIDWORKS RESELLER, and more than 150 USER GROUPS. And now showing ALL EPISODES, TIPS, DEMOS, DOWNLOADABLE POSTERS, and even NEW RINGTONES.

NR
NOT RATED

WATCH SEASON ONE AT **3DUDESGONE3D.COM**

SolidWorks

the repair of cleft palates in children to a personal vertical take-off and landing vehicle.

These examples as well as the others we chose as winners this past December (see them at deskeng.com) are proof that engineers are answering the needs of society every day. Whether the changes come in industry, agriculture, or in consumer products, they are improving the way we live, work, and interact with the world.

It's always gratifying to see how design and analysis engineers are answering society's needs and it's almost always surprising to see the myriad ways in which they are solving the world's toughest problems. It takes a lot of talent and imagination, and at DE we'd like to turn the spotlight on that combination.

We believe that DE readers (design, process, and analysis engineers) have the best potential to change the world for the better than any other segment of our population. Our collection of 2009 winners shows this potential is being realized on both small and large scales in every corner of the world.

So, if you are working on something that will change the world, or know someone who is, let us know. If you or a colleague is working on a project or a process that will make a positive impact on our lives, or the lives of our children or grandchildren, let us know. Visit deskeng.com/changetheworld by August 13, 2010, fill in the details, and you'll be entered in our 2010 Change the World Challenge.

We've rounded up an independent panel of judges charged with choosing the best examples in each of four categories: design, simulation, rapid technologies, and computing technology. And we'll announce all the winners in our December 2010 issue. ■

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

EDITORIAL

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

CONTRIBUTING EDITORS

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

PUBLISHER

Brian Vaillancourt (x263)

ADVERTISING SALES

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

ART DEPARTMENT

Darlene Sweeney — Art & Production Director (x257)

A LEVEL 5 COMMUNICATIONS PUBLICATION

Steve Robbins — Chief Executive Officer
Thomas Conlon — President

ADVERTISING, BUSINESS, AND 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
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.

CONTENTS

Desktop Engineering®

DESKENG.COM

"Learning is what most adults will do for a living in the 21st century."

> Lewis Perelman

COVER STORY

CONTENTS

APRIL 2010 VOLUME 15 ISSUE 8

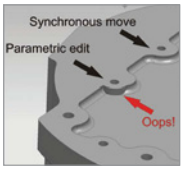
MATERIALS SCIENCE

PLM

RAPID TECHNOLOGIES

ELEMENTS OF VISUALIZATION

PRODUCT OF THE MONTH



COMMENTARY

DEPARTMENTS

ONLINE @ DESKENG.COM

DE PRODUCT SHOWCASE

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

SPEC SEARCH

> Search for products and services from more than 11,800 supplier catalogs.

NEWSLETTER REGISTRATION

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

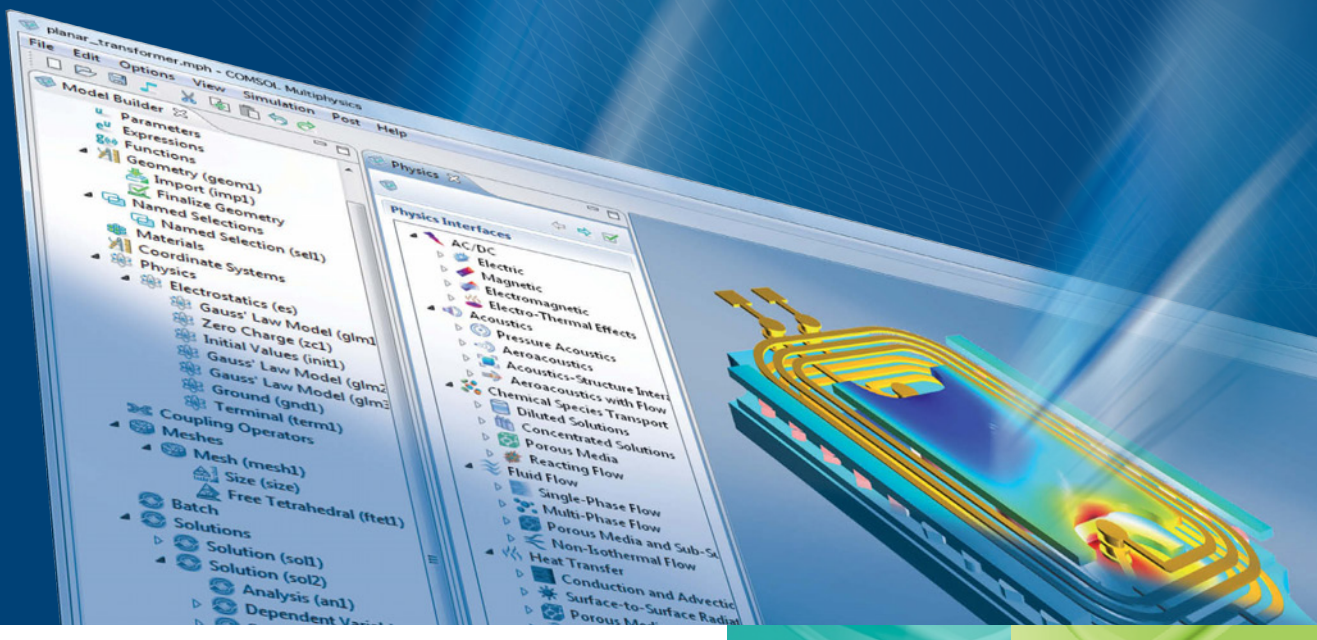
ON THE COVER >

This visualization of a racing bicycle in a wind tunnel indicates pressure fringe plots and streamlines. It was simulated using STAR-CCM+ v 4.06. Read Vince Adams' review beginning on page 58. Image courtesy of Felt Bicycles.

COMSOL MULTIPHYSICS

Capture the Concept™

80% of product ideas never make it to market. Let multiphysics simulation bring your designs to life.



With COMSOL Multiphysics® you are empowered to build the 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. This multiphysics approach delivers results — tangible results that save precious development time and spark innovation.

Get a free Proceedings CD containing over 350 published simulation projects at:
comsol.com/conference/cd

COMSOL

Picking the Right Sensor for Your Design

> To select the optimal sensor, you must be aware of the interdependencies and interactions of many attributes and factors. In the end, it's still a series of tradeoffs.

BY TOM KEVAN

Methodologies such as mechatronics and systems engineering stress the importance of the interdependencies of all domains in design. To create a successful product, you must operate on the principle that the performance characteristics of one component can have a major effect on those of another. The selection of sensors for designs only reinforces this principle.

Choosing the right sensor for an application is a balancing act of juggling factors such as architecture, range, accuracy, repeatability, resolution, output, noise, bandwidth, power, communications, and expense. By understanding the interactions among the relevant attributes, you can make intelligent tradeoffs and select the right sensor for the application.

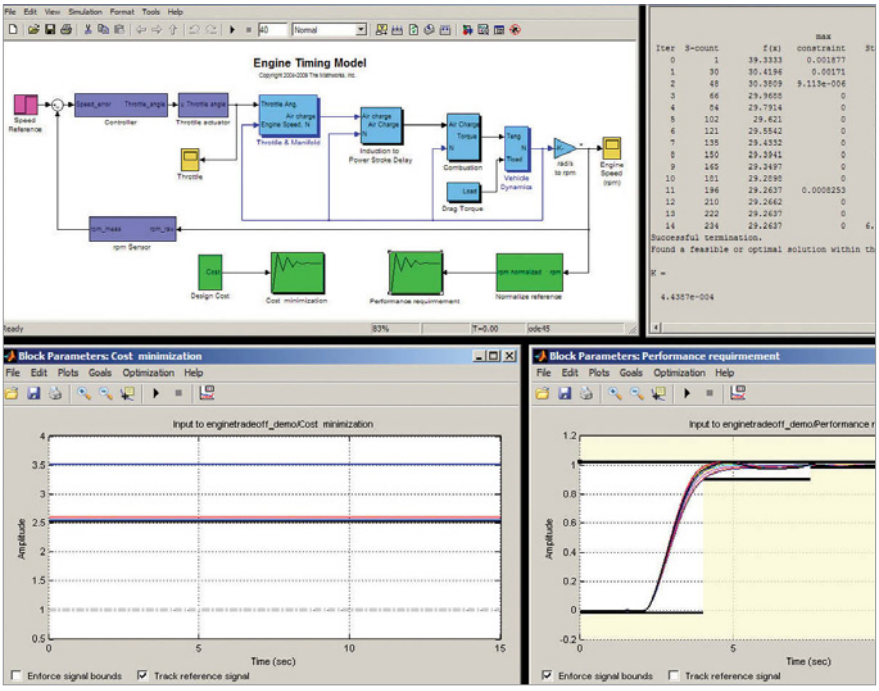


Figure 1: Designers optimize an engine-timing model in Simulink to automatically find the combination of controller gains and sensor accuracy (above, right) that minimizes cost (below, left) and maintains specified controller performance (below, right).
Image courtesy of The MathWorks

The Larger Picture

The first step in selecting a sensor is the definition of the system and architecture in which the sensor will function. From this larger "picture," you determine what physical properties must be measured and, thus, what types of sensors are required.

Once you've narrowed the field of sensors from

SENSOR OFFERINGS

Advanced Motion Sensing / Consumer

Freescale Semiconductor's (freescale.com) MMA8450Q 3-axis accelerometer promises accurate measurements and extended battery life that will serve smart mobile devices well. The MEMS device supports technology that captures precise movement via highly sensitive gesture- and orientation-detection capabilities. The accelerometer's embedded features include tap, double tap, jolt, and shake-detection capabilities

Features

- >Digital output 12-bit
- >3-axis digital accelerometer with I2C (±2g, ±4g, ±8g)
- >Accessible 32-sample FIFO for simplified motion detection analysis
- >Low current consumption in three modes
- >27 µA typical (ODR=50 Hz, low power mode)
- >42 µA typical (ODR=100 Hz, low power mode)
- >Programmable 2 interrupt pins for 8 interrupt sources
- >Low voltage operation 1.71–1.89 V
- >Embedded functions/features
- >Freefall or motion detection: 2 channels
- >Pulse detection: 1 channel
- >Transient detection: 1 channel
  —Automatic output data rate change
  —Self test

Wireless Range Extender

Texas Instrument's (ti.com) single-chip CC1190 radio frequency range extender for low-power wireless applications operates in the 850–950 MHz frequency spectrum, serving wireless sensor network, automatic meter reading, wireless industrial control, and consumer and audio applications. The unit's highly integrated design eliminates expensive discrete components, simplifies design layout, reduces test time, improves RF performance, and shrinks overall board space. Additional product information is available at ti.com/cc1190-pr.

Features

- >Power amplifier that increases output power and link budget
- >LNA with low-noise figure that improves receiver sensitivity.
- >Integrated power amplifier, low-noise amplifier, switches, and RF matching, which reduces the product design cycle
- >Seamless interface to sub-1 GHz low-power RF devices from TI
- >Output power up to 27-dBm (0.5 W)
- >Typical sensitivity improvement of 6-dB with CC11xx and CC430

Multipurpose Digital Pressure Sensor

Sensonor Technologies' (sensonor.com) SP300-series low-power sensors are fully calibrated and compensated and include a programmable, embedded RISC microcontroller and an optional 125 g accelerometer. Communications are available through five general-purpose I/O pins and a two channel LF receiver. The units include electronic ID, temperature measurement, supply voltage measurement, and diagnostics. The sensors' ROM library functions simplify code development.

Features

- >Pressure range 0.5–16 bar F.S
- >Operating temperature range –40°C to 125°C
- >Stand-by current 0.3 µA
- >Two-channel LF interface that supports wireless command and data reception
- >Robust, miniaturized surface-mountable SOIC-package

which you can make your selection, you determine whether you are making a direct or indirect measurement. A temperature sensor provides a direct measurement. On the other hand, if you are measuring force or velocity, you may have to make an indirect measurement. "If you want to measure a force, you can use an accelerometer and then compute force from that," says Alex Gomez, a principal engineer at Boston Engineering, a leading engineering service provider. "If you are trying to measure velocity, the easiest way is to use an encoder. That gives you position, and from position, you derive velocity."

Attributes

Your next step in the selection process is to identify the important sensor attributes, which vary with each application, and then match each sensor candidate's performance with the application's requirements. At this stage, you're looking at range, accuracy, repeatability, and resolution.

An example of a range consideration can be seen in the selection of an accelerometer. In this case, you may be interested in sub-G accelerations or accelerations involving hundreds or thousands of Gs. Then later would be an application requiring shock and vibration measurements. Reliable vendors provide good benchmarks that help you evaluate each sensor's attributes.

Now evaluate electrical issues within the context of the product's architecture and the processor receiving the sensor's signals. One of the leading concerns here is the device's output. Sensor outputs come in a number of forms. The most common are voltage (e.g., 0-5 V), current (e.g., 4–20 mA), and serial (e.g., RS-232, I2C, and parallel).

To choose the right output, you have to look at the application and determine some basic performance requirements, starting with the speed of the acquisition required. "If you need to acquire very fast signals because your process requires it, you may want to go to an analog output and use a fast A/D converter," says Gomez. These features give you more control over how often you are sampling."

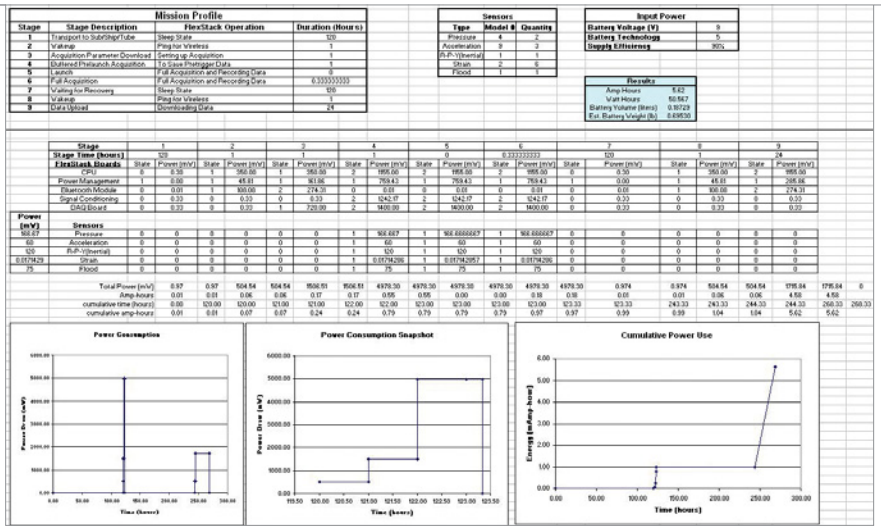
If you are concerned about noise, an analog sensor may not be the best option. Noise tends to be a bigger problem with analog sensors. A better choice might be to use a digital device that generates a serial output. These sensors are often slower Than analog sensors, so there is a tradeoff for signal integrity over speed.

Physical properties tend to change at different paces. For example, if you are measuring temperature, you don't require a high sampling rate because temperature changes relatively slowly. In that case, you can use a digital temperature sensor, but they tend to be more expensive.

In other situations, however, you need high sampling rates. For example, if you are going to use a sensor to control a motor that operates at 35,000 RPM, you want a sensing device that takes many measurements quickly. In that case, you would use either an analog velocity sensor or a very fast pulse-type of output. With analog, you can acquire data very fast.

Tools of the Trade

There are a number of tools that facilitate sensor selection. Some are available on vendor Web sites gratis. For example, Analog Devices offers tools, software, and simulation models tailored



Boston Engineering's power consumption spreadsheet looks at the mission profile, sensors by type and quantity, and input power to determine how much power is consumed and dissipated. *Image courtesy of Boston Engineering*

for specific components to assist with design goals and criteria. Others are homegrown by individual service providers, such as Boston Engineering's power consumption spreadsheet, which its engineers use to determine power dissipation in an application.

Then there are tried and true commercial software applications that validate sensor selections before designs are completed and resources are expended. "We use MathWorks' Simulink to simulate sensors and controls, with the effects of noise factored in to get a better understanding of feasibility," says Gomez. "The better you make your simulation, the less the risk. The key is you have some high fidelity that you are inserting into your model and simulation. You are inserting the proper attributes of the sensor, so you see if it will succeed or fail (see Figure 1). ■

FOR MORE INFO:

> Analog Devices
> Boston Engineering
> The MathWorks

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

RAPID Show 2010 Debut on West Coast To Feature Additive Manufacturing

Technology that enables surgeons to make custom-fitted brain plates in hospital settings, car enthusiasts to produce obsolete missing parts in their own garages, and movie studios to create imaginary worlds inhabited by new forms of life was once the purview of science fiction. Today, these kinds of applications can be seen at the RAPID 2010 and 3D IMAGING Conference and Exposition, a multi-day event organized by the Society of Manufacturing Engineers (SME), from May 18-20 to take place at the Disneyland Hotel in Anaheim, CA.

Making its West Coast debut, RAPID 2010 will bring manufacturing professionals, designers, and artists together to view, explore, and discuss new innovations in 3D scanning and rapid technology. Exhibits, keynotes, and presentations will illustrate applications in industries such as aerospace and defense, automotive, arts and entertainment, medicine, and sports and recreation. Buyers and end-users of design, prototyping, tooling, and direct manufacturing equipment will get a chance to compare processes, talk to industry experts, and participate in more than 70 technical presentations.

Among the examples are medical presentations that will explore uses of additive manufacturing for organ replacement and prosthetic manufacturing, a seminar track to explore special effects for movies and the development of video games for education, discussions of rapid prototyping for airplane parts, and how the automotive industry applies the technology to machining and tooling needs.

The conference will also include a special interactive session, "Design Considerations for Additive Manufacturing," which will cover real-world applications reviewed and discussed by a panel of experts. Attendees can participate live or virtually, via several social media avenues, before and during the conference.

Additive manufacturing processes, in combination with creative thinking, have also contributed to new forms of contemporary art. Attendees can learn how new approaches and use of unique materials enable artists to turn any creative idea into reality. Sculptures and other pieces created with the technology by artist Bathsheba Grossman will be displayed on the show floor. Grossman, who explores the link between art and mathematics to produce 3D sculpture and other objects, will present at the conference.

For expo attendees new to the topic of additive manufacturing, RAPID will host two briefings on the show floor, "Rapid Technologies" and "3D Imaging and Reverse Engineering," Tuesday and Wednesday, starting at noon. *Image courtesy of EOS*

FOR MORE INFO & REGISTRATION:

> Society of Manufacturing Engineers

SIGGRAPH Selects Carnegie Mellon's Don Marinelli as a Keynote Speaker

ACM SIGGRAPH announced Don Marinelli, a leading Carnegie Mellon scholar and educator, would give one of its keynote presentations at SIGGRAPH, the 37th International Conference and Exhibition on Computer Graphics and Interactive Techniques, July 25-July 29 at the Los Angeles Convention Center.

◄ Marinelli is the executive producer of Carnegie Mellon's Entertainment Technology Center, a joint initiative between the College of Fine Arts and the School of Computer Science, where technologists and non-technologists work together on projects that produce installations intended to entertain, inform, inspire, or otherwise affect an audience, guest, player, or participant.

"With each passing year, the boundary between artists, scientists, and graphic experts becomes more blurred," stated Terrence Masson, SIGGRAPH 2010 Conference Chair from Northeastern University. "To truly have the highest quality final product, whether that is a film or an interactive installation, collaborators from different fields must understand each other. Marinelli is an expert at bridging these different disciplines for the best end result."

For the past 29 years Marinelli has served different roles at Carnegie Mellon including co-creator of the Master of Arts Management Program, co-creator of the Master of Fine Arts in Acting degree program with the Moscow Art Theatre School in Russia, and co-founding the Master of Entertainment Technology Degree Program with Randy Pausch.

FOR MORE INFO:

> SIGGRAPH

PTC Acquires Environmental Impact Technology from Planet Metrics

PTC has extended its InSight Product Analytics solution with technology to help manufacturers analyze carbon and other environmental impacts during product development and manufacturing.

The core of PTC's Insight Product Analytics solution is built upon delivering a suite of capabilities to enable bill of material (BOM) analysis for environmental performance, cost, and reliability throughout the product lifecycle. PTC has acquired technology from Planet Metrics, Inc., a provider of environmental impact analysis technology. This new technology enables manufacturers and retailers to model, analyze, and optimize carbon emissions and energy use from concept to end-of-life. The Planet Metrics software includes a normalized database of environmental profiles and combines both analytics and heat map displays that allow users to identify high-impact "hot spots" in materials, packaging, supply chain, transportation, and disposal.

"The process of predicting, measuring, and improving a product's environmental performance is becoming increasingly important to the success of manufacturers across all industries," says Howard Heppelmann, vice president of Product Analytics solutions at PTC. "The acquisition of this technology is an important step in the execution of our product analytics strategy and overall differentiation in PLM. We are excited to expand our Product Analytics capabilities to further enable manufacturers to analyze the environmental footprint of products early in the product development cycle, helping them make informed design and supply chain decisions that can lower risk and cost."

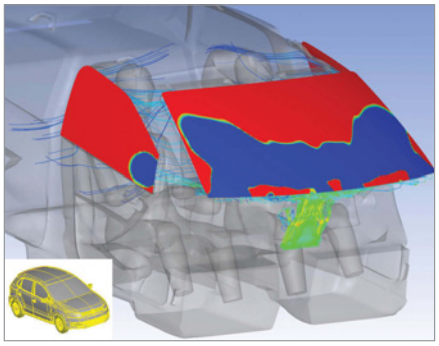
PTC plans to embed the technology within its InSight Product Analytics solution with an official software release.

FOR MORE INFO: > PTC

DESKENG.COM TOP TEN ARTICLES

1. Meshing: The Critical Bridge for CAD-to-Analysis Flow
2. New NVIDIA Quadro FX Series Workstation Graphics Cards Deliver HPC for Less
3. Adobe Photoshop CS3 Links Digital Design Process
4. New AutoCAD 2008 Works Like Magic
5. Autodesk's 3ds Max Design 2009 Offers New Modeling Tools
6. New Pro/ENGINEER Wildfire 4.0 Simplifies the Computer Aided Design Process
7. Altair's solidThinking Rolls Out V7.6 for 3D Computer Aided Design
8. Adobe Systems Releases New Acrobat 3D Version 8: A Classic Made Better
9. HP's New XW4600 Workstation: Another Winner
10. Alienware's Area-51 ALX Crossfire Is a Powerhouse Workstation

Volkswagen Signs Master Agreement with ANSYS



Volkswagen AG has signed a master agreement with ANSYS, Inc. and intends to widen its use of the company's engineering simulation solution. The decision to use ANSYS software was due both to the applications that can be addressed as well as to the ANSYS Workbench platform that allows for a substantial process compression.

In its research and development, Volkswagen uses structural mechanics, fluid dynamics, and explicit analysis tools from ANSYS to perform, among other applications, studies on climate control, headlights and engine internal flow.

"The automotive market is highly competitive, and technological advances are being incorporated in modern cars at an ever-faster pace," says Ralph Sundermeier, head of the Department for CAE-methods at Volkswagen AG. "To stay at the top, there is no way around applying simulation tools to drive product development and innovation. Our decision for simulation software from ANSYS is based on the depth and breadth of the solution we needed to cover our simulation needs. The ANSYS Workbench concept is convincing because we can easily do coupled simulations and, in this way, accurately account for the entire range of physics." *Image courtesy Volkswagen AG.*

FOR MORE INFO:

> ANSYS, Inc.

R 20 of Dassault V5 PLM Released

Dassault Systèmes has launched Release 20 of its collaborative V5 PLM portfolio, including CATIA, ENOVIA, SIMULIA, and DELMIA. V5R20 includes enhancements to DS' ENOVIA SmarTeam multi-CAD collaboration software, integration of SIMULIA's nonlinear and thermal realistic simulation capabilities into the V5 platform, as well as composites design and simulation capabilities in the CATIA and SIMULIA brand portfolios. V5R20 also features enhancements across the portfolio, including digital manufacturing, furthering support for production deployments, and overall usability.

V5's openness is advanced in Release 20 with updated multi-CAD integrations and a new 3D viewer available directly within ENOVIA SmarTeam. In addition, V5R20 introduces a new product, CATIA Extended STEP Interface. It enhances large assembly archiving with nested assembly support. In V5R20's update second quarter 2010 update, CATIA Extended STEP Interface will feature support for composites design attributes, and functional tolerancing and annotation data. The second quarter 2010 update to the entire V5 portfolio will also include support for Windows 7.

Click the link below for the full story on the features and functionalities of V5R20.

FOR MORE INFO:

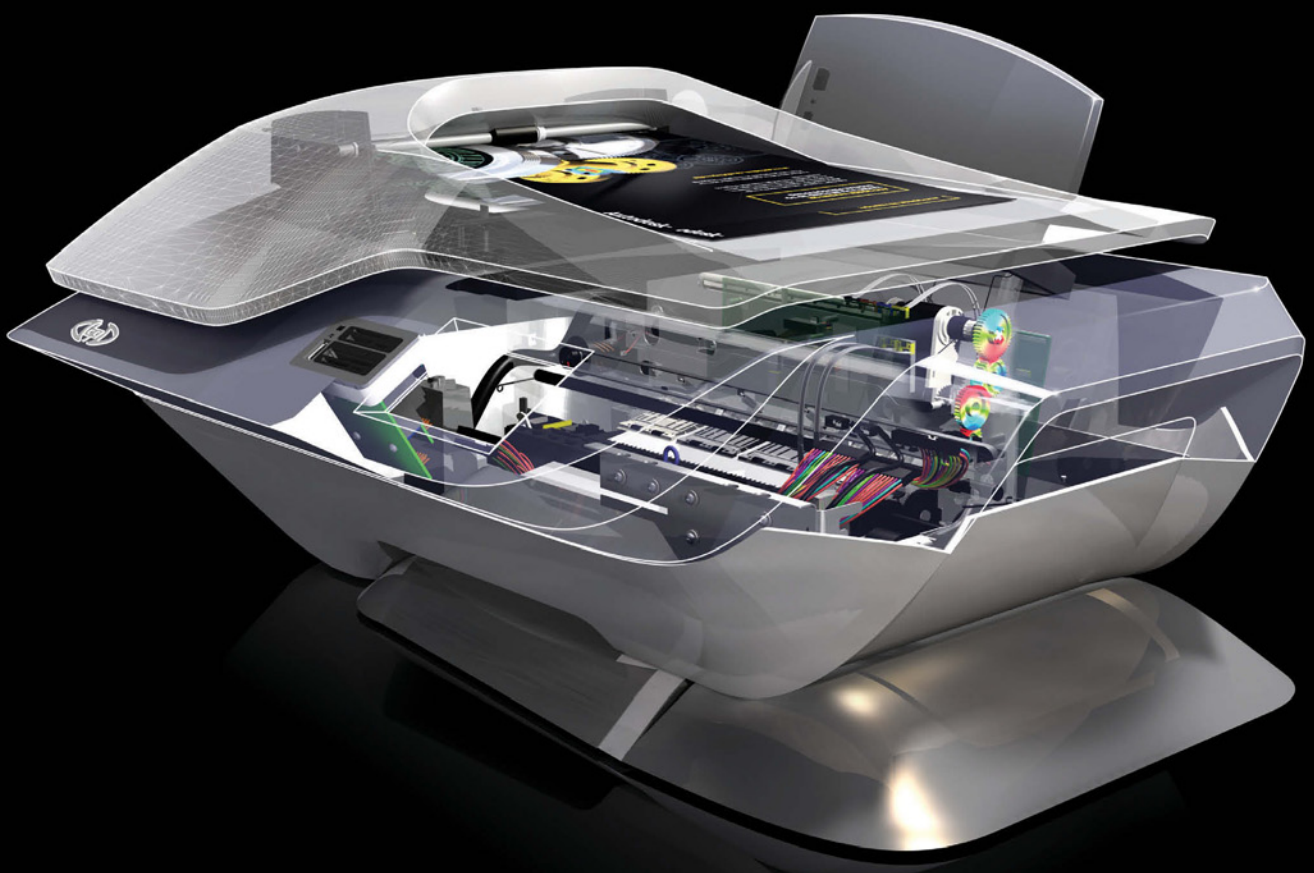
> Dassault Systèmes

Autodesk®

AUTODESK INVENTOR
TAKES YOU BEYOND 3D TO DIGITAL PROTOTYPING

Autodesk® Inventor® software creates a single digital model that enables you to design, visualize, and simulate your products. Inventor helps you to reduce product costs and get innovative designs to market faster. Learn how Inventor can take your designs beyond 3D at autodesk.com/beyond3d.

AUTODESK INVENTOR



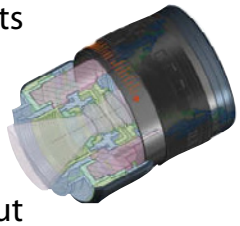
EDITOR'S PICK OF THE WEEK

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

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

SpaceClaim 2009+ Software Released

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



SpaceClaim Corp. unveiled its 2009+ release immediately before the chaos known as the holiday season, meaning I missed telling you about it when I should have. So, I'm here to tell you that you shouldn't miss it now. SpaceClaim is a game changer for your entire organization and not just for the design gurus. In fact, those guys don't even have to change what they do—except that part where everyone hurries up to wait for them. SpaceClaim keeps things rolling and now, with the 2009+ release, it helps you get designs and end products out of the gate more quickly than ever.

SpaceClaim itself strives to be what the engineering community needs: An easy to use modeling tool that brings together the enterprise. It provides true direct modeling—meaning that everybody in your organization does not have to be a parametric CAD maven—and interoperability with pretty much every format out there.

READ MY COMPLETE REVIEW:
>SpaceClaim 2009+

Clusters Optimized for CAE

> HPC solutions are Intel Cluster ready and preconfigured for ANSYS analyses.

HPC is where it's at for you people who need high throughput and the ability to run large, detailed simulations that would choke a workstation. But figuring out what you need to get into HPC is not where it's at. In fact, it's a drag. Such a drag, that you often have too little power available to match your investment in software power. Appro International is out to change that.

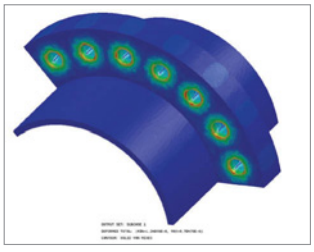
Appro has begun to offer what it calls the Appro Ready-To-Go Cluster series. These clusters are pre-tested, integrated, certified Intel Cluster Ready, and optimized to run ANSYS apps. They even include pre-installed cluster management software. Essentially, you set up your Linux-based Ready-To-Go cluster, get some training, and everybody gets back to work.

The Appro Ready-To-Go Cluster series is available in configurations that support 4, 8, and 16 nodes (32 to 128 cores), and they run Intel Xeon 5500 processors at speeds of up to 2.93GHz.

READ MY COMPLETE REVIEW:
>HPC

NEi Works 2.1 Debuts at SolidWorks World

> New analysis types, usability enhancements among key features in embedded Nastran tool.



Steve Robbins, the editorial director at *DE*, doesn't let me out in public much any more—regular readers probably surmised that long ago—but I'm told that David Weinberg, the CEO at NEi Software, was at SolidWorks World in Anaheim unveiling version 2.1 of NEi Works. David is one smart guy, and NEi Works is one smart tool for any SolidWorks user who needs to get FEA data to pre- and postprocessors.

I've liked NEi Works since I first saw it at its earliest stages a few years back. The basic outline is that NEi Works is Nastran right smack dab inside of SolidWorks, including SolidWorks 2010. It is Nastran power that looks and feels like SolidWorks as much as possible, meaning that you do not have to shift gears to operate some unfamiliar application. And, since it's embedded so fully, whenever you make a change to your SolidWorks model, all the loads, boundary conditions, and meshes change too.

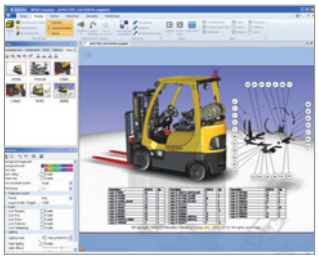
Version 2.1 makes the associativity between model and analysis more robust, flexible, and quicker. A bunch of new element types are introduced in 2.1, such as user-dimensioned cross-section save and load, section offset, defined profile selection, and tapered beam.

READ MY COMPLETE REVIEW:

>NEi Works

Content Creation, Delivery, and Collaboration Enhanced

> Dassault unveils new version of 3DVIA Composer



I am a lot of things: Incredibly macho male, uncle, dyspeptic colleague, come to mind. But, in the end, I am a content guy. I love creating and delivering content. I love communicating with you through these messages and the articles and commentaries that I write or edit. I love collaborating with authors, colleagues, designers, and editors to create great content. It's this love of creating, collaborating on, and delivering content that drew me toto explore the latest release of 3DVIA Composer from Dassault.

Romantically tagged with V6R2010x as this new revision's last name, 3DVIA Composer is a toolset for the individual, workgroup, or enterprise to communicate and collaborate. And not everyone has to be an engineer to use it. In fact, you don't have to be an engineer at all, which is a attribute that should attract a lot of attention from all of you who waste untold amounts of patience trying to show sales, marketing, PR, and, well, certain managers what it is that you do for a living.

Essentially what 3DVIA Composer does is it lets you take CAD data and create 2D and 3D documents: animations, assembly instructions, illustrations, training stuff, and what have you.

READ MY COMPLETE REVIEW:

>3DVIA

FASTApps

> FOR COMPLETE APPLICATION STORIES CLICK HERE

Summit Safety Uses Quickparts for Fast Intro of Lifesaving Device

> When Summit Safety was in the process of finalizing the design for its new RIT Tracker, a next-generation hand-held firefighter tracking and locator device, it was faced with an aggressive schedule to have product to market.

The RIT Tracker detects the ultrasound signal from a beacon and follow it back to its source. Ultrasound has the unique capability of following the air path between the beacon and tracker, avoiding the delay of breaking through separating walls.

Summit Safety was pushing their timelines because they built in several improvements into the new Tracker from previous versions and wanted to get the product to market fast so firefighters could begin using it right away.

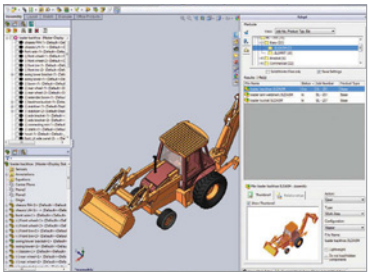
After searching the Internet and remembering Quickparts from past tradeshows and trade publications, Summit Safety contacted Quickparts and submitted design files online. Within minutes, a Quickparts sales manager called to discuss the specific requirements of the project.

Quickparts engineers helped Summit Safety understand certain design limitations and teams worked through changes together. Quickparts delivered the parts on schedule and provided invaluable design for manufacturing help.

> More info

Synergis Helps W.L. Gore Optimize Collaboration and Efficiency on a Global Scale

> W.L. Gore & Associates, the company that revolutionized industrial filtration theory and practice, needed to control costs, reduce customer response and product lead times, shorten manufacturing process times, and improve quality management on a global scale.

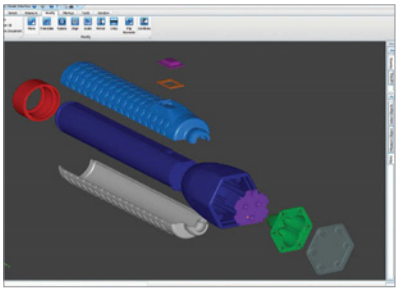


After searching and evaluating multiple document management solutions, Gore decided that Synergis Software would work globally to integrate design centers and aid collaboration. Gore also needed the flexibility to expand and configure the system as the company's requirements changed.

Under the new document management system, when design information is required, Gore's response time has been reduced from 24 to 48 hours to less than 15 minutes. It has reduced design time by sharing the workload between its two design teams, can locate similar designs in its centralized repository within seconds, and use existing documents as base templates for new designs. Adept also allows Gore to keep a full history of each design, and Adept's relationship feature enables the company to link associated documents to the family history for each design, enabling worldwide access to data.

> More info

SolidView Enables Access to CAD Data Minus Expense of Full-Blown CAD Tools



> As Midwest Composite Technologies' (MCT) CAD services business began to grow, MCT added more designers and adopted Solid Concepts' SolidView viewing software to streamline processes and reduce expenses.

With SolidView, MCT can supply the necessary functionality to those who need only certain CAD functions, providing data to all who need it, from concept to product. Customers upload a file in its native program, and SolidView pulls it onto the screen for real-time rendering of the component. The software also has the ability to rotate; obtain volumes, dimensions, and measurements; and add comments with ease.

SolidView/Pro also offers users an exclusive publishing capability. This allows the user to send the company's free version, SolidView/Lite, with the design. The Lite version provides rendering, reads Solid File eXchange (SFX) files, provides 3D dimensioning of SFX data, and supports STL, SolidWorks, VRML, and OBJ CAD files. By passing the Lite version along, the recipient can view and measure the altered design without having to purchase any software. SolidView/Pro provides the added capability of cross-section display with measurements.

> More info

Systems Engineering Offers Big-Picture Design

> Particularly useful in electronics, systems engineering counters silos and discipline-centric tunnel vision with a holistic view of product development.

BY TOM KEVAN

Systems are becoming more complex, and the traditional ways of driving product development and analyzing system requirements no longer work. In most cases, "the way we've always done it" does not adequately consider the product as a whole nor make the customer's requirements the top priority.

Figure 1: This functional diagram shows how a systems simulation depends on a functional modeling perspective, integrated with requirements and logical and physical models.
Courtesy of Dassault Systèmes

It's not just the products that have become complex, but product development itself. The technologies used in devices are more difficult to master. The functional complexity of products has exploded. New devices must now meet an elaborate array of regulatory requirements that include environmental, safety, and trade guidelines. And the nature of design teams has become more heterogeneous. Today, it's not unusual for team members to be distributed throughout the world and come from multiple engineering disciplines. The answer to these challenges is a big-picture view and understanding of the product and how its parts work together. "As products have gotten more complex, we've had to look at the product in more totality," says Kenneth Amann, director of research for CIMdata. "We've had to take a more holistic view of it to truly understand it and to make sure the tradeoffs we are making in the design are proper."

Systems Engineering

Systems engineering provides that big-picture view with an interdisciplinary approach that

Figure 2: The mapping of allocations between parameters on physical parts to requirements on functional and logical models in Teamcenter, enables the use of independent groups of parts in the design of multiple products.
Courtesy of Siemens PLM

focuses on work processes and tools to manage complex product development and to ensure customer needs are met. The objective is to consider product development in a holistic way (see Figure 1) and to achieve the optimal architecture of the system, justified in terms of operation, cost, performance, and capabilities.

Design decisions are reached after evaluation of alternative approaches and iterative testing, validation, and verification early in the development process (see Diagram 1, page 28). And systems engineering is concerned with the entire lifecycle of the product, so it encompasses downstream concerns such as manufacturing optimization, interoperability, maintenance and upgrades, training, recyclability, and disposal.

Today, companies cannot survive unless they can quickly deliver high-function products to market at a competitive cost. And because everyone is striving to achieve these goals, companies have to work harder to differentiate themselves from their competitors and one clear way to do that is to offer complex capabilities in products.

The biggest technical factor driving the adoption of systems engineering is that widespread complexity. "I was doing systems engineering on satellite collection systems 10 or 15 years ago, but today you have the same level of complexity in the cell phone hanging off your belt or the MP3 player you have in your pocket," says Bill Boswell, a Senior Director of Teamcenter for Siemens PLM Software.

With complex systems, it is harder to predict and simulate a product's behavior. Someone has to be looking out for the overall satisfaction of the product requirements, so there is a need for people that have a big-picture view of the product and an understanding of how the components and subsystems work together. In the past, silos of knowledge and the limited number of engineers with cross-functional domain knowledge stood in the way of achieving these goals, but systems engineering addresses these issues.

Translating and Tracing Requirements

A systems engineer's most fundamental task might be to define the product's requirements. The idea is to start with the voice of the customer, break down the requirements, and build a tree

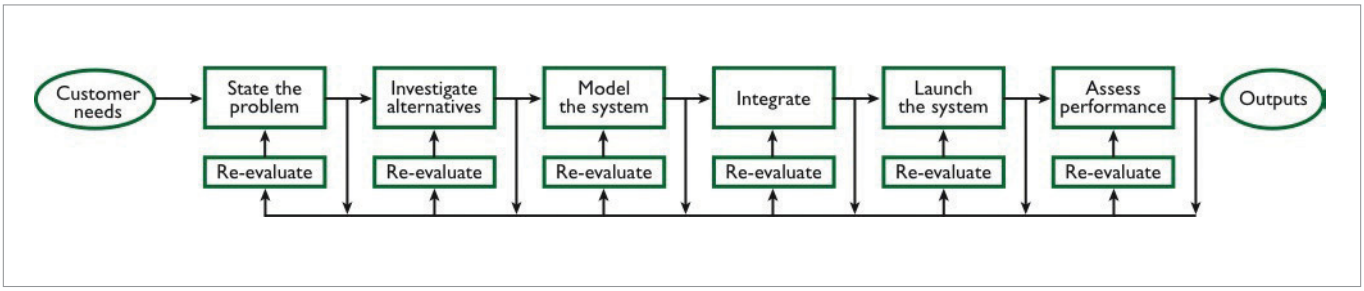


Diagram 1: Designers should re-evaluate design decisions as an ongoing process, with multiple parallel loops to improve system architecture and performance. *Courtesy of Siemens PLM Software*

that will help you convert something ambiguous into specific, measurable requirements that you can then build to.

"Usually, customers are not engineers. They typically say something like, 'I want the door to sound solid when I close it,'" says Patrick Hale, past president of the International Council on Systems Engineering. "You intuitively have a feel for what that means, but you can't design to that intuitive feeling. You have to somehow turn that into a set of engineering requirements that people can design to, measure, and ensure that it meets the customer's intent.

After translating the customer's needs, you should be able to trace the requirements across the various development steps (see Figure 2, page 27). This is especially true of requirements relating to the product's capabilities, architecture, implementation, integration, and test and validation plans. If you are going to change the requirements, you have to consider the effect on the architecture and the implementation. You also have to update how you are going to test and integrate the system to verify that you comply with the requirements. When traceability is incomplete or absent, projects suffer.

"If you look at research, you see that about 40 percent of the projects fail due to a lack of requirements traceability to the different capabilities," says Laurent Cherprenet, director of high-tech industry for Dassault Systèmes. "If you cannot comply with some requirements in the software domain, you are also going to impact requirements in other domains. And in the end, your product is not going to fulfill the overall requirements…."

Interfaces, Interactions, Integration

Systems engineering places a high value on understanding the interfaces and behaviors you expect to see in the system. According to Hale, NASA believed "the role of systems engineering differs from design engineering in that it deals with the relationships of the thing being designed to its environment and subsystems rather than with the internal details of how it is to accomplish its objectives."

This translates into understanding how the intended and unintended interactions of all of the components and subsystems will occur and whether they will help satisfy the customer's needs. Increasingly, this takes place in a model-based environment, where long before you've done

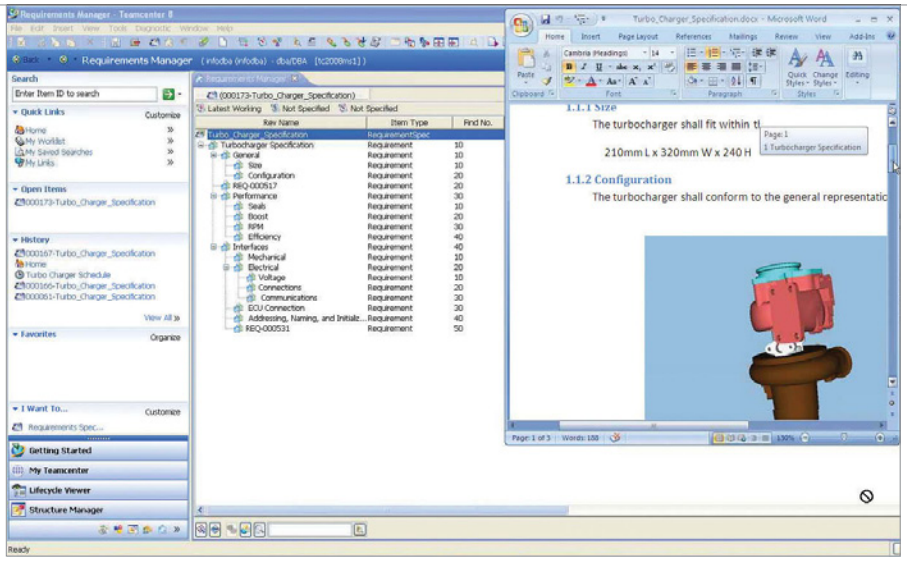


Figure 3: Teamcenter builds a structure of requirements that can connect live with Microsoft Word. *Courtesy of Siemens PLM Software*

detailed design or built a prototype, you try to capture the potential—positive and negative—behaviors at a conceptual level.

The importance of understanding the interfaces through modeling and simulation is spelled out by recent research. "Nearly 50 percent of projects fail due to poor system architecture validation," adds Dassault's Cherprenet. "Most of the issues are relative to the poor specification of the interfaces between the different components of the architecture, especially how they are going to communicate between software and electronics."

Two leading providers of systems engineering

Systems Engineering Recharges Electronics Industry

For electronics components destined for use in larger system, requirements management determines success or failure.

When you achieve a certain level of complexity, it is no longer possible to continue to develop products and to have a global understanding of them without using systems engineering. This is particularly true of electronics used in defense, automotive, and medical devices or applications.

Electronics designers and manufacturers produce discrete stand-alone products for commercial markets, but an even larger number of products are sold to add value and functionality to larger systems. Systems engineering ensures the necessary requirements have been considered so the product can function well inside other systems.

For example, a disk-drive manufacturer must think about how its product is going to be used, what people want in terms of power management or form factor. The manufacturer not only has to systems engineer its own product, it has to systems engineer all the possible uses of its product in someone else's system. You can have the fastest, most reliable disk drive in the world, but if it is an eighth of an inch too high to fit into the next generation of laptops, you might as well close up shop.

According to Dassault Systèmes, adoption of systems engineering has grown quickly in the electronics industry. This is particularly true of the domain where complex electronics are embedded in systems to control the interaction of the equipment with the external environment.

— TK

software tools are Siemens PLM Software and Dassault Systèmes. Both of these vendors provide integrated interdisciplinary platforms that facilitate a holistic understanding of products and include data management and modeling and simulation functionality (see Figure 3, page 29).

Siemens' Teamcenter systems engineering module includes Web-based groupware collaboration and information-linking functionality that integrate with requirements management capabilities. The software enables alternative design evaluation and optimized design tradeoffs.

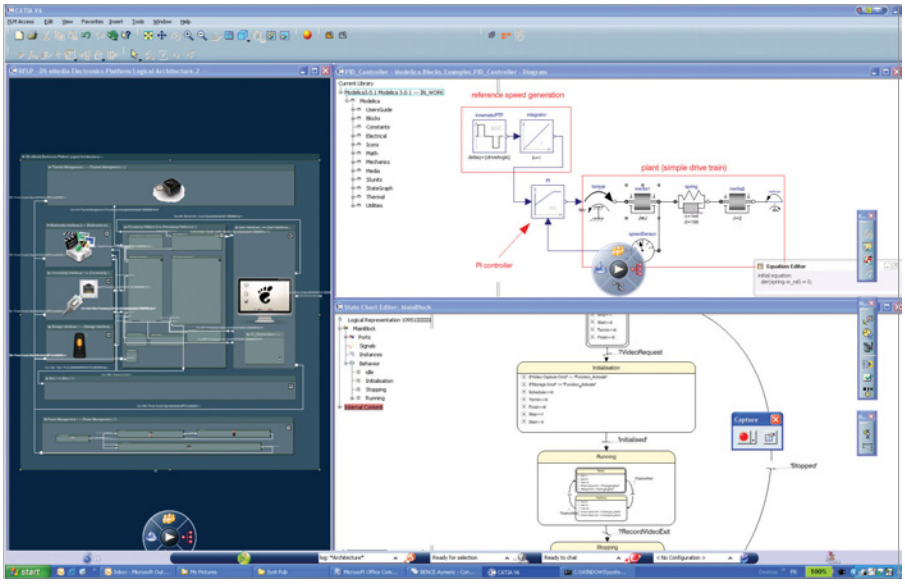


Figure 4: This screenshot shows the logical diagram of a system (left); the V6 solution's use of the open, industry-standard Modelica systems modeling language (right top); and a state chart of the system in question (right bottom).
Courtesy of Dassault Systèmes

Tools of the Trade

"The module has tools that help you define system architecture, interfaces, and options, and track pieces throughout the design process, helping you create the cross-domain systems definition," says Siemens' Boswell.

Dassault's virtual design solution, CATIA, captures and manages product requirements with full traceability throughout the product development cycle, from functional architecture and logical breakdown to physical design and testing (see Figure 4, above). Components from multiple disciplines (e.g., mechanical and electrical) are modeled on a common platform to enable dynamic simulation of the complete system. While leveraging numerous capabilities from a broad PLM platform, the functionality is aggregated in CATIA V6. The CATIA Systems domain includes solutions for architecture design, logical 3D architecture, control and logic modeling, logic code generator, and dynamic behavior. ■

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

FOR MORE INFO:

> CIMdata
> Dassault Systèmes
> International Council on Systems Engineering
> Siemens PLM Software
> Teradyne

Anark Core 3.0 Now Does More than Ever

> 3D PDFs, product data integration, and new annotation capabilities are just some of the new capabilities offered by the latest version of this collaboration program.

BY MIKE HUDSPETH

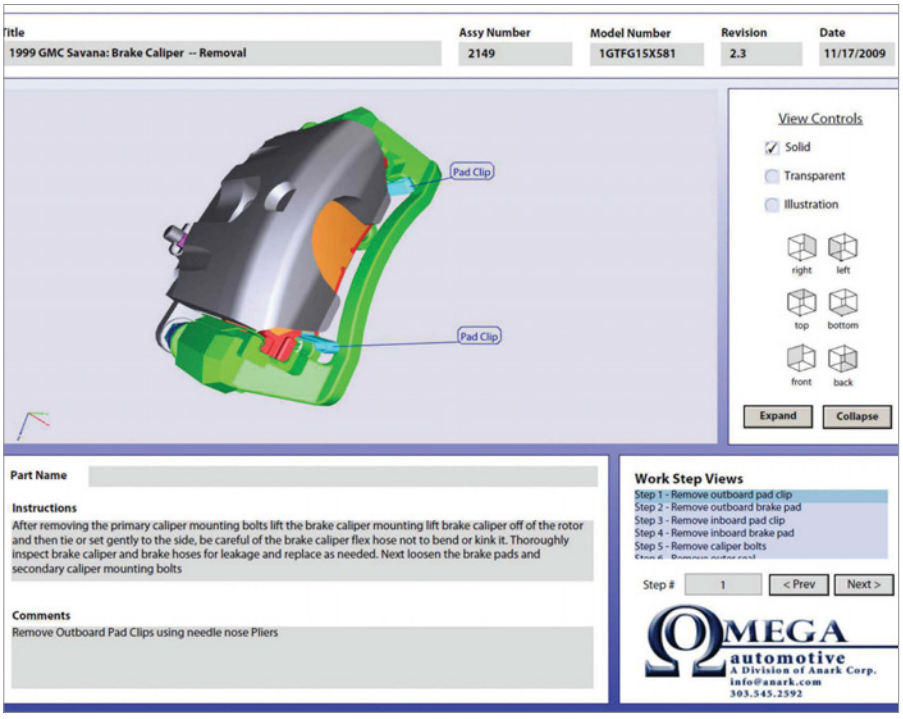


Figure 1: Your customers need to know how to work your products. You can set up your data to show them how to do anything.

Demands on your time and attention can be enormous. At work, your boss wants you to do stuff. Your coworkers want you to do stuff. Your customers want you to do stuff. At home, your significant other wants you to do stuff. And if you've got'em, your kids want you to do stuff. And you want to do your own stuff. The two things all these have in common is that 1) it's you that does the stuff and 2) all the stuff you have to do is different depending on who wants it done. Your engineering data has it just as bad.

Anark Core 3 administers those demands. And that's good news because your engineering data is solid gold to your company. If it wasn't they wouldn't need you. Anark Core lets you share your data with everyone in your company (and outside of your company) while protecting the important stuff.

The Work Flow

Your data tells everything there is to know about your products. It has to be kept under wraps, but has to be let out to be useful and go to work for you. Anark Core 3 lets you grant access to your data to people outside your sphere of influence who might not understand your data, but can use parts of it without ruining it.

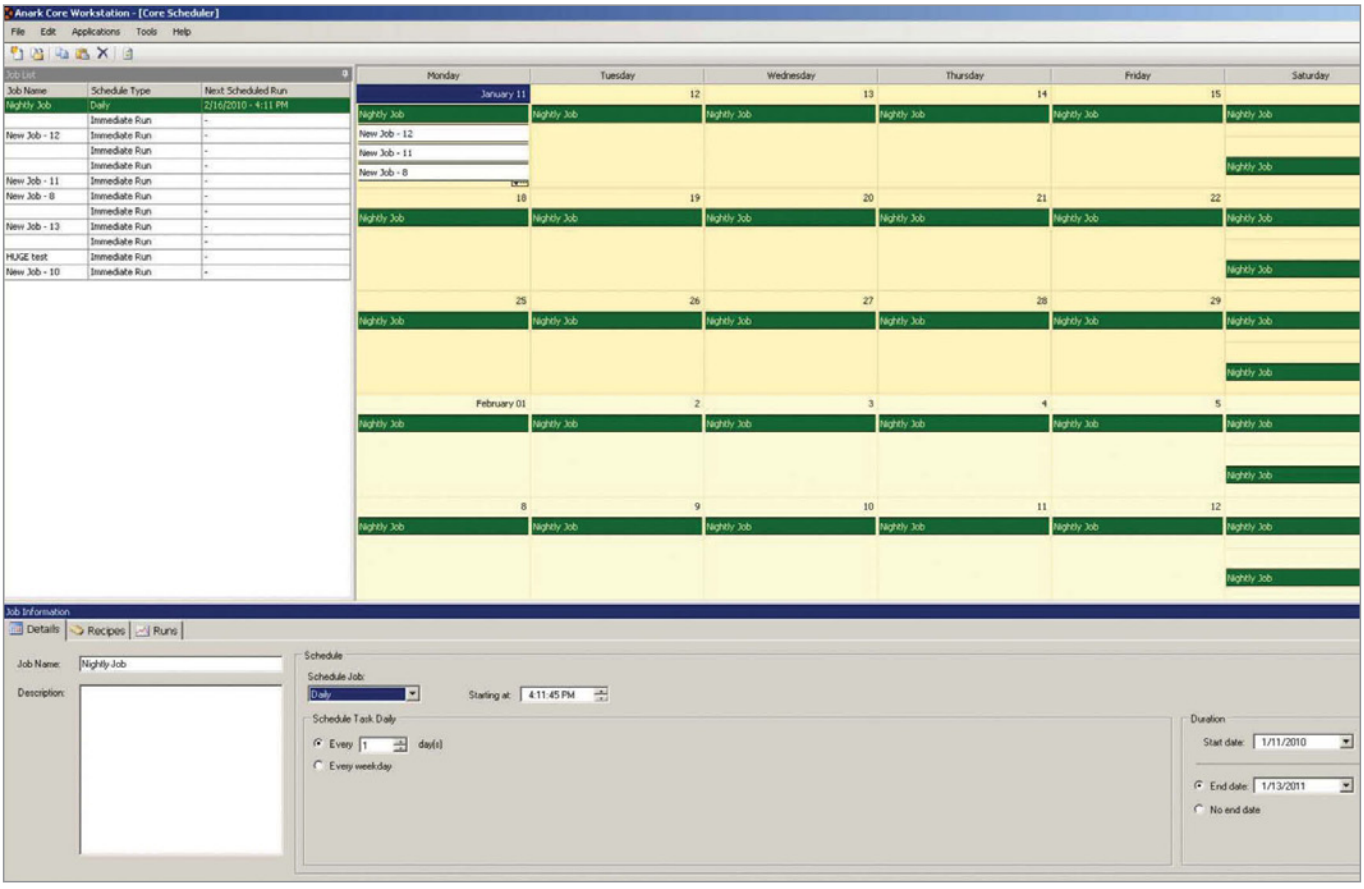


Figure 2: Anark Core 3 has a great extra add-on called Scheduler. With it, you can rebuild and/or update all your files when there's no one in the office. Of course, that will eliminate your need for one coffee break.

Anark Core has always protected your engineering data, but the latest version makes it easier for you to present it via tighter integration with your software. It enables you to control who gets what so collaboration is simplified and streamlined. Most companies have technical illustrators that work hard to build the manuals your customers are going to need (see Figure 1). These guys (and gals) don't need all the detail you've put into the model, so Anark Core 3 will give them just what they need by enabling your illustrators to edit the data and simplify it. The same goes for the sales department that needs to put your data into a form like a catalog page the customer can access to make a buying decision; procurement who needs your data to order materials for production; packaging who needs it to design a container for the product; and so on. Anark Core 3 can give it to them all—and then some.

Information In

Anark Core 3 can also pull data in from just about any source. Special licensing agreements with numerous software vendors allow data to be imported. It enables great versatility in how you can use data that you didn't create. It grants access to data found on many vendor websites to import models and material attributes. This means

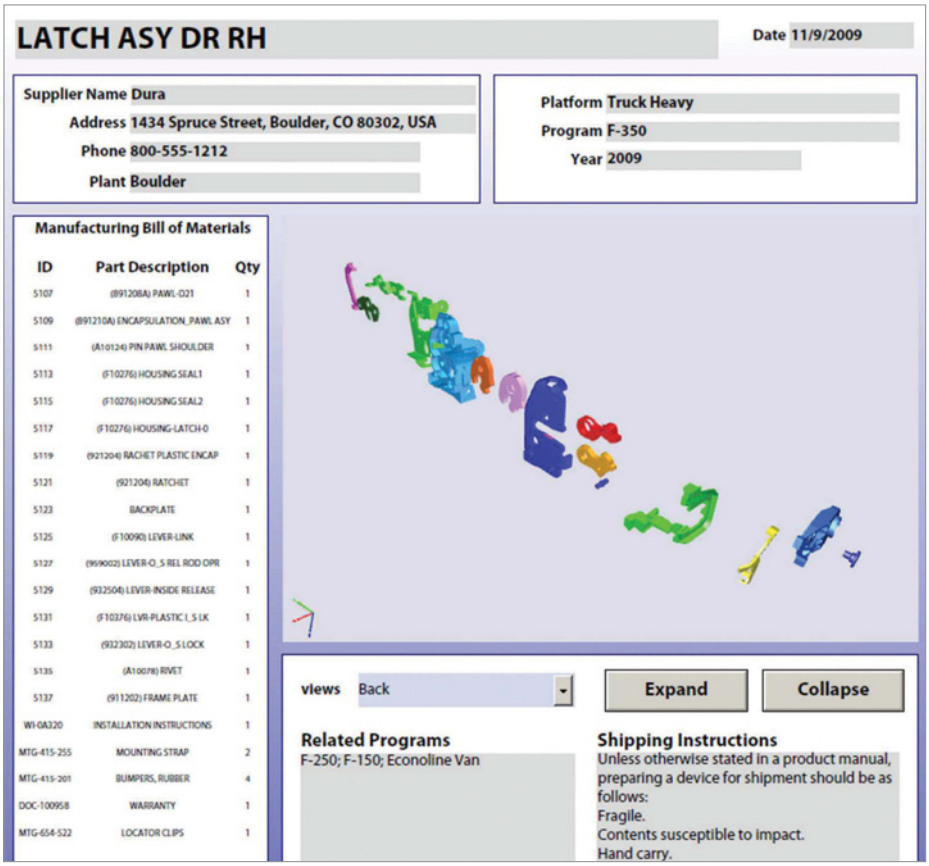


Figure 3: When you make your catalog pages you can even build in the capability to explode your assemblies.

you don't have to model all of your resistors, transformers, capacitors, LEDs, chips, etc. You can link to the manufacturer's website or even import data from your PDM system. The really nice part is that this is live data linked back to all systems. That means if something changes in the original system, it will update in Anark Core 3.

Changes and Recipes

As mentioned earlier, all sorts of people need to access your data but they don't need all of it. They just need what they can use. So when the data is imported into Anark Core 3 you can change it to meet your needs. You can eliminate what you don't need and change what you do. You can mix different data sources and come up with something new. You're not linked to just CAD data anymore, you get everything. You can import attribute data from multiple sources. You can click and display attributes (some of which you can change), all without changing the original data. That way it's safe. Anything you do with the data, any changes you make, gets stored in a "recipe." These recipes are lists of instructions that Anark Core 3 uses to recreate data the next time it's opened. You can build recipes that reference data from PDM, MES, and other systems. When changes are made, you run the recipe and everything updates.

Information Out

Anark Core 3 is particularly useful for design reviews. You can mark up your data for later changes. You can import work instructions from your MES system. When you display your data, you don't have to use the original colors from models. (I had an engineer friend once who insisted on using all kinds of colors in his models. His eyes weren't what they used to be so he wanted the highest visibility he could get. Consequently, his models fairly glowed with unnatural combinations.) In Anark Core 3 you can change all that and make things the way you want them.

Of course, once you've made all the changes you want and have added in the information you need, you can then export it in many different formats so it can work for you.

When you buy Anark Core 3, you get a full license of Adobe Acrobat Pro Extended. A strategic alliance with Adobe means you can create all kinds of PDF documents—especially 3D PDFs. If you've not looked at Acrobat Pro Extended lately you'll likely be amazed at what you can do with it.

The Acrobat license means you can attach annotations to faces, then export them with views to a PDF. You can export PDFs of each component in your assembly, if you want. You can put actual B-rep data in your PDFs. That means you can rotate and zoom in 3D. You can even explode your assembly in the PDF (see Figure 3). That's great for online work instructions and manuals. It also makes for a good support tool (think call center support). No one need guess anymore at how things go together. It's also good on the manufacturing shop floor. No more fumbling for dirty, out of date drawings. You can include data dimensions so technicians can measure and record the actual product and compare it to the intended values. Queries can access data configurations just like in SolidWorks (e.g., common components are found in two-door vs. four-door cars). So it's no problem if one model of your product has four LEDs on its PCB and another model has only two. Just access the right configuration. It's that easy. All that makes your PDFs a good quoting tool (design engineer meets procurement). And don't worry about the security of your data. Digital Rights Management protection comes from Adobe. You can tether privilege control back to you and revoke it at will.

You also have access to Adobe Life Cycle Designer, which means you can design PDF templates, mapping the fields to the data. And lastly, you can add Scheduler (see Figure 2). This is an Outlook-like program that you can set to keep things up to date. It will wait patiently until the time of your choosing, then go out and access every link in your Anark Core 3 file and check to see if anything has changed. If so, Scheduler will activate an update.

The Core ROI

Anark Core 3 does plenty, but it's not cheap, ranging from $4,500 to $10,000 (for the individual Workstation license and support docs), including the bells and whistles you choose, to $5,400 to $10,000 (for the Server license), which includes automation and Scheduler. But if it lets you do your job in half the time, it's like having another full-time employee helping you. I'd say that's a bargain. ■

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

FOR MORE INFO:

> Anark Corp.

Abaqus FEA Enables Lighter, Cleaner Aircraft

> EADS pushes the composite envelope in the design of the Airbus A340 using Abaqus from SIMULIA.

BY TIM WEBB

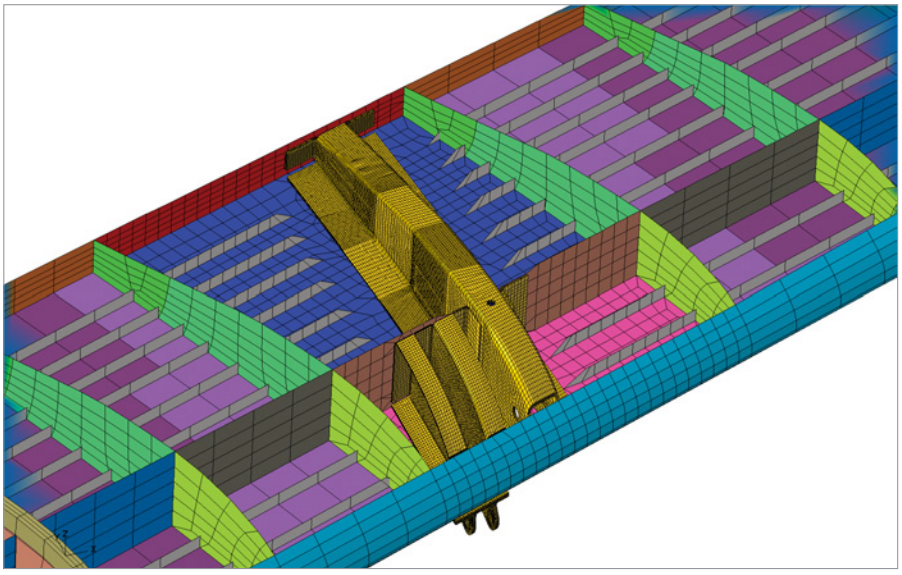


Figure 1: Model of load introduction rib (LIR) and surrounding flap and wing structure.

In 2001, the Advisory Council for Aeronautics Research in Europe (ACARE) published a report that looked at air travel 20 years into the future. The report—European Aeronautics: A Vision for 2020—created guidelines for the continent's 400,000 aviation workers to create an industry that satisfied "constantly rising demands for lower travel costs, better service quality, (and) the very highest safety and environmental standards."

On the environmental front, the report set goals that would shrink the aeronautics industry's footprint by cutting aircraft fuel consumption 50 percent, CO2 emissions 50 percent, and NOx emissions 80 percent by 2020. To reach these goals, aircraft engineers are competing to design lighter aircraft with greater range. One of the key strategies is replacing current metal components with innovative composite structures.

At EADS (European Aeronautic Defence and Space Company), a number of business units and partners are engaged in the development of "greener, cleaner" commercial aircraft. Through a global network of technical capabilities centers, collectively known as EADS Innovation Works, engineering teams at the $60.2 billion company are looking for ways to bring sustainability to aircraft design—one component at a time.

Sustainable Aircraft Design Takes Off

Dr. Tamas Havar, a specialist at an EADS Innovation Worksite near Munich, Germany, leads a variety

of projects in the Structure Integration & Mechanical Systems department. He and his team are tasked with developing new aircraft structures using composite materials. "The goal of our ongoing analysis program," Havar says, "is to reduce emissions and manufacturing costs by focusing on the development of innovative composite design and manufacturing methods."

A project team of engineers from various EADS business units and university partners, lead by the Airbus High-Lift R&T group, recently completed the analysis of an advanced composite load introduction rib (LIR), an important wing flap support structure in the Airbus A340 aircraft. While an Airbus A340 component was used for this study, Havar says that the analysis results will be applied to new designs in general. In aeronautic applications, pre-impregnated carbon fiber reinforced polymer (CFRP) composites are typically the composite of choice. In this instance, however, the EADS engineering team—while looking to reduce costs—chose an autoclave-free manufacturing process that led to the use of textile composites instead. Textile composites are also used in the bulkhead of the A380—Airbus' most composite-intensive aircraft to date.

A critical factor in the design of composite aeronautic structures is how the parts attach to the surrounding aircraft structure. Current composite high-lift structures—such as a flap—typically use metal load introduction structures to attach to the wing. These structures, with fail-safe designs, lead to heavier aircraft and higher manufacturing costs. There are also differences in thermal coefficients between the connected metal and composite parts. Composite-load introduction structures, on the other hand, permit a damage-tolerance design, since a failure of one ply is compensated by other plies that remain intact. The use of composite material also eliminates the problem of thermally induced loads, since both the high-lift and load introduction structures are made of the same composite materials.

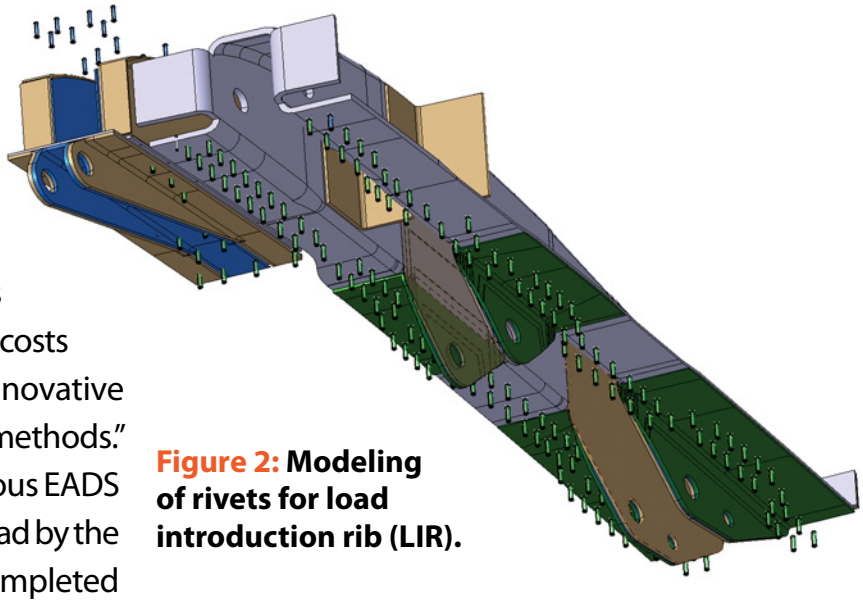


Figure 2: Modeling of rivets for load introduction rib (LIR).

The EADS Innovation Works team chose Abaqus FEA from SIMULIA to analyze the design of their composite LIR. "Abaqus is our preferred nonlinear solver," says Havar. "It has powerful composite analysis capabilities, especially for 3D elements such as in our LIR study."

Abaqus FEA Fuels Composite Analysis

Abaqus FEA is used throughout the product design lifecycle at EADS—to narrow down initial concepts, to design the preferred concept predesign, and to ensure all specifications are met in the final design stage.

The new composite LIR included a drive rib with integrated lugs so it could be attached to the flap drive, and rivets to attach the assembly to the flap skin. The team's goal was to trim manufacturing costs by simplifying the LIR's geometrically complex pre-form so that its thickness was uniform, except in those areas where pre-forming could be relatively simple and inexpensive. The team's solution used LIR profiles that allowed the pre-form layup to be automated, thereby minimizing manufacturing costs.

To model the new design, the EADS team—working within the framework of the German-funded Aerospace Program and Project HIGHER-TE (High Lift Enhanced Research: Trailing Edge)—needed to consider the complexity of the composite structures: thicknesses vary from 4mm to 10mm; plies run out and are chamfered with resin pockets; gusset fillers are used in the radius.

"Given the variables inherent in composites, we needed to use 3D elements for the calculation of composite load introduction and to obtain an accurate analysis of all stress components," says Havar. "Since delamination is a common type of failure for composite load introduction, both the transversal shear and peel stresses are of high interest." With these factors in mind, EADS engineering group built the LIR model using a variety of different Abaqus elements. For the flap, the group used approximately 20,000 2D elements. For the LIR itself—and to calculate load introduction—it used approximately 100,000 continuum shell 3D elements, including hex-elements for the composite plies (with 4-8 plies per element, orthotropic properties per ply, and 3D element orientation) and penta-elements for the ply run out. Isotropic properties were applied to the resin matrix. All together the LIR model had approximately 450,000 degrees of freedom (see Figure 1).

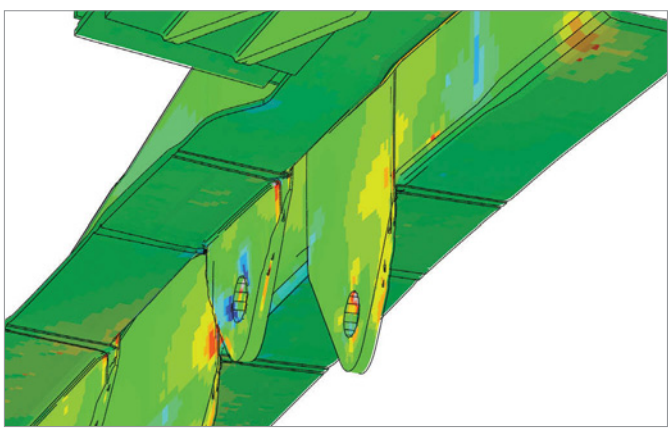


Figure 3: FEA results showing stress in composite fiber direction.

The team's solution used LIR profiles that allowed the pre-form layup to be automated, thereby minimizing manufacturing costs.

The engineering team also had to demonstrate that each of the 324 rivets in the assembly, which attach the LIR to the surrounding structure, would withstand loading (see Figure 2). "This is dependent not only on the attached structures but also on the rivet material and the size of the rivet itself," Havar says. To accomplish this, each rivet was modeled with an elastic connector between the parts. On one side the rivet was attached to the composite flap skin, and on the other side it was attached using a multipoint constraint to distribute the loads over the skin thickness. The

resulting connector forces are used to calculate the reserve factor for skin-bearing failure and rivet fractures.

The engineers also examined the composite lugs used to attach the flap kinematic system to the LIR. The lugs were analyzed by applying loads using a rigid body element in the direction of the load. For each load case, the team created a new rigid body element due to the varying load conditions. To complete the LIR analysis, the EADS team calculated several load cases using the Abaqus implicit solver and postprocessing. In these scenarios, the flap was fixed at the edges with beam elements representing the test setup fixed at the ends in all three translational degrees of freedom. For some load cases, the beam elements at the outboard end were translated symmetrically causing an additional torsion on the flap. The analyses looked for both intralaminar (within plies) and interlaminar (between plies) failure, as well as rivet and lug loading. The analysis team used Fujitsu-Siemens Linux 64-bit workstations with run times of approximately 15 minutes for each load case.

Positive Results for Composites Analysis

If composites are key to the design of future sustainable "greener, cleaner" aircraft—with lighter weight, greater fuel efficiency, and fewer emissions—the results of EADS composite analyses were positive on all counts: in-plane and transversal stress components were within tolerances for the new composite LIR design (see Figure 3); strength specifications for all rivets connecting the LIR to the surrounding structure were met or surpassed; and performance of the composite lugs was within industry safety specifications.

"There's no doubt that composite structures will increase in future aircraft. To keep up with our ongoing innovation, we'll need additional FEA capabilities." — Dr. Tamas Havar

"There's no doubt that composite structures will increase in future aircraft," Havar says. "To keep up with our ongoing innovation, we'll need additional FEA capabilities."

As design engineers and FEA software developers work together to solve such analysis challenges, composites will certainly be part of new, more environmentally friendly aircraft coming soon to a runway near you. ■

Tim Webb *is the director of marketing communications and programs at Dassault Systèmes' SIMULIA, based in Providence, RI. To comment on this article, send e-mail to DE-Editors@deskeng.com.*

FOR MORE INFO:

> Airbus
> EADS
> SIMULIA

Duplicating Lightning via Vector Fields, Opera

> Groundbreaking aircraft lightning-strike simulation project by Cobham Technical Services heralds easy protection design for modern composite structures.

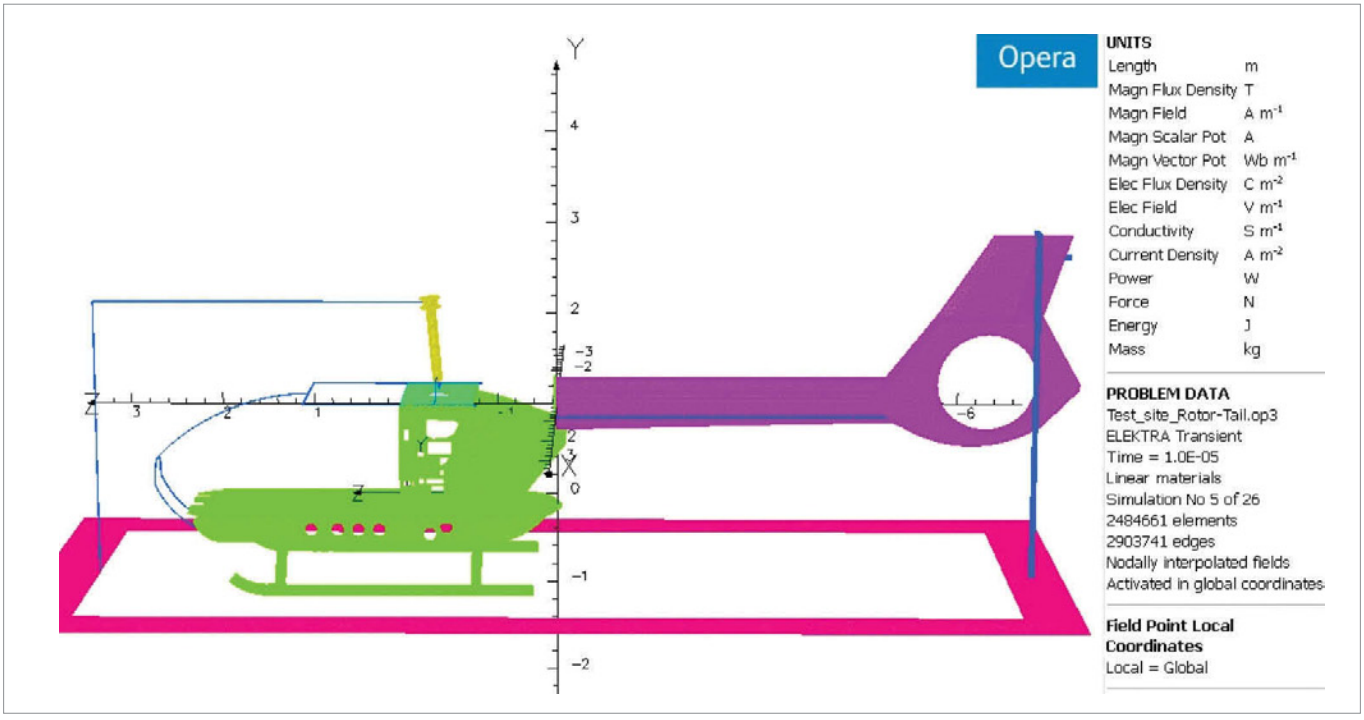
BY LOIS LEE

This physical test rig was used to conduct lightning-strike tests of a helicopter at Eurocopter's Donauwörth facility in Munich, Germany. The tests verified the accuracy of Opera FEA models.

Commercial passenger aircraft are struck by lightning an average of once a year and powerful strikes can result in costly delays for inspection and repair. While the industry's current certification against lightning—based on threat levels derived from measurements of cloud-to-ground strikes—has served well for traditional airframes with good metallic conduction, modern aircraft built of composite materials are more susceptible to direct damage.

Industry's use of increasing amounts of lightweight composite materials in airframes has redirected simulations aimed at discovering the effect lightning has on composites, which are more vulnerable to physical disruption at lightning entry and exit points, and potentially to indirect energy coupling effects in electrical systems as current flows through the aircraft. As a result, it has become increasingly important to understand the exact nature of the threat and develop software to reduce costly testing procedures.

"Airframe structures making extensive use of composite materials have less natural protection against lightning," says John Hardwick of Cobham Technical Services (Lightning Testing & Consultancy). "As lightning protection measures such as conductive coatings or strips add weight, it's important to optimize the design, and simulation



The Opera user interface from Cobham Technical Services was used to predict the effect of lightning strikes on composite materials used in modern airframes.

provides an effective means of achieving this."

To accrue data on actual in-flight strikes, and help solve the issue of modeling current flow patterns within complete assembled airframes with validated software, the Netherlands' National Aerospace Laboratory coordinated the In-flight Lightning Strike Damage Assessment System (ILDAS) project. As a first step, the plan was to develop an in-flight embedded system for measuring actual lightning strikes. This would help to better understand the threat, aid the design of lightning protection measures, and streamline post-strike inspections and maintenance by capturing and communicating actual data on occurrences, intensity, and strike points.

The Netherlands' aerospace lab assembled a team of partners, including Airbus, Air France Industries, EADS Innovation Works, Cobham Technical Services, Eurocopter Deutschland, Groupe Socius, LA Composite, Lufthansa Technik, ONERA, and Technische Universiteit Eindhoven to study and solve the problem.

A 3D model used to simulate the effects of the lightning strike was derived from CATIA CAD files of a helicopter assembly provided by Eurocopter. The key issue was to "de-feature" this information, to remove irrelevant data to reduce simulation time, while maintaining accurate models of the electrical impedance of the structure. If the complete CAD data was used, such as the myriad details of fastenings like holes, bolts, rivets, etc., the simulation could literally take years. This detail would add a huge amount of simulation time with negligible benefit to understanding the lightning effects, so it was simplified by filling holes and removing fastenings.

Opera Helps predict current flow

Opera software was used to predict lightning strike current-flow patterns on structures with carbon-fiber composite materials. This knowledge helped ILDAS partners select the best locations for sensors, and then to compare current-flow predictions against actual measurements. To achieve this goal, Cobham Technical Services generated an electromagnetic design model of a specific airframe configuration for an EC135 helicopter using the CAD files from Eurocopter. This part of the exercise mainly involved simplifying non-critical parts of the original design data as stated earlier while maintaining good representations of critical elements. The elements Cobham focused on included metal space frames and surface panels, carbon composite panels, electrical bonding, and cable harnesses such as those for client-specific equipment.

Measurements have shown that the current flowing in a lightning strike has a typical signature. There is a high frequency, low current pre-attachment sequence, followed by the main current pulse, which may last for 200 milliseconds; a sequence of high current bursts with rise and decay times of tens of microseconds occurs during and after the main current pulse. The most severe electromagnetic interference effects occur during the high current bursts, and these were therefore simulated.

The modeling work took around two weeks, but this depended on experience gained from detailed modeling and analysis of typical composite structures, together with comparison with measurements and simulations performed by other partners in the project. Once the model was ready, the simulation itself took a little over a day to run on an office PC. With this supporting work in place, subsequent models of variations on the basic helicopter airframe would be easier and faster to create, providing a simple means of evaluating aircraft construction programs.

Finite element modeling

The Cobham lightning-strike simulation uses a finite element solver and direct time integration. This also provides some significant benefits in terms of both simulation speed and modeling accuracy. Finite element modeling is better at representing the curved surfaces of the helicopter compared with other approaches such as finite difference time domain (FDTD) software (which is used by some aerospace companies). Using the rectangular cells of an FDTD solver can result in models with billions of cells, requiring both high-performance multi-processor computers and very lengthy simulation times (up to weeks) to perform the matrix multiplication required. The finite element solver used in this application—Opera—will simulate a problem of this size on a single-processor PC in about a day.

Physical lightning-strike tests of a helicopter were then completed at Eurocopter's Donauwörth facility in Munich, Germany, and they verified the accuracy of finite element analysis techniques for characterizing the electromagnetic behavior of complete and custom-cabled modern aircraft structures using advanced composite materials.

These real-life tests at Eurocopter's facility have shown that the theoretical predictions of energy diffusion effects agreed very well with simulation predictions.

"These real-life tests of ILDAS's embedded monitoring system concept illustrate how airframe-specific lightning protection can now be accurately evaluated and optimized during the design cycle," says John Simkin of Cobham Technical Services (Vector Fields Software). "Finite element techniques make it easy to model complex airframe surfaces and important electrical details. The functionality of the Opera geometric modeler made it simple to accept CAD files and reduce the complexity of non-critical elements to ensure rapid simulation." ■

Lois Lee *manages the U.S. office of Cobham Technical Services (Vector Fields Software). Send comments about this article to DE-Editors@deskeng.com.*

Editor's note: *At the time the project started, Culham Lightning and Vector Fields were separate companies. Since then, they have become part of the avionics and surveillance division of Cobham Technical Services. For the purpose of this article, they are referred to as Cobham Technical Services (Lightning Testing & Consultancy) and Cobham Technical Services (Vector Fields Software).*

FOR MORE INFO:

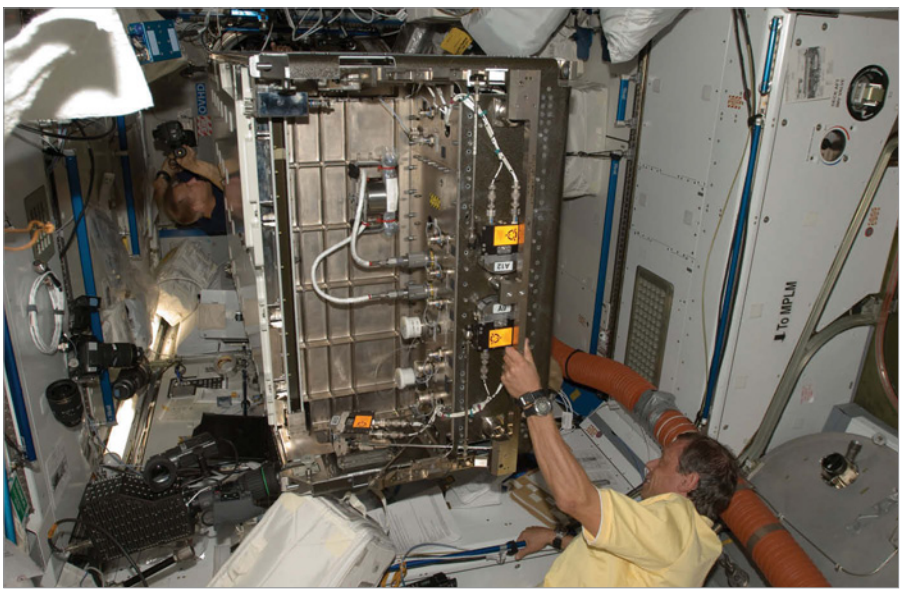
> Cobham Technical Services

> ILDAS

Studying Material Properties in Space

> NASA fuels the future with studies of how single-crystal castings solidify in space.

BY SUSAN SMITH



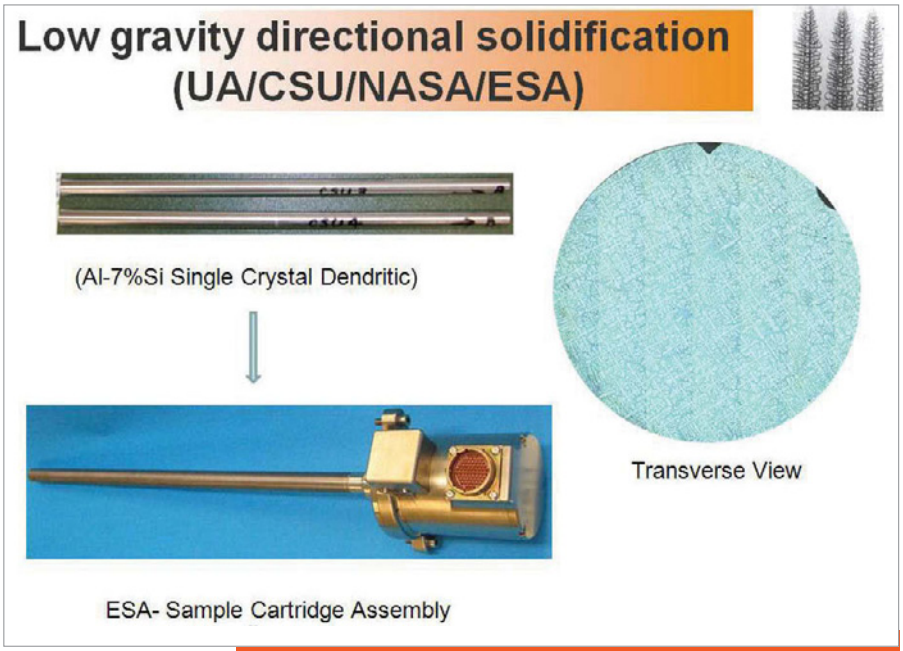
European Space Agency Astronaut Christer Fuglesang (left background) and NASA Astronaut Tim Kopra, both STS-128 mission specialists, install a Materials Science Research Rack-1 (MSRR-1) in the Destiny laboratory of the International Space Station.

On August 25, 2009, NASA took six materials experiments into space aboard the space shuttle Discovery in its first Materials Science Research Rack (MSRR-1). These experiments were conducted onboard the shuttle by astronauts and integrated into the U.S. Laboratory Module Destiny, the primary research laboratory of U.S. payloads, on the International Space Station.

The MSRR-1, developed by the Marshall Space Flight Center, in Huntsville, AL, is part of a collaborative research program with the European Space Agency (ESA). The MSRR-1 carries the ESA-Materials Science Laboratory Low Gradient Furnace (MSL-LGF) to be used for future low-gravity materials-science experiments by astronauts. Two of the experiments are U.S. projects and four are European.

The two U.S. experiments focus on the ways single-crystal castings solidify on earth vs. in space. As critical components in high-temperature gas turbine engines used in high-speed aircraft and land-based power turbines, single-crystal castings are subject to convection, the transfer of heat by movement. Because of this, they frequently end up with defects (misaligned grains and macro segregation) and can't be used for applications such as airplane engine blades.

Space has less convection, so researchers are interested in finding out if and how single-crystal cast-



The Opera user interface from Cobham Technical Services was used to predict the effect of lightning strikes on composite materials used in modern airframes.

ings solidify differently in space. The theory is that single-crystal castings solidify in space free of convection-related defects. If this is true, it would have widespread ramifications for industry.

What Constitutes the MSRR-1

The MSRR-1 is comprised of a thermos called a Materials Science Laboratory in a refrigerator-sized body developed by the ESA. Within the Materials Science Laboratory is the MSL-LGF that was transferred from the shuttle onto the Space Station.

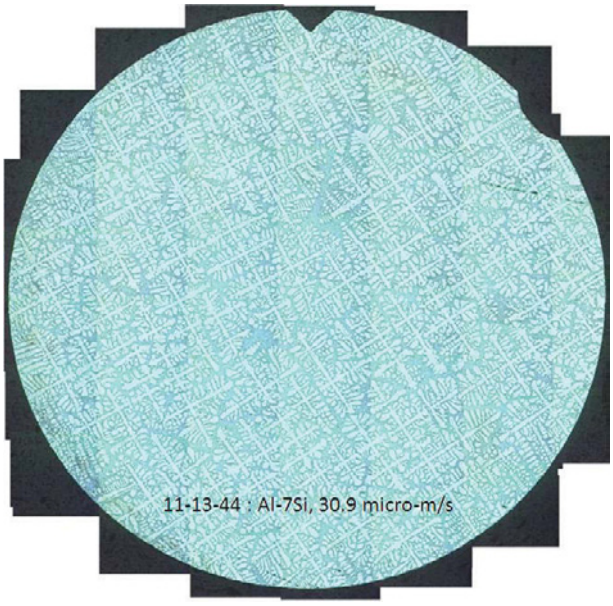
"There are currently 13 experiments planned, these are all materials-science experiments," said Surrendra Tewari from Cleveland State University, head of a team responsible for the U.S. experiments. Of those 13, six are part of this current flight.

Tewari said each sample is approximately 9 millimeters in diameter and about 10 inches long, cylinders of a 7 percent silicon aluminum alloy. The cylinder is kept in an alumina crucible, which in turn is encapsulated in a tantalum closed-end cylinder (as protection) from which electrical wires and thermocouples, etc., protrude. Each assembled piece is called a Specimen Cartridge Assembly (SCA).

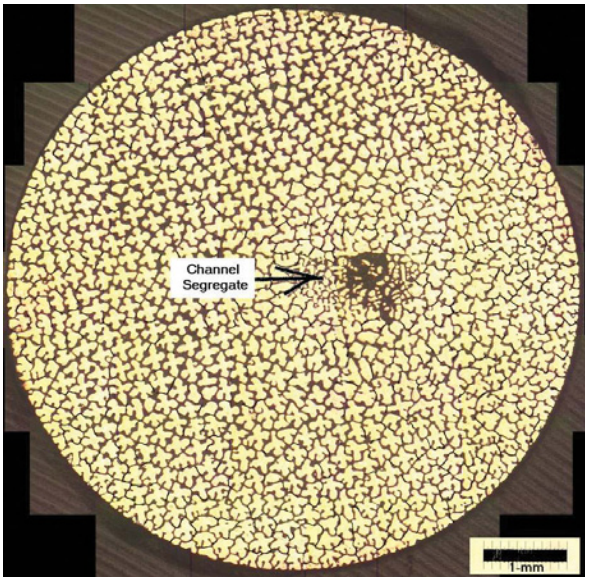
For each one of these 13 experiments, there is one cartridge assembly per sample. "The astronaut will open this thermos door, which looks like a pressure cooker which is sitting horizontal, and insert this one cartridge into the cylindrical furnace," says Tewari. "Then they'll have a laptop, which will already have a preprogrammed temperature profile loaded into it. They'll turn it on and the furnace will begin to process the samples. This will happen with each one of these samples."

Low-Gravity Directional Solidification

Tewari described the process thus: To cast a turbine blade for an airplane engine or a power turbine, you usually create a ceramic mold of the blade into which is poured molten metal that is going to solidify at many locations. Each part that solidifies independently is a grain or crystal. In the usual casting process, many such grains or crystals are formed. If, however, you allow only one grain of solid to form at one end of the cavity and enable this one grain to grow, the solid that



Single-crystal Al-7% Si alloy dendrite array (directionally solidified cylinder 9mm diameter and 29cm long).



A typical defect "freckle" due to convection (transverse section through a directionally solidified alloy cylinder: The crosses below are cut-section through dendrite trees).

results will be a single grain or a single crystal. This is achieved by "directional solidification," or freezing in one particular direction.

There is a liquid at the top, solid at the bottom, and a mushy zone in between where solid and liquid exist together. As you pull the mold away from the hot zone of the furnace toward its cold zone, the mushy zone is continually forming and solidifying, finally yielding to the directionally solidified casting.

The mush consists of long slender tree-like branched fingers of solid called dendrites. In between the dendrites is the melted liquid. When there is fluid flow (convection) in the melt, then these dendrites break, change directions, form new grains, and these in turn show up as defects in the final casting. How the dendrites are arranged is critical, says Tewari. When making turbine-blade castings on earth there is always convection because of gravity. As soon as one end of the fluid becomes hot and the other is cold, the fluid begins to flow.

Computational fluid dynamics (CFD) professionals have tried to model that. Yet the spacing between the dendrites is of the order of 100-150 micrometers, whereas the sample size in this case is 9 mm, and the actual turbine blade is several inches in diameter. So the fluid flow is occurring over a scale that is millimeter to centimeters, but the solid that is forming is at a scale of several micrometers. Therefore, at this stage the fluid dynamics models are not capable of being able to predict what is happening in the solid at the micro scale. Defects are formed like disorder in the dendrites, nucleation of new grains that are totally misaligned in a different direction altogether.

"What we're trying to do is to see if these defects can be completely eliminated when we don't have

MSRR-1 in launch configuration. The right side of the rack contains the MSL Engineering Model. The left side contains the MSRR-1 Rack Support Subsystems (lower portion) and the stowage container (upper portion). The left side has the accommodations/interfaces to support an additional furnace module if required.

fluid flow present in space," says Tewari, "because in space there is no gravity or very little gravity, therefore we'll expect there will be no flow, hence some of these defects that we observe will not be observed in space. So that's one purpose. The second purpose is to quantitatively compare predictions from the current theoretical models with the experimentally observed size and distribution of these dendrites. The experimental data we're generating on Earth always has convection associated with it, but the theoretical models that we are using to compare the data with have got only diffusion and no convection...."

To Outer Space and Back

ALCOA partnered with Cleveland State University to provide the aluminum silicon alloy bars. These were re-directionally solidified and converted into directionally solidified single-crystal dendritic seed bars at Cleveland State. Then the bars were sent to ESA in France where they were machined and assembled into SCAs. The rods were expected to return to Kennedy Space Center via the return of the STS flight 20A in February 2010.

When the samples return, scientists will cut them up and look at the microstructure as it changes along their length. The next sample will return about eight or nine months after the first one. ■

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

FOR MORE INFO:

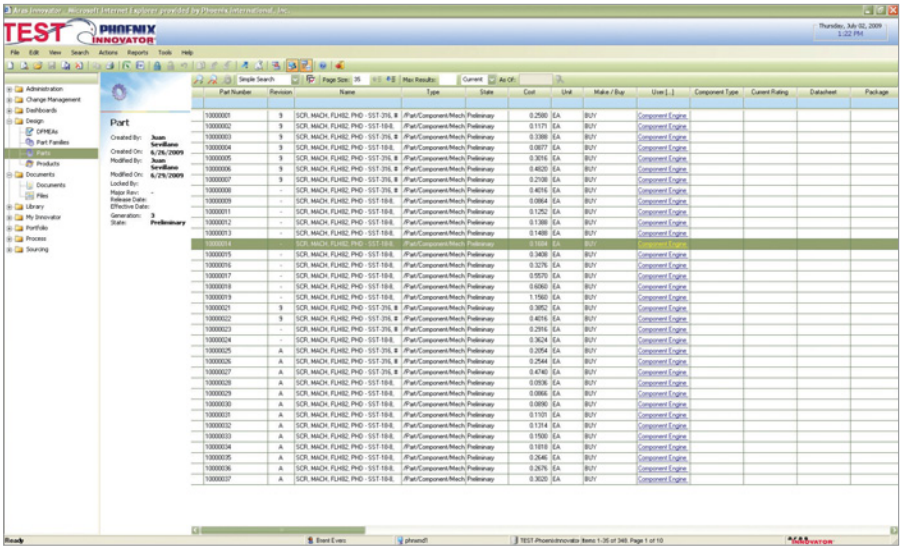
> ALCOA
> Cleveland State University
> European Space Agency (ESA)
> Kennedy Space Center
> Marshall Space Flight Center
> NASA-Johnson Space Center
> NASA

Aras Innovator: PLM on a Shoestring

> Part 3: The realities of going live and going forward with a DIY implementation.

BY BRENT EVERS

This is the final in a series of three articles on Phoenix International's internal implementation of Aras Innovator. This segment discusses some of the realities of installation and configuration of the database, uploading of all Phoenix parts, and how its engineers are becoming day-to-day users of the system.



The process of implementing a PLM system forced Phoenix to take a close look at its business processes. To evaluate its new PLM system, it used multiple test databases for development and implementation, preventing errors and contamination of our real data.

Engineering generates a lot of data. Getting it all to the point where it can be managed well is no simple matter. Phoenix reviewed and generated parametric data for approximately 8,000 parts and 7,200 documents in preparation for uploading to Innovator. The process was time consuming and tedious, but for the first time, we have a handle on where everything is, how it is used, who modifies it, and when it is revised.

Perhaps even more important, the process of implementing a PLM system forced us to take a close look at how that system operated out of the box in comparison to our own business processes. This led to significant revisions of our processes, some in support of Innovator, and others just because we learned a better way to do things. At times, the debate has been vigorous—and it has been rewarding to see engineers take ownership of the process to make sure that we emerge a stronger, more capable engineering team.

Implementation Results and Gains

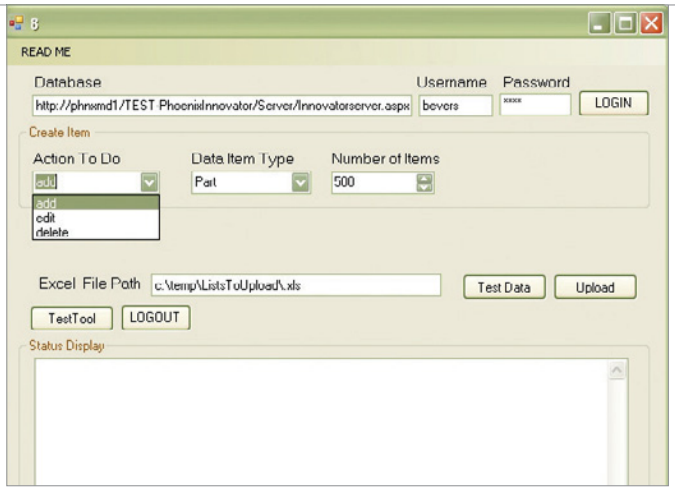
To evaluate the benefits Phoenix gained from the effort, we needed to review our initial goals and requirements. One of those goals was to

secure a single process for development and documentation of all engineering projects. Innovator provides a framework that ensures every engineering project uses the same process for development, regardless of the project's size or scope or whether it is for an internal or external customer. The processes are rigorous enough to ensure a quality, cohesive product across multiple projects, but flexible enough to allow for rapid response, demanding customer requirements, and tight budgets.

We also aimed for a single repository (vault) for all project data. All document data (e.g., CAD data, photos, MS Office documents, etc.) is vaulted in Innovator. This is augmented through the use of deeply integrated CAD connectors. At Phoenix we developed our own ECAD connection, but will most likely purchase an MCAD connection. The only exception to this single repository is that OrCAD uses an additional repository for datasheets that are called up within the tool. In the future, we hope to have OrCAD draw these from the Innovator vault as well.

We had to have the ability to establish and revise a product structure. Innovator is built on an SQL database that provides a rich set of relationships between items. Product structures are built on the relationships of parts and assemblies. Aras Innovator greatly extends the concept of relationships to all supporting documents, including 3D CAD models, schematics, PCB layouts, CAM/MFG files, software, mechanical drawings, assembly instructions, test plans, photos, requirements documents, etc.

Phoenix wanted the ability to control all documentation. Innovator provides revision control for all data in and out of the system, and in and out of the document vault through the engineering change process.



Aras Innovator offers a single source of data for all associated part information. This is augmented via CAD connectors.

A formal document (drawing) change process was also a must. Innovator's control of documents is via a customizable change process that tracks revision of all documents, parts, assemblies—everything, actually.

In addition, we had to have the ability to pack and go with all project data. This enables vehicle operators to pull everything they need prior to a job and take it to an offshore environment where a connection to Phoenix's network is likely to be nonexistent. Phoenix has not yet completed this, but our initial investigation indicates that this capability is possible.

Cost Outlay

The out-of-pocket costs to implement Aras were zero. This assumes of course that you have the hardware and software infrastructure in place to run the database application. The system runs on MS SQL Server, but can also run on SQL Server

Express, which provides a quick-and-dirty method to get the system up and running with minimal outlay for testing and evaluation.

The bulk of the cost, like any PLM system, will come in implementation, and the extent of that will largely depend on how well the company has organized its data to date and the need to tailor Innovator's baseline processes. In Phoenix's case, this meant a lot of data cleanup and research. By adding a rich set of parameters to all part data, we will significantly improve our part selection and commonality in the future.

Customizing Innovator was also a significant effort, but that was largely driven by our goal of developing a rich data set, not just a repository. It helped that we have talented software engineers on our staff, but that is not a requirement. We kept a couple of engineers busy part-time for a few months getting Aras Innovator up and running. It became clear that the sooner an engineering group embarks on this process, the less it will cost. Much of our implementation was in 'repair' work—cleaning up and taking down old data that had never been properly stored.

Going Forward with the System

Embarking on an enterprise-wide PLM implementation is a significant commitment of effort and resources. Making that commitment to a free or open-source solution only adds to the skepticism

of many managers and IT departments. Aside from the obvious benefits of no out-of-pocket upfront costs and no licensing or user costs, we have noted real benefits in implementing Aras Innovator.

Aras Innovator is freely available and the solutions are governed by the OSI approved Ms-PL license. The source code to the core application is not available to non-paying customers, but was not needed in our implementation. There is some debate that this model does not meet the definition of open source. The bottom line for Phoenix was that we didn't need to pay a dime out of pocket to capitalize on the availability of a ready-for-prime-time, ready-to-go PLM system.

Innovator is also a real out-of-the-box solution. The documentation is sufficient, the platform is stable and community support is growing.

Nearly all of our work was in preparing data and modifying the base solution to suit our needs, CAD tools, and processes. An organization that starts out using Innovator from day one, and adopts the default processes, would not face these issues. The sooner the Innovator solution is adopted, the less the impact on the organization.

It can also be implemented completely independent of Aras assistance. In fact, for small to mid-sized organizations, this might be the preferred method. We learned a lot and implemented the system we needed. If we had paid for upfront support costs, we might have saved some internal costs and might have implemented Innovator faster.

In our case, in-house implementation proved to be the right vehicle because it forced us to determine—as we went along—exactly what we needed in a PLM system. But now that we know our needs, and as our use of Innovator becomes more sophisticated, we will review Aras' support services to see how they might fit our future growth of the system.

Aras Innovator is a big system and we are not using all its capabilities. Right now we have the basics up and running—all of our design data and documents captured, product structures in place, documents under control, and a change process working—but we intend to continue to expand our use of Innovator's project management capabilities, integrate it with our Microsoft Dynamics accounting system, investigate the use of variants, and expand its utility to other corporate users beyond engineering (e.g., purchasing and production).

Phoenix exceeded several long overdue goals by implementing Aras Innovator while learning a lot about our organization in the process. Implementing a homebrew PLM system with Aras Innovator isn't wholly free, but it's about as close as you can get. The rewards of implementing this robust, stable, and well-supported system are immediately tangible and we expect our PLM system to reveal even more benefits in the future. ■

Brent Evers *is the engineering manager at Phoenix International Holdings, Inc. Send comments about this article to DE-Editors@deskeng.com.*

FOR MORE INFO:

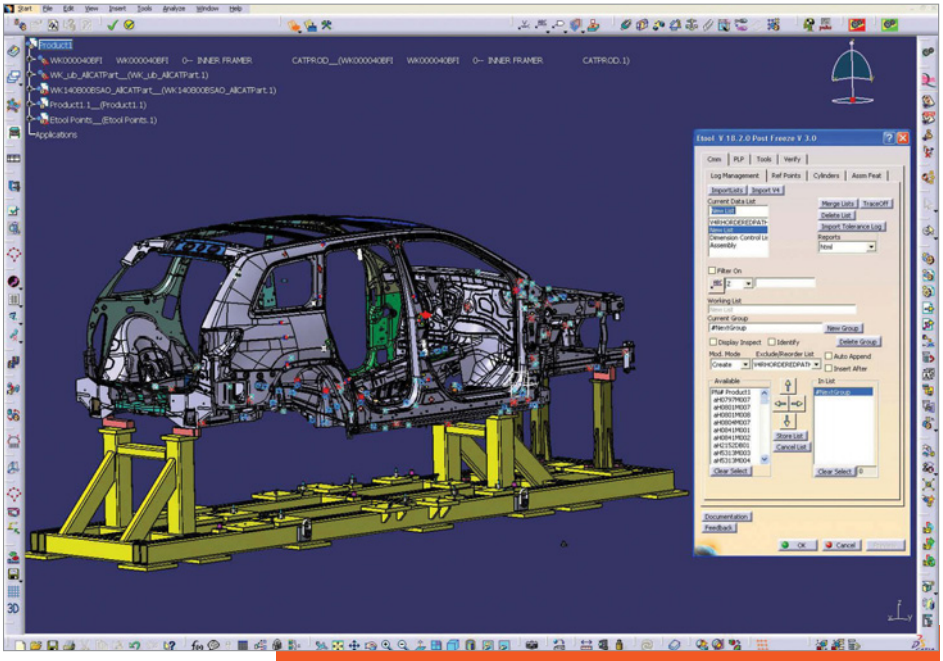
> Aras Corp.

> Phoenix International Holdings

PC-DMIS Planner Links Chrysler's Design to Manufacturing

> Hexagon and Chrysler Corporation developed an automatic inspection-plan tool to ensure that the correct information sticks with the CAD model.

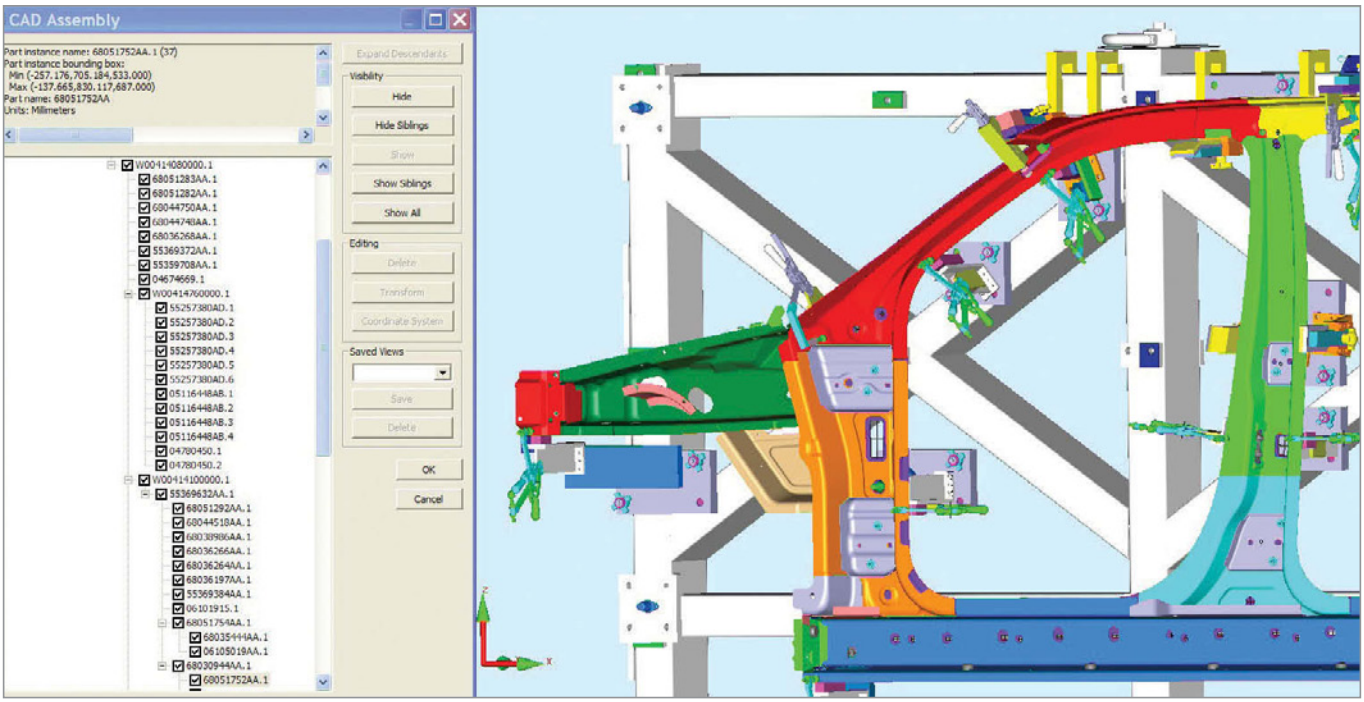
BY JOE FINK



For the past two years, the Sheet Metal Team at Chrysler's Advanced Metrology Group has been developing unique tools for automatically capturing and storing inspection data within CATIA V5 models. These tools allow users to generate and use inspection plans that make it possible to generate PC-DMIS inspection programs automatically. The inspection plans are linked directly to the latest version of the CAD models.

Another tool, the Change Manager (developed by Hexagon Metrology's Wilcox Associates), automatically detects changes made to inspection plans, so that the programmers can quickly reconcile any differences between the inspection programs and the master CAD model.

As part of their upgrade to CATIA V5, Chrysler developed a software module called eTool. It allows designers to incorporate plans for verifying their part into CAD models. PC-DMIS CMM software then uses these plans to generate optimized inspection programs. This integrated approach ensures that the links between the inspection criteria and resultant measurement programs and the CAD file are never broken.



Once PC-DMIS converts an eTool Plan into a measurement program, it provides a computer-simulated CMM where Chrysler programmers can quickly fine-tune their programs to accommodate fixturing and other physical components that may not be present in the CAD model.

Wilcox Associates has now made a version of these tools available to any manufacturer, regardless of which CAD systems they use.

A Recurring Problem

Part designers must convey to programmers the dimensions and tolerances they should evaluate to create their inspection routines. There are many ways to do this, but each shares the same flaw. In many cases designers print out 2D blueprints of the part model and mark up the critical dimensions, or they might jot down some notes in a text document, or pass on the information via phone calls. In each case, the link between manufacturing and the original design data is broken, and there is no assurance that the parameters used to inspect the parts are current.

Chrysler knew that there had to be a better way. So, as part of its upgrade to Dassault Systèmes CATIA V5, it developed a module inside a software package called "eTool" that allows designers to embed their inspection plans in the CATIA file. This ensures that the link between design data and its inspection requirements is never broken. The plans include datum definitions, feature measurement information, and dimensional evaluation information.

Chrysler's next objective was to find a software tool that could use its inspection plans to automatically create inspection programs for a range of CMMs used at several of its facilities. This would save a substantial amount of time and money. Hexagon's software arm, Wilcox Associates, was already at work on this very problem. They were

developing a new, stand-alone product, PC-DMIS Planner, which would let designers embed inspection plans inside their CAD data. Not only that, but they were developing tools inside PC-DMIS to convert these plans into part programs.

Missing Pieces

Work began to meld Chrysler's eTool inspection plan technology with the new PC-DMIS-based capabilities about two years ago. The tools inside PC-DMIS were a natural fit for converting eTool plans into part programs. They included a plan importer, a path optimization module, an auto clearance move insertion tool, and a change manager, which keeps the plan and the part program in sync.

The plan importer takes a PC-DMIS Planner inspection plan (.ip) file and converts it into a part program. The task required the team to first identify differences in file formats and command structures. Then they developed software to convert from one format to the other. The end result enabled Chrysler to use eTool plans to create PC-DMIS part programs that are 98 percent complete. In most cases, the only tasks remaining to do before sending programs to the end users are for the part programmers to personalize and verify them.

The other significant contribution Wilcox engineers made to the project was the change manager. It automatically compares changes made to the inspection

plans with the part programs at the plant level so that the programmers can quickly reconcile any differences between the programs and the master CAD model. The part program always maintains a link to the inspection plan.

This module recognizes changes made on the plan by designers. It notifies the part programmer of any modifications, shows what the changes are, and then allows the part programmer to decide whether to accept each change.

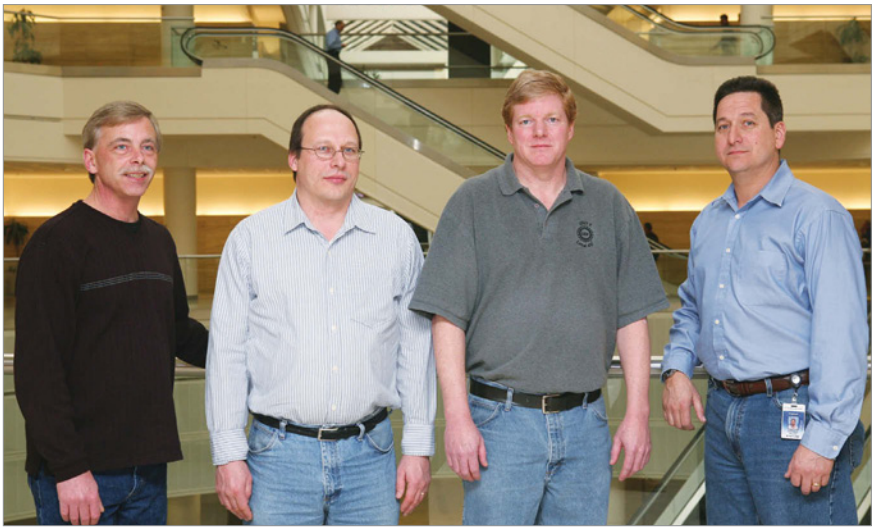
New Approach Benefits

In the past, Chrysler's Sheet-Metal Team spent countless hours comparing the CMM programs used at the plant to the ones used by the Advanced Metrology Group and reconciling the differences. Now, using the most current CATIA model as a reference, team members use Change Manager to review differences between inspection programs and reconcile them quickly by clicking an accept- or a reject-button. Sheet-Metal Team Leader Howard Casey estimates that this procedure reduces labor by as much as 70 percent.

The four members of Chrysler's Sheet-Metal Team are currently working on CMM programs for evaluating new Chrysler truck and passenger car designs including model launches scheduled for 2010 and 2011. This year, Casey believes his team is already 40 percent more productive than it has been in previous years because of the new software tools. As the team becomes more proficient, the goal is to increase productivity by 60 percent.

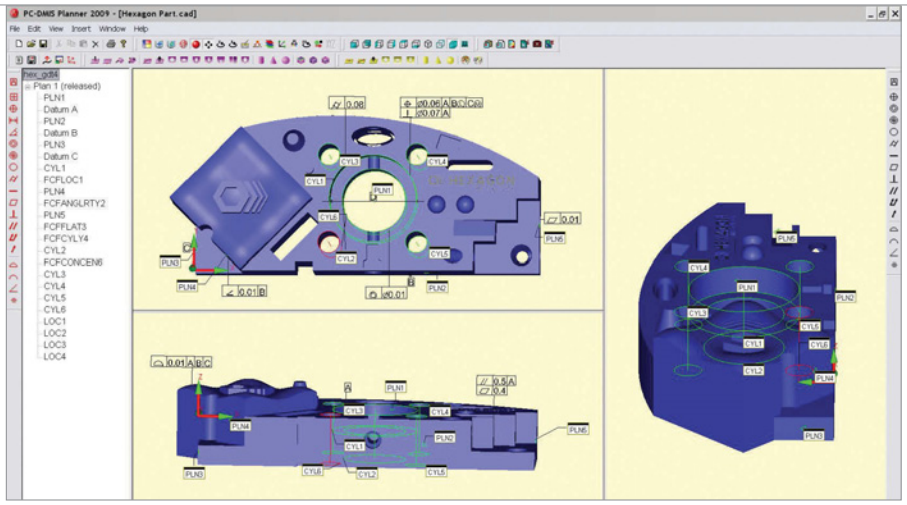
According to team members, there are a number of reasons why this new approach is so effective.

"Everybody gets the same information," says Casey. "It is all standardized in accordance with our corporate feature definitions. It's really important to give anyone who is touching Chrysler parts throughout the world exactly the same information all of the time. That information is stored in the CATIA model. Anytime somebody pulls a model, no matter where they are, no matter if they are third tier or second tier supplier, they get exactly the same information as anyone else."



The Sheet Metal Team for Chrysler's Advanced Metrology Group (from left): Dave Roudebush, Norbert Sprunk, Howard Casey (team leader), and Donald Miller.

"Consistency is a huge deal," says team member Donald Miller. "One of the best things about eTool is that all of our dimensional engineers are now naming hundreds of features consistently according to corporate standards. Measurement parameters are then applied automatically according to the feature definitions we helped to develop. This removes all sorts of



PC-DMIS Planner Software developed by Wilcox Associates is commercial software similar to Chrysler's eTool. It enables users to automatically generate inspection programs using models from most CAD systems.

guess work from the task of creating part validation programs and makes the entire process much more efficient."

According to team member David Roudebush, eTool and Change Manager are the main reason the team's overall productivity is up 30 to 50 percent. "That's because there are fewer steps and there are so many checks and balances to ensure that no inappropriate changes have been made to the inspection procedures and data during six stages of product development," he says.

Team member Norbert Sprunk noted the importance of being failure free. "We have a pretty heavy workload so we are continually bouncing tasks from one team member to another to keep on schedule," he says. "This is not a problem because everything is so consistent that it's easy to share work. Even though we are working with a smaller staff, we have not had a single failure, which is defined as not meeting a validation software delivery date for prove-outs at one of our plants. Everything is getting done."

Commercial Product Release

With the latest version of PC-DMIS CMM software, Wilcox is releasing a planning product similar to eTool for manufacturers looking to close the loop between their CAD models and measurement programs. PC-DMIS Planner is a tool for part designers to record their intentions for validation or verification of a part without getting involved in the technology of the inspection process. With it they define datums, specify the features to measure, and establish the dimensional relations among them. Then PC-DMIS uses this plan, along with the associated CAD model, as the basis for automatically generating a measurement program.

PC-DMIS Planner offers a full range of tools for developing and maintaining inspection plans. It also includes a Change Manager for keeping the inspection plans and the CAD model in sync. ■

Joe Zink *is the global product manager for PC-DMIS Planner at Wilcox Associates, a division of Hexagon Metrology. Please send your comments to DE-Editors@deskeng.com.*

FOR MORE INFO:

> Chrysler Corporation
> Dassault Systèmes
> Hexagon Metrology

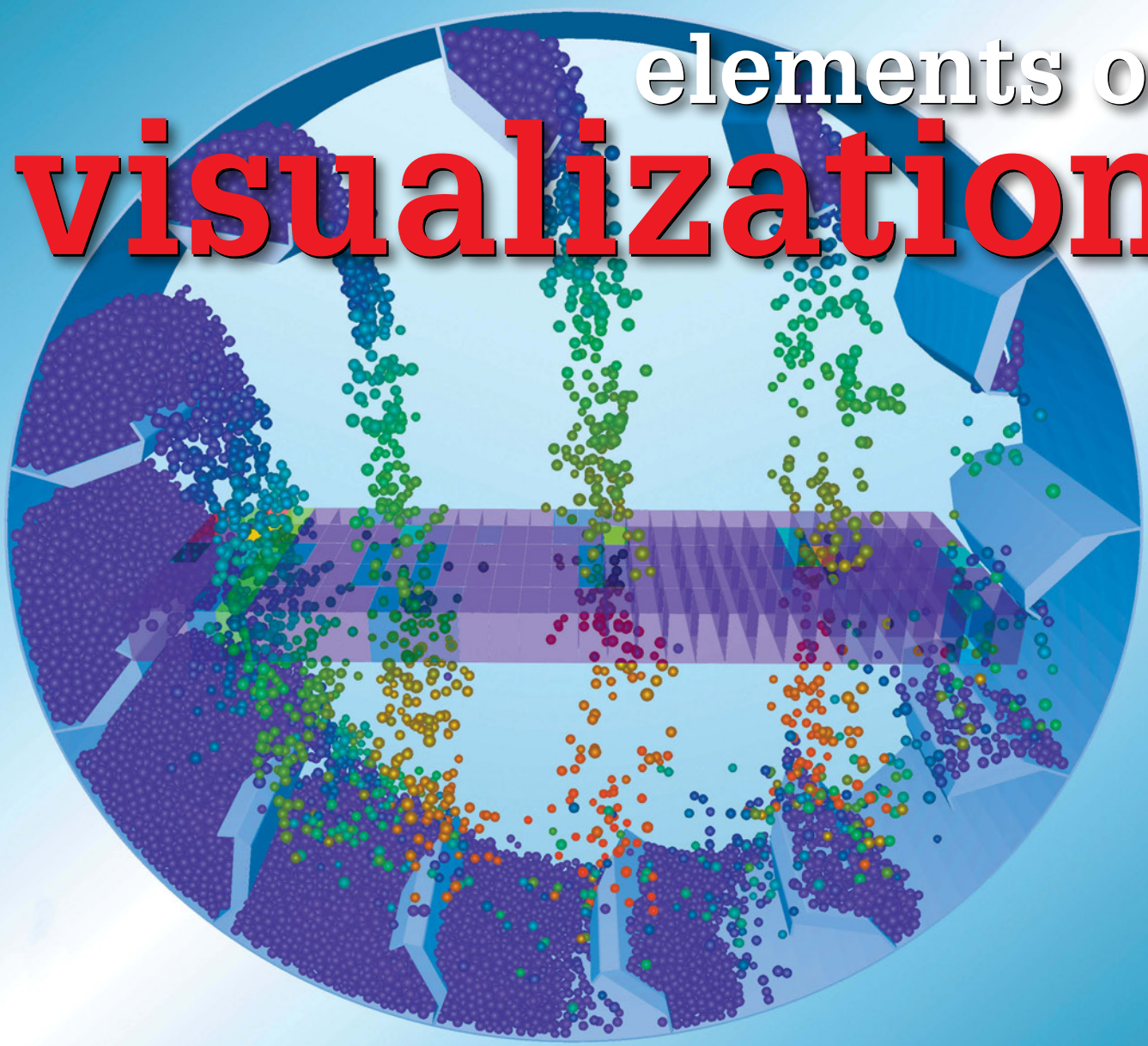
DE MARKETPLACE

APRIL 2010 • VOL. 15, ISSUE 8 • A SPECIAL SUPPLEMENT

DESKENG.COM

KNOWLEDGE TO SUCCEED
NOW AND TOMORROW

elements of visualization



> Scalable CFD for All: STAR-CCM+ v 4.06

> Tecplot Provides a View to MAV Flight

> EDEM Helps Astec Engineer a Better Dryer

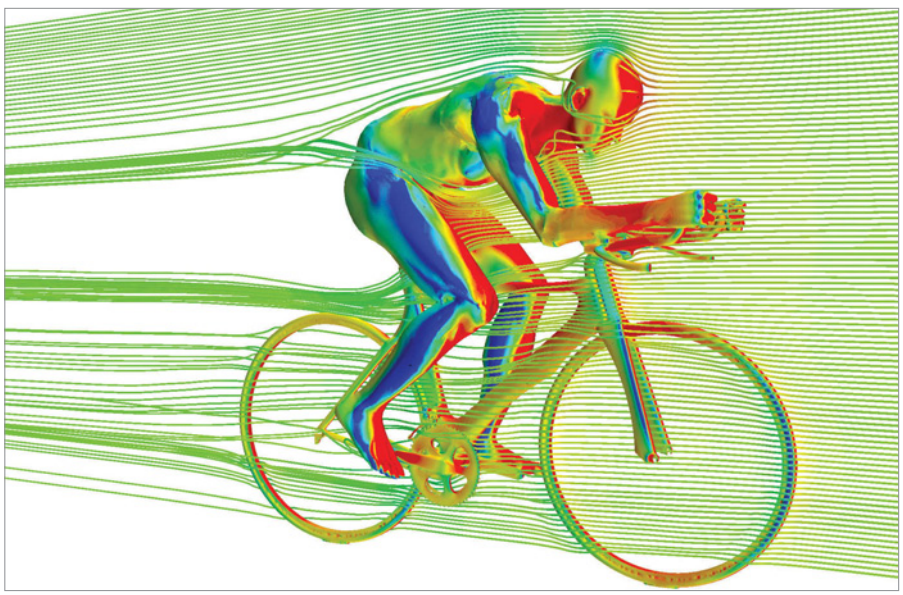
This is a simulation of a gravel dryer drum in action showing the veiling of aggregate using EDEM simulation software from DEM Solutions. *Image courtesy Astec, Inc.*

By Vince Adams

Scalable CFD for All: STAR-CCM+ v 4.06

> CAD-integrated or independent, STAR-CCM+ is suitable for analysis and visualization users at all levels in all industries.

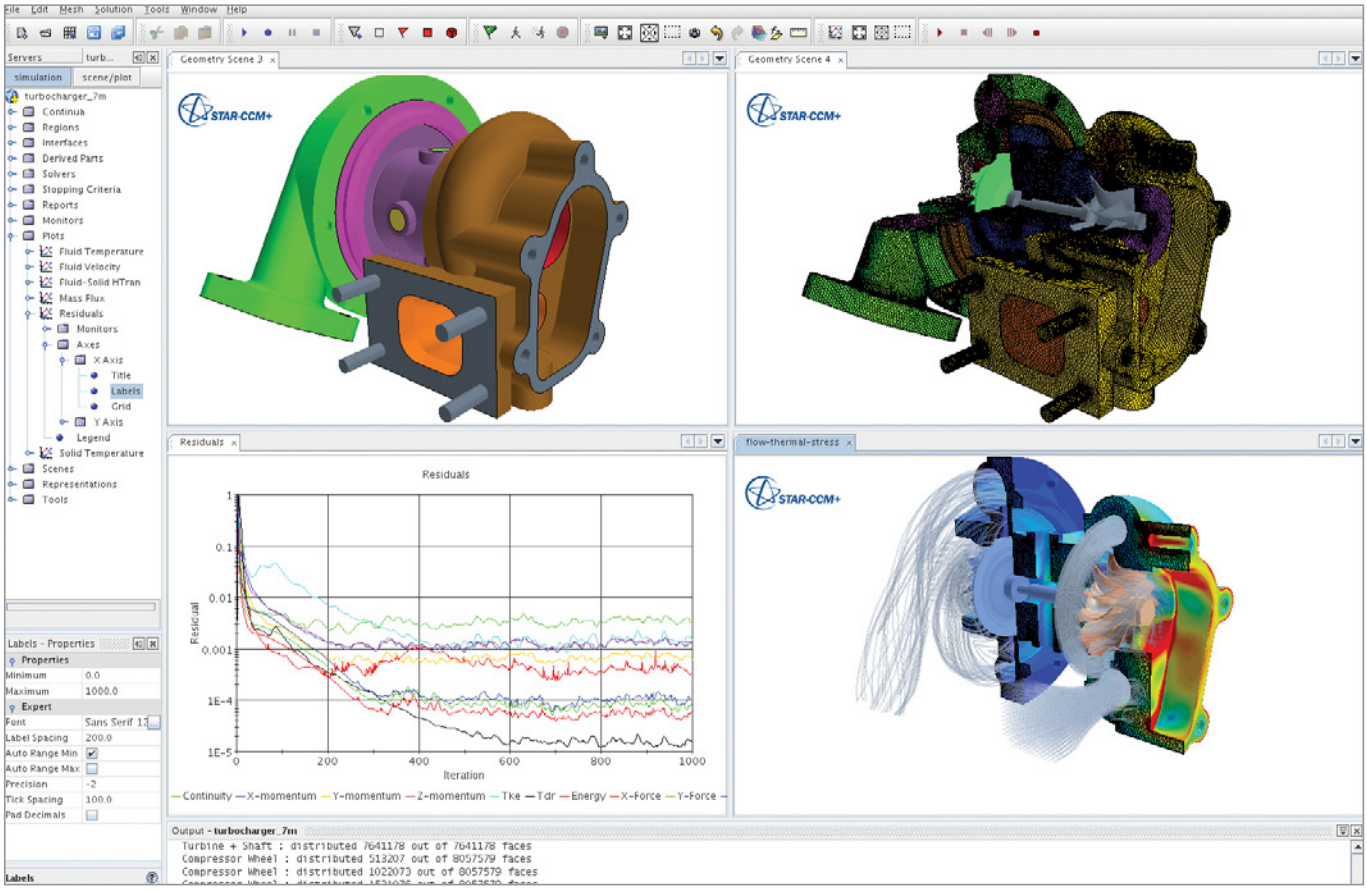
STAR-CCM+, the flagship product from CD-adapco and currently in v4.06, builds on a strong leadership position in advanced computational fluid dynamics (CFD) for both analysis professionals and design engineers who need fast insight without the burden of detailed modeling tasks. Developers have created an associative and embedded CAD interface to Pro/ENGINEER, SolidWorks, CATIA, and NX so engineers can optimize flow-related performance at the earliest conceptual stages of a design. STAR-CCM+ also comes in a CAD-independent product that provides the same geometry-based ease-of-use with import from many native CAD formats, all standard geometry neutral formats, and commonly available finite element mesh (FEM) neutral formats. This, combined with a familiar-feeling, feature-tree based user interface, makes STAR-CCM+ suitable for all sorts of users.



Pressure fringe plots and streamlines simulating a racing bicycle in a wind tunnel. *Image courtesy of Felt Bicycles*

Skeleton Files

A powerful feature of STAR-CCM+ that enables knowledge capture and sharing within an organization is the implementation of Skeleton Files. Skeleton Files are essentially templates that



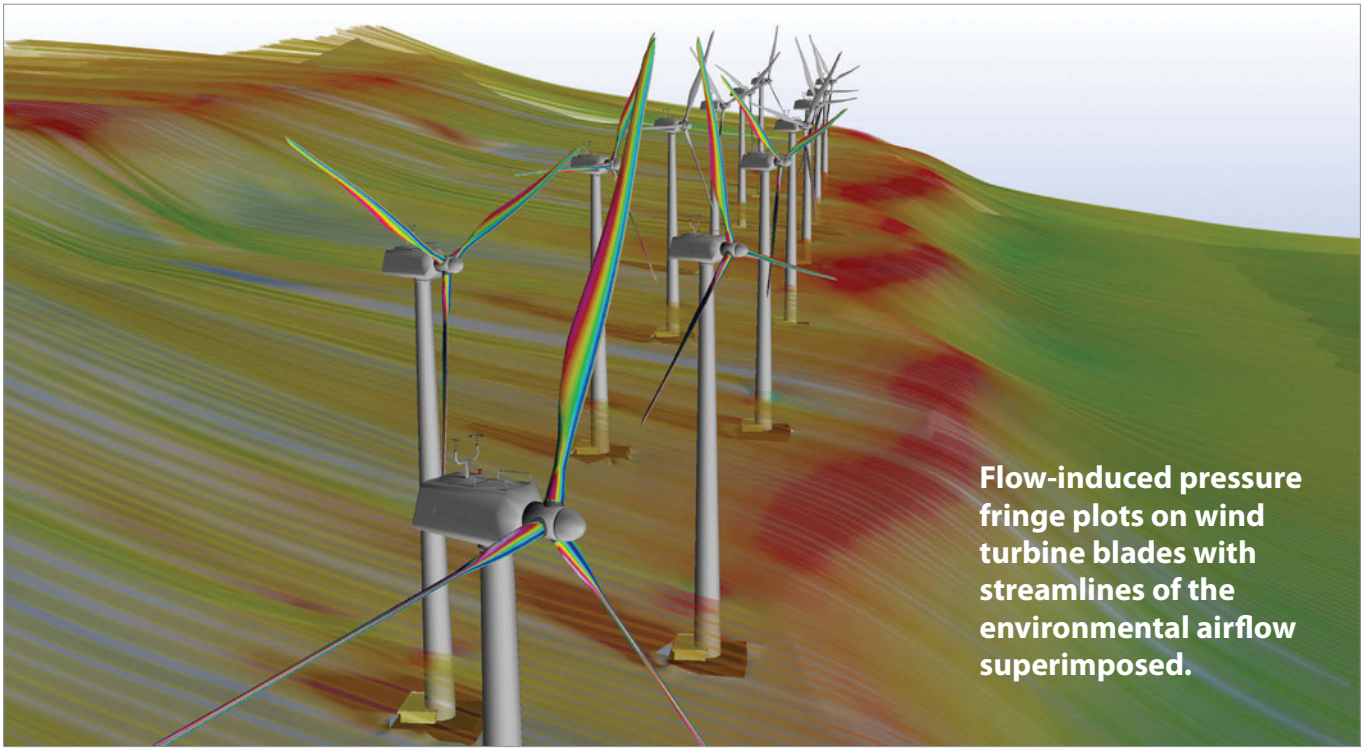
The STAR-CCM+ interface shows tiled graphics windows in addition to the feature tree and properties alongside, and the log below the windows.

contain all the property, boundary condition, and CFD-specific input for a given type of problem. Skeleton Files can be used at all levels as just one of the many automation tools to increase productivity. Skeleton Files can also be created by CFD specialists to capture all the important setup information, results displays, and reports needed to evaluate iterations. All a design engineer needs to do is import geometry and update part names. The rest can be automated.

Geometry & Interchangeability

The STAR-CCM+ workflow is optimized for CFD model development. From within a pre-defined Skeleton File or in a project developed from scratch, users can complete a baseline study with inlets, outlets, and boundary conditions defined. Then a part or group of parts can be swapped and the solution re-run with minimal effort. Three features in STAR-CCM+ greatly facilitate this. The first is that properties or boundaries are associated to part or body names. When a part is replaced and assigned the proper tag, STAR-CCM+ immediately recognizes its proper place in the model setup. This greatly improves efficiency and "time to insight" over traditional CAD-based interfaces requiring body or face selection and re-assignment.

The second feature that is unique to STAR-CCM+

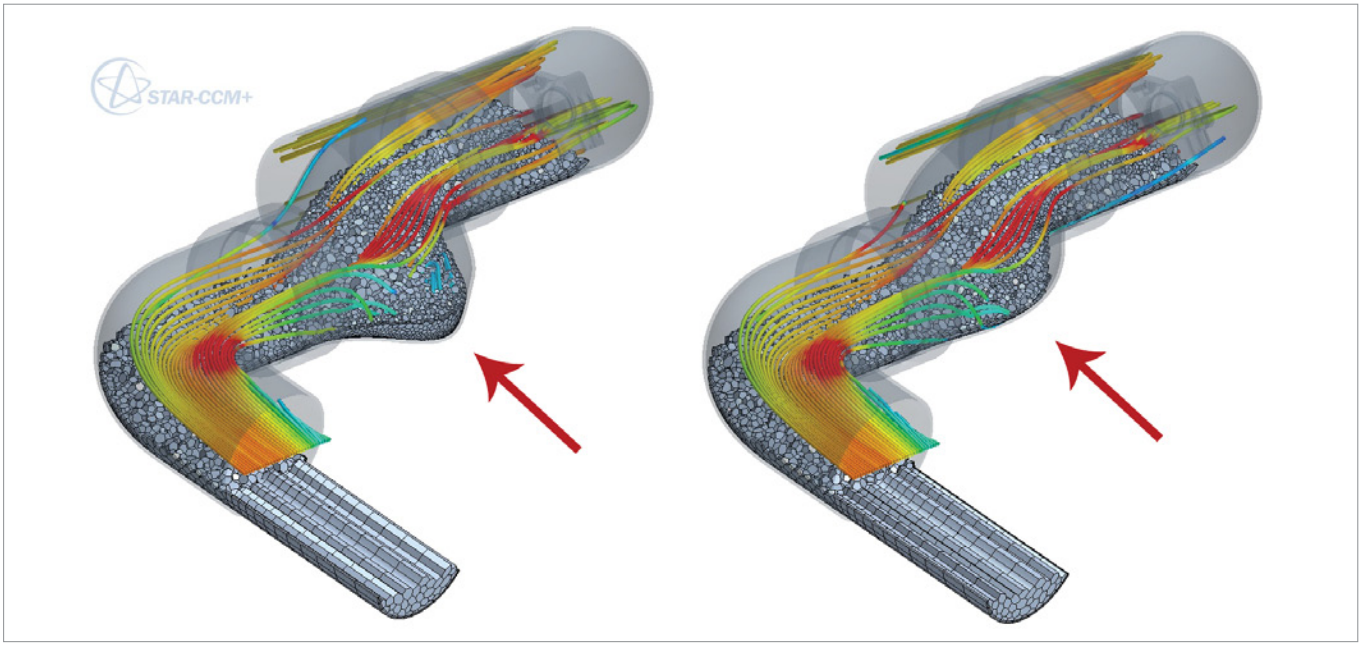


Flow-induced pressure fringe plots on wind turbine blades with streamlines of the environmental airflow superimposed.

is the ability to estimate initial conditions in the replaced part by extrapolating the converged results from the previous solution to the new geometry. CFD relies on iterative calculations converging to a final solution. As with any iterative process, the closer the starting conditions are to the final solution, the faster convergence is achieved. Each design iteration in STAR-CCM+ solves much faster than a solution from scratch.

Meshing

The third feature in STAR-CCM+ that enables fast and intuitive design iterations is called surface wrapping. Surface wrapping creates a clean closed surface from discontinuous CAD geometry. This technology can automatically build a CFD-optimized triangular surface mesh around the most complex assembly, which then serves as the basis for the rest of an automated mesh—often the biggest hurdle to efficiently integrating CFD in the design process. For more traditional analysts, this process still allows for intervention so that meshing parameters and surface closure can be tweaked, but that's the beauty of STAR-CCM+. The program can be used at any level necessary. There are even more important features of STAR-CCM+ that facilitate meshing. One is the use of dynamically sized control volumes for mesh refinement. While local, geometry-based mesh refinement is an option, mesh control within the flow field can be as important as on the surface. A rectangular mesh control volume around a flow system can ensure a good mesh everywhere the results are important. Another important feature in the automatic mesher is the ability to create body-fitted prism cells at the critical boundary-layer transition areas. Unlike tetrahedra in the rest of the flow field, more regular shaped elements in



The complex connector was changed after the initial solution in STAR-CCM+ to improve flow results with no manual re-meshing and minimal effort to re-solve.

the boundary layers will converge more quickly and capture more accurate results.

User Interface

STAR-CCM+ developed an intuitive multiwindow, feature-tree based interface years ago that is now popular among other geometry-focused tools. A feature tree window allows parts, properties, input data, and other modeling entities to be dragged and dropped within a single model or across multiple open models. When any feature in the tree is selected, a Property Window displays all the relevant properties of that feature for easy review and modification. The Graphics or Working Window can support multiple open models with a tabbed structure.

Finally, for the more traditional user, a Log Window echoes keystrokes, inputs, and messages. Many design users will simply turn this off to create more viewing space but power users will welcome the feedback. This log also forms the basis of a powerful record-and-play scripting capability to further automate repetitive tasks.

Postprocessing

STAR-CCM+ provides results feedback to the user after each converged iteration. This important feature lets users catch setup errors or inappropriate model response before the solution completes. Once a valid solution is completes, STAR-CCM+ has a full suite of results-processing tools to ensure an in-depth understanding of system performance. These include 2D graphs, fringe, and streamline plots. One interesting plot is a reverse streamline. In a typical streamline plot, nodes at an inlet are selected and their travel through the flow stream is mapped. This can be hit-or-miss for adequate streamline coverage at all outlets. STAR-CCM+ allows you to select outlets of importance instead

and the upstream paths are identified.

An important reporting tool offered by STAR-CCM+ is Scene Files. Much like Active Pictures in LMS Test.Lab or eDrawings from SolidWorks, Scene Files of results can be embedded in PowerPoint or other MS applications. A Scene Files Viewer can also be downloaded from CD-adapco to enable results viewing on any PC even without embedded data.

Power-User Capabilities

Seasoned CFD users should appreciate the ease-of-use enhancements of STAR-CCM+ but it doesn't end there for power users. Breaking free from the common licensing structure for high-end analysis tools, a STAR-CCM+ license contains all the features that are available in the product versus having to purchase individual line items. The list of high-end features covers nearly everything a CFD specialist needs. These include transient and unsteady Implicit/Explicit events; fluid-structure coupling with moving parts in the flow stream and moving reference frames; small displacement stress calculations from flow pressures or thermal effects so CFD-Stress iterations are no longer required; multiphase conditions including free surface, boiling, cavitation, and Lagrangian; porous media, fan, and heat exchanger models; and heat transfer with conduction, convection, solar, and thermal radiation. STAR-CCM+ is fast on a typical workstation or laptop but when model size or transient-run resolution becomes great, the software can easily be run on multiple cores, CPUs, or in a computing cluster. STAR-CCM+ does require additional licenses for multiple CPU solutions but offers a Power Session license allowing unlimited CPU or core usage for even more solution flexibility. This is most cost-effective when runs requiring eight or more CPUs are regular occurrences.

CFD is the fastest growing CAE domain, but integration of this technology into the design phase is still a challenge. STAR-CCM+ offers a powerful and unique solution to the integration of both high-end and design-level CFD and should be considered by any company hoping to grow this skill set in their product development process.

And beyond the technology is a STAR-CCM+ team committed to making their customers successful. As some customers have pointed out, the greatest advantage to STAR-CCM+ is the support.

CD-adapco assigns a support engineer to each one of its customers. The report engineer is charged with learning the customer's challenges and acts as a consulting CFD expert to the staff. The service is part of the standard maintenance charge and is seen—by both CD-adapco and its customers—as critical to a lean engineering team. ■

Vince Adams *is DE's expert in simulation, having worked and taught in the field for 20 years. He is the co-author of three books and numerous articles on FEA and design analysis. Comments should be sent to DE-Editors@deskeng.com.*

FOR MORE INFO:

> CD-adapco

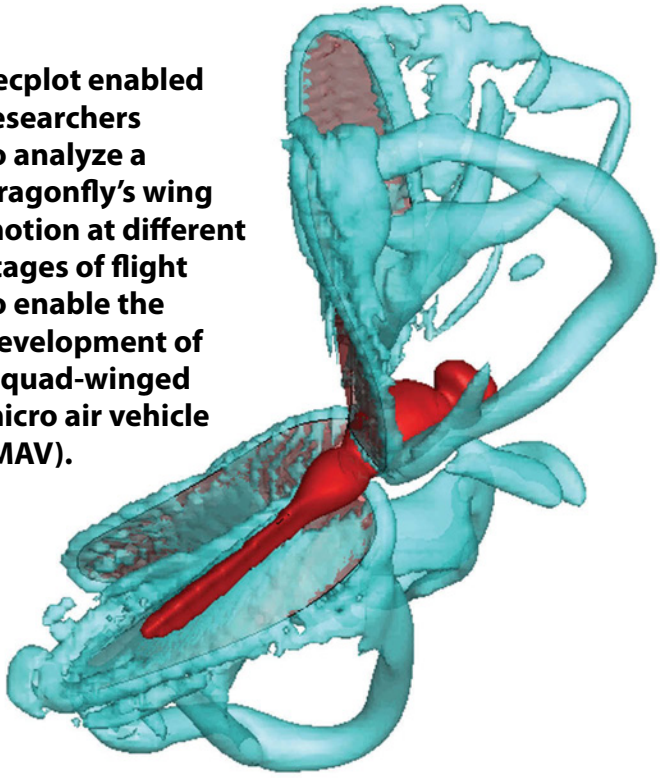
By Mike Peery

Tecplot Provides a View to MAV Flight

> Researchers use CFD analysis and Tecplot visualization to map the flight of dragonflies for development of micro air vehicles.

In an increasingly disorienting and unsettling world—one filled with acts of terrorism, military conflicts across intractable geographies, and devastating natural disasters—the need to gather reliable information in difficult situations is more critical than ever. Whether it is in helping to prevent such an event or respond to one, having immediate access to accurate situational information can save lives, minimize injuries, and prevent the destruction of buildings, property, and infrastructure.

It's a big problem. But research currently being conducted at Wright State University in Dayton, Ohio, is focused on one solution no bigger than a bug. No bigger than a dragonfly, to be exact. Led by Haibo Dong, Ph.D., assistant professor at Wright State, the researchers' goal is to develop quad-winged micro air vehicles (MAVs) that mimic the flight of the dragonfly. Among the purposes of such vehicles would be surveillance, environmental monitoring, search and rescue missions, and more in spaces too small or too dangerous for humans.



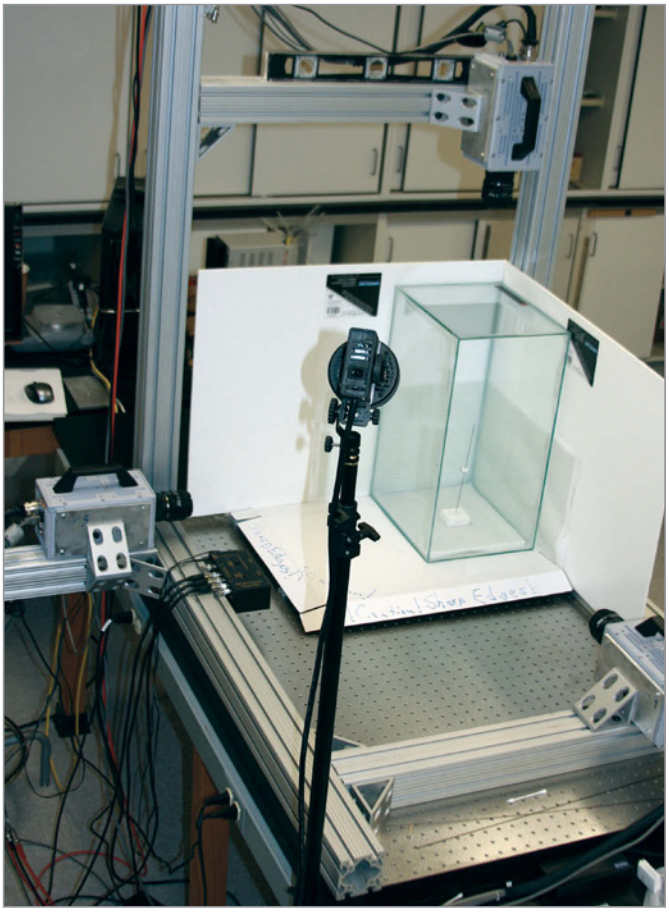
Tecplot enabled researchers to analyze a dragonfly's wing motion at different stages of flight to enable the development of a quad-winged micro air vehicle (MAV).

"Any time you can use robotics instead of people to gather information in areas that may be unstable, toxic, or hard to reach, you minimize the risk to public safety workers," said Dong. "And any time you can use robotics in spaces that are too dangerous or too small for people to enter, you create an opportunity to prevent a catastrophe

that might otherwise have occurred, or you create a chance for rescue where there might otherwise have been no hope."

Building a Tiny, Agile Vehicle

The engineering challenge is to build a vehicle tiny and agile enough to maneuver in inaccessible spaces but that has enough power and lift to carry the payload it needs to gather information. It must negotiate hazards like fire, smoke, temperature extremes and toxic chemicals, as well as communicate with public safety officials.



This photolab developed by researchers at Wright State University in Dayton, Ohio, was used to photograph and study the various stages of dragonfly flight.

Nature perfected such a "device" millions of years ago in the form of the dragonfly.

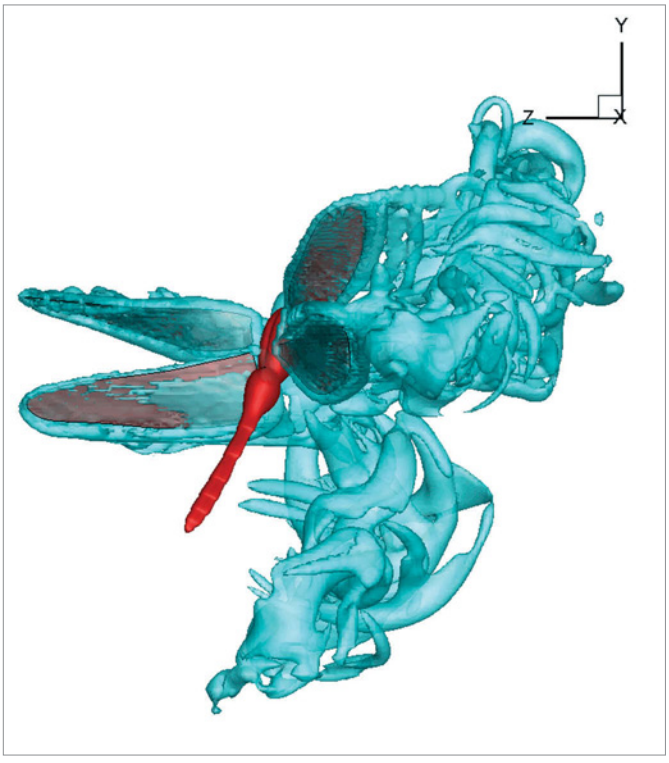
Scientists have long known that this quad-winged creature is fast, agile, and requires significantly less energy than birds to lift and maneuver its relatively large body. But the complexities of the insect's body motion, wing deformation and interaction, and the subsequent flow physics have been too difficult to unravel—until now.

Using state-of-the-art image processing and computation tools, Dong and his team have recently become the first to create full-body 3D simulations of a four-winged insect in free flight. This latest development finally makes it possible for them to get the detailed information they need to build an MAV that truly mimics a dragonfly.

"Until recently, scientists have been able to look at individual insect parts," said Dr. Dong. "We could look at a modeled wing in motion, for example, but we could not consider wing deformation and multi-wing interactions simultaneously. That may have been fine with two-winged insects, but the flow physics become so much more complex with four wings that we really must study the entire insect in free flight. We need to see how the wings and body deform or flex in relation to each other as it moves through the air. We need to look at the vortices, how they form, how they pass over the wings. We need to see how they respond to different conditions in nature. And all of it must be extremely precise."

CFD Viz Pulls it Together

Dong has dedicated his career to the study of the flow physics that underlie the flight of hum-



This slice from an AVI visualized with Tecplot shows the unique movements of the four-winged insect. View a movie of the intricate wing movements and flow of air around them at deskeng.com.

mingbirds and insects like bees, fruit flies, and dragonflies. He launched Wright State University's Flow Simulation Research Group in the Department of Mechanical and Materials Engineering in 2006. Working on several multi-year grants, one of the group's long-term goals is to develop quad-winged MAVs that can be used to monitor public areas, detect biological or chemical weapons, or help with search and rescue efforts.

It has been a slow, painstaking process for the team because of the large amount of data involved and the need for precision. The first step was to construct an efficient simulation model and then validate it against hundreds of scientific publications, studies, and observations on insect motion.

Next, the team used three high-speed cameras at various critical angles to film dragonflies lifting off, and then imported those video images into SolidWorks 3D modeling software to reconstruct the insects' surface shape. Once that was finished, the data was created in an in-house incompressible flow immersed-boundary Cartesian grids solver that simulates fluid flow around the dragonfly. High-performance computing in the form of beowulf clusters consisting of 20 compute nodes (each with a 2.8 GHz dual core Pentium 4 processor, 6 GB RAM, and 250 GB hard drive) were used in the number crunching.

Tecplot Illustrates the Science

Finally, the team's work was ready to come to life using the Tecplot 360 CFD visualization software tool for visualization and data analysis. Pulling the 3D model and the solver data into Tecplot 360, they were able to replay simulations with enough precision, detail, and accuracy to recreate every motion a dragonfly makes on a lab computer.

Leveraging Tecplot's CFD visualization technology will play a key role in helping Dong's team develop these future aircraft. Because of the complexities of the four-winged insect's body motion and wing deformation and interaction, the subsequent flow physics have been too difficult to unravel without being able to look at it with the human eye.

The team's CFD solver generated all the numbers needed, but the researchers needed Tecplot 360 to find and understand the information hidden in their data. For example, the researchers might want to extract key features in the flow field, such as a streamlines, vortices, integrating pressure,

and shear stress to calculate lift and drag. Tecplot 360 takes care of that for them.

While the 3D animations grab the most attention and fire the imagination, the researchers also rely heavily on the 2D images, plots, and charts created with Tecplot 360 to analyze data and communicate results. Still images help them examine the action frame by frame and x,y plotting enables the team to look at force history to learn how the wing is generating force or where the air is moving. 2D cross-sections can offer more detail on wing tips, for example, that show how they influence force production.

Cool Animations, But Data Key

"The 3D animations are probably the coolest part. We can rotate the body, look at the structure, examine vortices, and gain a deep understanding of the physics," said Dong. "But this is physics-based analysis, and that always involves lots of plots and graphs. To us, the information we glean from the 2D results is just as exciting."

This knowledge will also lead to a greater understanding of how dragonflies control their four separate wings. The wings, each controlled by five muscles, deform in shape and move in complicated patterns. It's important for researchers to understand exactly how the individual muscles interact with the wings to create the correct flow physics. That requires a great deal of data and a lot of visualization.

Dong, who has supervised several senior design teams in developing "flying robots" that included different actuators (e.g., motors and piezoelectric actuators) and different sizes (from 2.5 in. to 7 in.), suggests that the current design of the dragonfly MAV has two critical design steps that still need to be completed. They are currently working on a design 1.5 times larger than a dragonfly with a current model that has about a 6 in. wing span and is 3 in. long.

"Once that works," said Dong, "we will build a four-inch model. And then things will start to get very exciting."

Other project contributors include Dr. Hui Wan, Zongxian Liang, Zach Gaston, and Matt Maples from the WSU Mechanical Engineering Department; Dr. Thomas Wischgoll and Chris Koehler in the WSU Computer Sciences Department; and Dr. Yan Zhuang from the WSU Electrical Engineering Department. ■

Mike Peery *is co-founder, president, and CEO of Tecplot. He has more than 30 years of experience in the development of software products for CFD analysis and scientific/engineering visual data analysis. Send comments to DE-Editors@deskeng.com.*

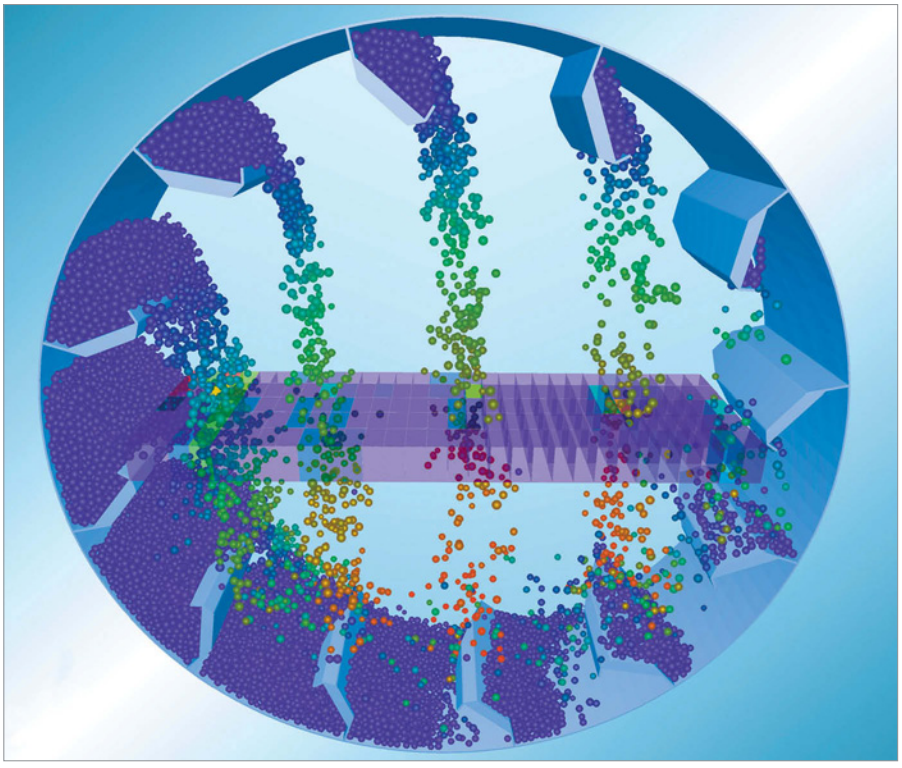
FOR MORE INFO:

> SolidWorks Corp.
> Tecplot, Inc.
> Wright State University

By Andrew Hobbs

EDEM Helps Astec Engineer a Better Dryer

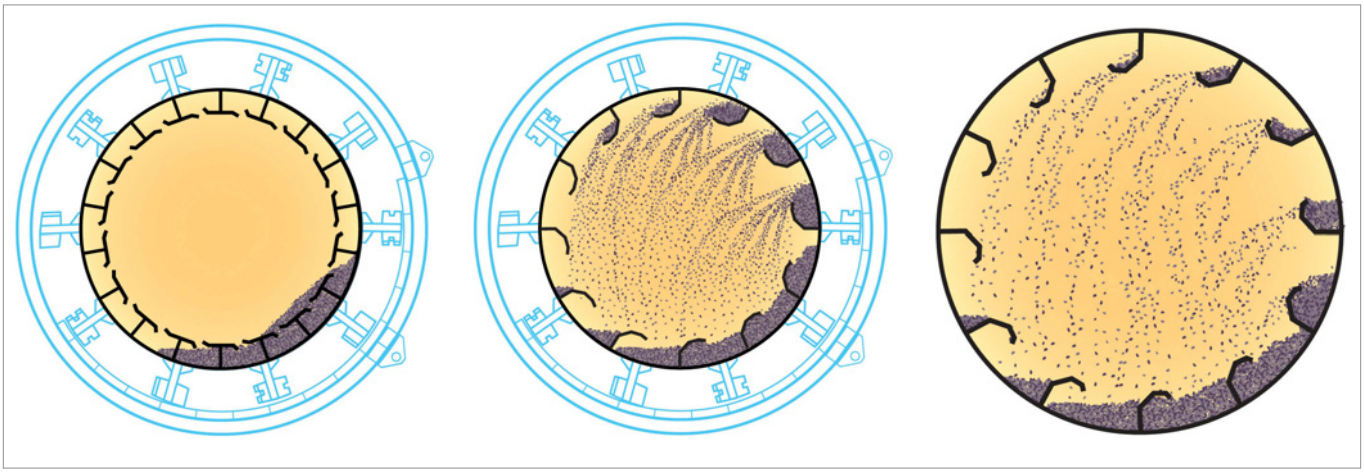
> DEM Solutions simulation software leads to operational efficiency and greener asphalt production via accurate visualization.



This is a close-up of the simulated drum in action showing the veiling of aggregate in the dryer.

When going green means using less energy and saving money, everyone's on board. This is especially true with asphalt production—an energy-intensive operation where hundreds of tons/hour of aggregate rock must be dried to ensure good binding between the asphalt cement and the rock particles. At Astec, Inc. we found that it's often small design changes that improve equipment efficiency and lead to less wasted heat, lower fuel costs, and lower emissions. When we set out to develop a more energy-efficient drum dryer that could process a wide range of aggregate types, at various tonnage rates, we turned to EDEM simulation software from DEM Solutions to test our designs. EDEM gives us a virtual environment to observe and analyze what can't be seen with the naked eye—the effect of flight design and operating parameters on material flow within an operating drum dryer.

The drum dryer is the heart of the hot-mix asphalt production process—typically a counter-flow dryer,

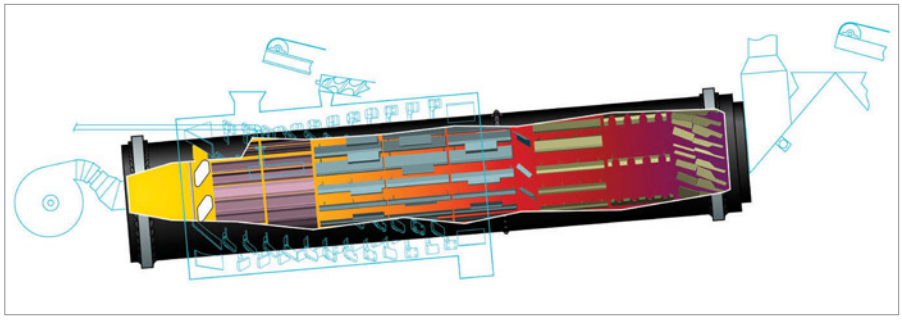


Cross-section of the drum showing examples of veiling action induced by different flight designs along the length of the drum.

heated by a burner at the far end. A conveyor feeds aggregate into the rotating inner drum where it is kept in motion by sections of flighting (cupped steel paddles of various design) that are attached to the inner surface. As the drum rotates, each flight collects aggregate and gradually releases it, producing a "veil" of falling material within the drum. Better veiling exposes more of the wet aggregate to the burner's heat—improving heat transfer, speeding the drying process, and directly reducing the unit's fuel consumption.

One of the goals in engineering a more efficient and economic dryer, then, is more effective veiling of the aggregate. Improved veiling, however, isn't straightforward. Both the amount of aggregate picked up and dispersed by the flights, as well as the rate of release of aggregate as the drum rotates are important. A given design may perform well at high tonnage rates, but not at lower rates. Flights may work well with some aggregate mixtures, but not with a wide range of materials. Also, aggregate properties change as the material dries, so the flight veiling pattern is typically altered over the length of the drum.

Field testing new flight designs is, in itself, a challenge. The harsh internal environment of the operating dryer makes direct measurement and observation inside the unit nearly impossible. Without the EDEM discrete element method simulation we would have to rely on trial and error. With EDEM simulations we were able to set up a virtual environment to examine—with particle-scale resolution—the veiling performance of prototype flight designs, and use this



Astec, Inc. counter-flow dryer: wet aggregate enters the drum at right, and travels toward the burner at left.

knowledge to design a new flight that improved the aggregate drying process.

To accurately simulate aggregate flow and veiling in the Astec dryer, we imported CAD files of the full drum geometry into EDEM. We also generated a 'virtual aggregate' model in EDEM, assigning physical properties to the particles to replicate the behavior of a range of aggregate rock types. Once the virtual aggregate rock particles were introduced into the model drum, EDEM simulated the dynamics of the particles as they were lifted and released by the flights.

EDEM allowed us to visualize the particle flow and analyze particle-particle and particle-equipment interaction within the rotating drum. Using EDEM's binning functionality, which calculates statistics such as the numbers of particles in a given volume, we were also able to quantify the density of the veiled aggregate in a given drum section. A grid of bins was positioned along a cross-section of the drum and the number of particles falling into each bin was recorded over time. We were able to compare the performance of different flight designs by examining plots of veil density across the drum as it rotated. Our objective was to achieve as uniform a distribution of particles as possible.

Ultimately, after simulating the veiling action of many design iterations, we identified a flight geometry that provided optimum veiling characteristics for a range of aggregate types and tonnage rates. The new flight design, which we call our "V-Flight," has proven successful in trials.

EDEM software has proven itself a valuable design tool and Astec engineers have made it an integral part of our design process. Using EDEM shortened the design cycle by giving us the capability to virtually test prototypes of new flights within a simulated operating dryer. We also have more confidence in our understanding of aggregate behavior in the drying process and we're now using EDEM for trouble-shooting existing dryers in the field, where local aggregate properties can present problems that require custom solutions.

The new design that EDEM helped us engineer is more efficient, reduces drying time, and uses less fuel than previous designs. This makes Astec customers more competitive and, at the same time, reduces the impact on the environment.

Astec is well known as a hot-mix asphalt plant market leader that makes improvements largely due to customer feedback. We are also moving ahead with research and development of green technology—such as low-emission warm-mix systems, solar heating, and the engineering of more energy-efficient asphalt production equipment. Green technology is no longer limited to cars on the road—it's now being applied to the equipment making the roads. ■

Andrew Hobbs *is an engineer at Astec, Inc., specializing in computer analysis. Send comments to DE-Editors@deskeng.com.*

FOR MORE INFO:

> **Astec, Inc.**

> **DEM Solutions**

Wacom Announces HD Interactive Pen Display

> **Wacom** has announced its first full HD interactive pen display, the DTU-2231. With direct pen-on-screen input, the DTU-2231 is designed to optimize efficiency and productivity by enabling users to create original content, edit maps as well as manage, analyze, and share geographic information.

Featuring a 21.5-in. widescreen LCD with a 1920 x 1080 resolution, the DTU-2231 reduces work cycle times and features:

- Cordless, battery-free pen with 512 levels of pressure sensitivity
- Built-in USB hub with two user-accessible ports
- Video pass-through with DVI-I input, output and a video scaler.
- A flat work surface with a 16:9 aspect ratio and adjustable stand.

The Wacom DTU-2231 is priced at $1,899 and will be available for purchase this spring.

QuickUSB module includes firmware and Windows device driver

> **Saelig Company, Inc.** has announced the QuickUSB, a customizable USB 2.0 connectivity solution. This 2 x 1 circuit board implements a bus-powered Hi-speed USB 2.0 endpoint terminating in a single 80-pin target interface connector.

With the companion QuickUSB Customizer software, users can tailor the QuickUSB Module to give their products a custom-developed look and feel with a user-defined 'My Product' string descriptor, a unique PID (Product ID), and a user-defined serial number to create uniquely identifiable products.

QuickUSB is a functional module that includes built-in firmware, a device driver, and software that works on Windows 98SE, ME, 2K, XP, Vista, and Windows 7. The supplied QuickUSB Library supports popular programming languages and works with any language that can call a DLL. QuickUSB

Sherborne Sensors Announces North American Market Debut of the LSI Series

> 

Sherborne Sensors has announced its LSI family of closed loop, gravity-referenced servo inclinometers. The LSI series is designed to withstand severe shock and vibration inputs for measurement capabilities in demanding environments.

The LSI series incorporates a flexure-supported torque balancing system, which the company says can withstand shocks of 1500 g. Sensor components and associated electronics are contained within IP64 environmentally sealed housing. Units are available in ranges of ±14.5°, ±30° and ±90°, and offer a 5V analog DC-output signal, proportional to sine of the angle of tilt.

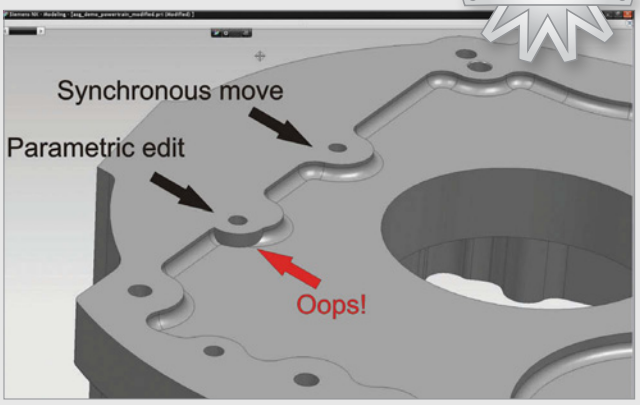
LSI series models are fully self-contained, and are able to connect to a DC power source and a readout or control device. The units carry a two-year warranty.

Siemens PLM's NX 7: The Best of Both Worlds

> Designers using NX 7, from **Siemens PLM Software**, get the best of both worlds via synchronous technology. Synchronous technology (introduced in NX 6, but enhanced in the new version) allows the modeler to use parameters to set up the model according to whatever rules he needs to apply, then go back in and make changes that don't affect the model's sketches or the parameters used in feature creation.

Theoretically you would always get it right the first time, but in the real world, changes will need to be made because you can never account for everything in the life of your part. And, when a change order comes in, it's seldom that the original modeler will be doing the work.

The synchronous technology (ST) in NX 7 does a great job of recognizing features and even geometric conditions. For example, if the part



you open has symmetrical features, ST will use Face Finder to look at the model's topology and recognize them and treat them accordingly. It gives you a list from which you can specify the conditions you want to see. You can turn conditions on or off as you see fit. (go to deskeng.com for the full story)

Mike Hudspeth's review of NX 7 received the most visitors in the month of February.

is supported on Linux too. MacOS X support will be available soon.

QuickUSB modules are available for $149 each.

AutoDesSys Releases bonzai3d 2.0, RenderZone

> **AutoDesSys** has released bonzai3d 2.0 along with the RenderZone Plugin, which adds rendering to the modeling application.

bonzai3d allows designers to create 3D models, share them with team members, investigate alternatives, prepare presentations, and take it to fabrication. The new version includes new features, such as dimensions, advanced NURBS modeling tools, and clipping planes.

The RenderZone Plugin adds the ability to create presentations and visuals, as an option. A trial version of the plugin is included with the bonzai3d 2.0 download.

Available for Windows and Mac, a free trial version is available to download and use for 30 days. The upgrade is free for users of the previous version.

Océ Releases PlotWave 300 All-In-One System

> **Océ** has announced the Océ PlotWave 300 system, a monochrome multifunction system that prints, copies, and scans low volumes of technical documents.

The Océ Plot Wave 300 printer incorporates Océ Radiant Fusing technology to efficient fuse toner onto paper. Thin metallic tiles are used to

radiate heat so they heat up and cool down very quickly. According to the company, that means the system starts up instantly, uses half the energy of comparable systems, makes no noise when it is idling, and requires no extra ventilation to keep it cool. The system also uses a catalytic convertor system to reduce ozone emissions.

IntelliCAD Technology Announces Beta2 Release of Version 7 Architecture

> **The IntelliCAD Technology Consortium** (ITC) has announced a Beta2 release for ITC members of the new IntelliCAD 7 CAD software incorporating a new software architecture designed to optimize the core data import/export and application programming functions.

The IntelliCAD 7 architecture uses DWGdirect from the Open Design Alliance (ODA) as its internal database for improved handling of DWG files. For companies building custom applications, IntelliCAD 7 also offers the DRX object oriented application programming language (API) developed by the Open Design Alliance (ODA) with custom IRX extensions specific to the IntelliCAD platform.

Meggitt Sensing Systems Releases Endevco Accelerometers

> **Meggitt Sensing Systems** has launched the Endevco model 7255A miniature piezoelectric accelerometer with integral electronics.

Endevco model 7255A incorporates a built-in

mechanical filter that blocks high-frequency energy associated with near-field high shock, and protects the sensing element from overstress. An internal electronic filter helps prevent saturation. The sensor features a two-wire system with integrated hybrid signal conditioner, which transmits a low-impedance voltage output through the same cable that supplies required constant current power. Signal ground is connected to the inner case, acting as a shield.

Graebert GmbH Announces ARES Cross-platform CAD Solution

> **Graebert GmbH** has announced ARES, a native cross-platform CAD solution. It uses a common design interface and runs natively across Microsoft Windows, Apple Mac OS X, and Linux, while also being optimized for specific operating system features and capabilities.

Upcoming versions of ARES will be available for Microsoft Windows Mobile devices. Both the Apple iPad and the Google Android operating system are under active evaluation for porting as well. ARES will be initially available in 13 languages.

The company says ARES is typically 3-5 times faster in operations such as open and save than other CAD packages on any platform. It has undergone more than a year of beta testing and will ship in two different configurations: ARES ($495) and ARES Commander Edition ($995).

Omega Releases 7th Edition of Temperature Measurement Handbook

> **Omega** announced the release of its Temperature Measurement Handbook 7th Edition. The handbook offers detailed information and specifications on more than 40,000 products for process measurement and control featured in more than 2,000 color pages.

The New 7th Edition contains the latest technology and new products in sanitary temperature sensors and devices, wireless connectors and instruments, profile temperature labels, thermal imagers and infrared temperature products, automation products, new technical books related to measurement and control, as well as updated technical references and data.

Lattice Technology Releases Updated Converter Products

> **Lattice Technology Inc.** has released updated converters that allow 3D CAD data to be read into XVL.

XVL Converter version 6.1 supports major 3D CAD formats, including Wildfire 5, Autodesk Inventor 2010, Solid Edge ST2, and Wildfire 5 64-bit platforms.

These converters are offered as plug-ins to CAD systems, as well as stand-alone applications alongside 3D CAD seats and inside PLM systems. According to the company, the plug-ins enable compression of 3D design data up to 0.5 percent of its original size with no loss of accuracy. This compression makes it possible for manufacturing enterprises to mock up, simulate, and manipulate 3D data on lower specification PCs. The Lattice3D Dataway application also supports import and export of 3D PDF data into XVL. ■

PRODUCT SHOWCASE

> To appear in the next Product Showcase, contact Jeanne DuVal at jduval@deskeng.com

Autodesk® Inventor®

Autodesk® Inventor® software takes engineers beyond 3D to Digital Prototyping by giving them a comprehensive set of tools for 3D mechanical design that enables them to design, visualize, and simulate products before they are ever built. Digital Prototyping with Inventor software helps companies design better products, reduce development costs, and get to market faster.

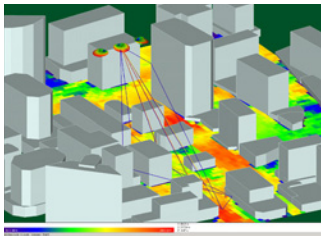
> Autodesk

CADRE Pro 6 For Windows 7/Vista/XP/2000

CADRE Pro 6 For Windows 7/ Vista/XP/2000 (32 & 64 Bit) with advanced modeling tools including CAD importing. A practical and affordable tool for engineers. CADRE Pro solves mechanical and architectural structures for internal loads, beam section or plate stresses, displacements, vibration modes, and natural frequencies. Advanced features for stability, buckling, shock and seismic loads. Eleven element types including specialized beams and plates.

> Cadre Analytic • 425.392.4309

Wireless InSite® for Wireless EM Propagation



Remcom's Wireless InSite® is site-specific radio propagation software for the analysis and design of wireless communication systems. It provides efficient and accurate predictions of propagation and communication channel characteristics in complex urban, indoor, rural and mixed path environments. Applications range from military defense to commercial communications, including wireless links, antenna coverage optimization, and jammer effectiveness. Visit www.remcom.com/wireless-insite for more information.

REMCOM

> Remcom • 814.861.1299

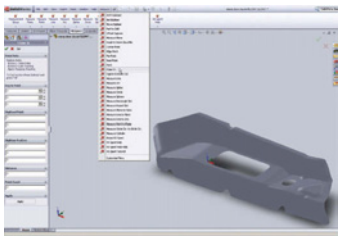
SOLIDS++

The next generation geometric modeling kernel, with non-manifold topology, and support for Solids, Surfaces, and polygonal modeling. With source code access, this high performance modeling kernel is the ideal solution for a variety of geometric modeling applications. Visit www.IntegrityWare.com for more information.

> IntegrityWare

858.592.8866 • Dgill@IntegrityWare.com

ReSpect™

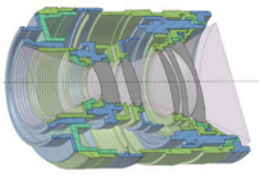


ReSpect™, the Inspection Software Plug-in from ReverseEngineering.com Integrates PCMM Hardware into SolidWorks

Current and future owners of inspection hardware devices (PCMMs) have long been asking if they can inspect and measure direct in their SolidWorks software. ReSpect, a robust inspection plug-in from ReverseEngineering.com does just that. Save hours and days while performing traditional inspection and measurement tasks. Easy to use and native in SolidWorks.

> ReSpect™

SpaceClaim® 3D Direct Modeling



Do you consider 3D to be too complicated for concept modeling? Have you ever wanted to quickly explore and test several different design ideas without getting bogged down in CAD details? Have you struggled to prepare CAD geometry for simulation? Direct modeling in SpaceClaim provides the 3D experience you've been waiting for. Get concepts right before going to detailed CAD, optimizing the design process.

SPACECLAIM CORPORATION

> SpaceClaim®

1-978-482-2148

Nothing as Authentic and Scalable as Open Source

WILL SCHROEDER
Kitware

Authenticity. It is one of the most important characteristics of open-source software, cutting through the marketing spin, half-truths, and gimmicks designed to attract attention without delivering the goods. With open-source, what you see is what you get. It offers a quality, low-cost solution that avoids the licensing issues that get in the way of solving real problems.

Open-source solutions enable customers to fully evaluate a technology to understand what is offered, what it does, how it can be improved, and how to fit it into a workflow. Like a refreshing blast of fresh air, I generally feel invigorated when I engage with open-source products.

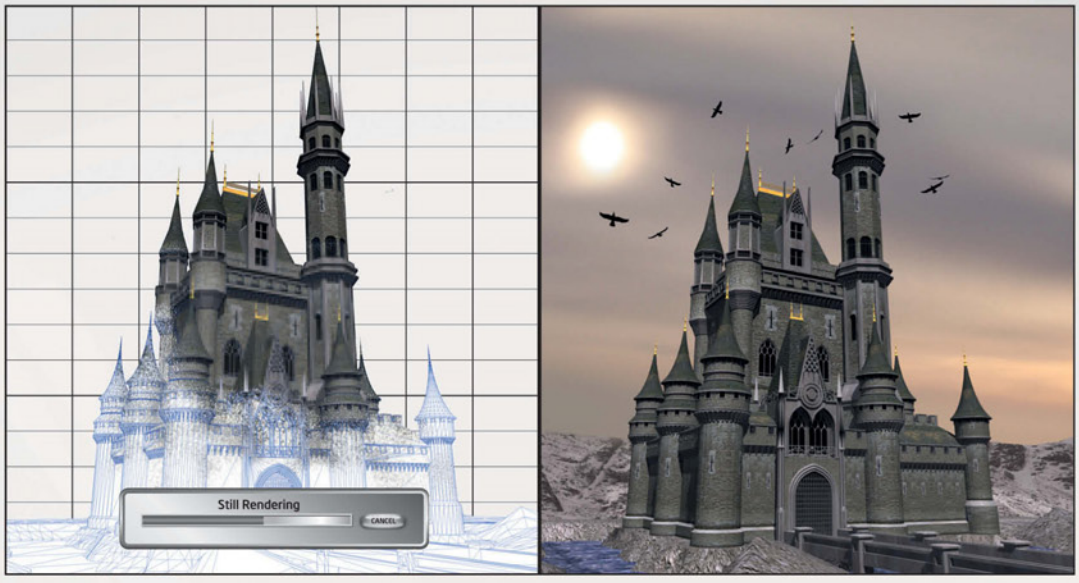
In the future, organizations and communities that can speak clearly, honestly, and openly about their products will excel; finding an oasis of authenticity in a desert of hype will be increasingly valued. This ability will spur the success of commercial, academic, and research ventures.

> Open-source approaches are more capable of solving difficult problems.

Open source leads to an agile, high-quality collaborative process that can be everyone's secret weapon. While there are a lot of individuals and organizations producing outstanding algorithms and systems, too often the resulting software won't cross platforms, breaks easily, and is unstable in response to new data and parameter settings. Open-source companies don't necessarily have better programmers, but their processes help identify and fix code problems faster. Thus open toolkits and applications are known for their stability, robustness, and flexibility, which is why thousands of users and

BEST PERFORMING PROCESSOR FOR DESKTOPS[1]

PROCESSOR PERFORMANCE



Previous Intel® Core™ Processor

Intel® Core™ i7 Processor

With faster, intelligent multi-core technology that automatically applies processing power where it's needed most, the new Intel® Core™ i7 Processor delivers an incredible break through in PC performance.

GREAT DESKTOP COMPUTING STARTS WITH INTEL INSIDE.

3DBOXX 4850 EXTREME

- Six-core Intel® Core™ i7 processor
- Fastest single processor workstation
- Performance enhanced to 4+ GHz

STARTING AT **$3,920**

GOBOXX

- Six-core Intel® Core™ i7 processor
- Fastest mobile workstation
- Performance enhanced to 3+ GHz

STARTING AT **$3,245**

BOXX

www.boxxtech.com
877-877-BOXX
512.835.0400

3DBOXX 4850 Extreme and GoBOXX are just two of the outstanding solutions from BOXX, the rendering and workstation leader, providing unparalleled, XXtreme performance for product design, CAD, industrial design, development, and more.

Intel is not responsible for and has not verified any statements or computer system product-specific claims contained herein.

intel CORE i7 inside

Look for **Intel Inside®**

1 Based on SPECint_rate_base2006* scores. Results have been estimated based on internal Intel analysis and are provided for informational purposes only.
Any difference in system hardware or software design or configuration may affect actual performance. See http://www.intel.com/performance for additional information.

customers build their own applications based on open-source languages.

For all these reasons, an agile software process is critical to scientific computing. Technology is advancing so rapidly that users and developers need to be able to respond to new developments, refactor code, and fix software issues to keep up; and while doing so they must have confidence that the technology they are developing is of high quality. Most organizations can't wait for a proprietary code base to respond to issues and technology challenges.

I believe open-source approaches are far more capable of solving difficult technology problems than other processes, and the future of scientific computing will depend on growing, managing, and coordinating large, ad hoc communities.

In the current environment, data sets are becoming bigger, systems more complex, research teams are growing in size and scope, and solutions require the integration of multiple technologies. As a result, keeping up and making use of technical advances is becoming more difficult. Open source software processes help by scaling better than proprietary models.

The book Wikinomics argues persuasively that open-source approaches successfully pull together teams from disparate organizations with widely ranging talents to solve difficult problems. I particularly enjoyed a recent example described in Nature: Timothy Gowers of the University of Cambridge ran an experiment in collaboration by describing the Polymath Project on his blog. While the goal was to solve a math problem, Gowers wanted to attack it using collaborative techniques inspired by open-source development. Within six weeks the problem was solved with the contribution of more than 800 comments and 170,000 words from participants as diverse as high school teachers and mathematical luminaries.

I believe open-source approaches are far more capable of solving difficult technology problems than other processes, and the future of scientific computing will depend on growing, managing, and coordinating large, ad hoc communities. This will challenge many of us, whether we are trying to coordinate international teams of researchers or businesses that must learn how to assemble, manage, and motivate disparate communities to provide effective technology solutions. ■

Will Schroeder *is the CEO of Kitware, which develops open-source computer vision, medical imaging, visualization, 3D data publishing, and technical software. Send feedback to DE-Editors@deskeng.com.*

REAL PARTS. REAL STORIES. JOE GIBBS RACING.

THIS COOLING DUCT WOULD HAVE TAKEN 33 DAYS TO DESIGN, TEST AND PRODUCE. WITH FORTUS, WE DID IT IN 3.

Nelson Cosgrove
Director of Engineering
Joe Gibbs Racing

Our engineers had just three days to correct an overheating brake rotor. We designed a new cooling duct in CAD, then used our versatile Fortus 3D Production System to help:

- Quickly produce and test a series of design iterations
- Test fitment of functional prototypes on the actual race car
- Produce a tooling buck for molding the final part
- Cut time and costs by 90% over traditional methods

With Fortus, we fixed the problem in time for the next race.

Watch the full story video and get a free sample part at:
WWW.FORTUS.COM/DE

STRATASYS®
Make It Real™

FORTUS™
3D PRODUCTION SYSTEMS

STRATASYS
Make It Real™

NOW THERE'S ROOM ON YOUR DESK AND IN YOUR BUDGET FOR BIGGER 3D PRINTING.

Modeling material available in nine colors with uPrint Plus.

Introducing the uPrint® Plus Personal 3D Printer. Turn big ideas into color 3D models right at your desk.

The uPrint Plus Personal 3D Printer gives you a 33% larger build envelope than the original uPrint Printer but in the same 25" x 26" footprint. uPrint Plus also gives you two layer resolutions and a choice of nine material colors. Both uPrint and uPrint Plus bring your ideas to life as durable plastic models you can use for proof of concept, functional testing, product mock-ups and much more.

Choose which uPrint is right for you at www.dimensionprinting.com/de3

STARTING AT
$19,900* USD

uPrint® plus
by dimension

*Manufacturer's worldwide list price. Additional options, shipping, applicable taxes/duties not included. ©2010 Stratasys, Inc.