DE
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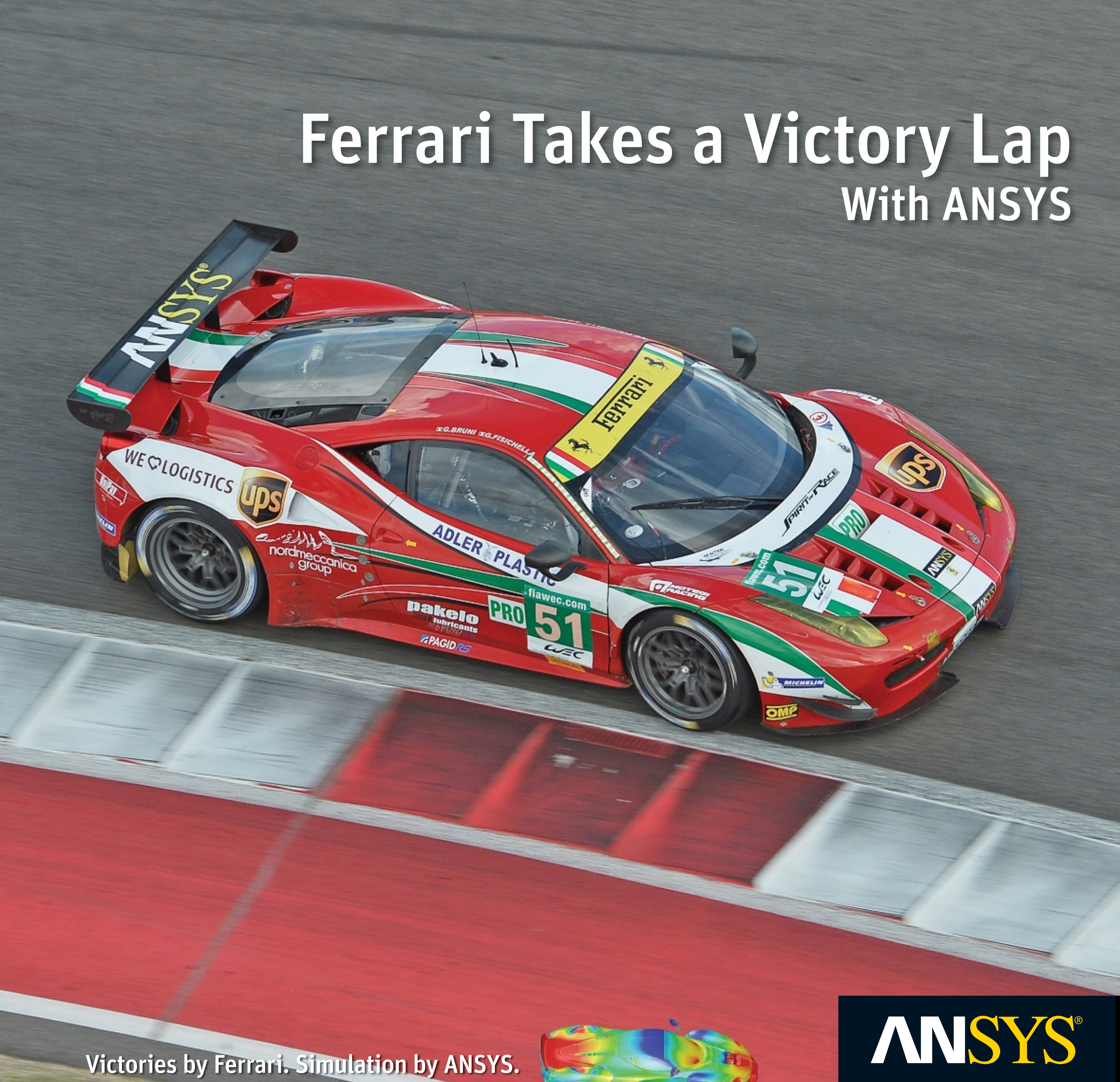
TECHNOLOGY FOR DESIGN ENGINEERING

December 2013 / deskeng.com

One Shot at Perfection

United Launch Alliance optimizes analysis data and processes to decrease its rocket design cycle without sacrificing quality. P.22



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by Jamie J. Gooch

Optimize the Design Cycle

As *Desktop Engineering* looks forward to its 19th year of covering the hardware and software that design engineers need, we see some amazing trends converging that are changing the way you work, and the way we cover the industry.

The primary driver of this change is evident: electronics, software and embedded systems are increasingly needed in more products, which in turn increases design complexity. Despite the need for engineers to conceptualize, simulate and test more complicated products, time-to-market deadlines continue to shrink. To meet the demands of consumers, regulators, and manufacturing in less time, engineers from different disciplines must collaborate with colleagues from different departments.

Fortunately, the design, analysis, prototyping, computing and testing technologies *Desktop Engineering* has traditionally covered provide part of the answer. However, that's not enough.

People change much more slowly than technology does.

Cultivate a Culture of Collaboration

Not enough? How can the ridiculous advancements in engineering computing speeds, coupled with the ability to design and accurately simulate entire systems not be enough? Because people make processes that efficiently integrate technologies, and people change much more slowly than technology does.

Perhaps no one sees the people and process challenges as clearly as engineering service providers who work with multiple companies, and so have the opportunity to familiarize themselves with the details of various engineering workflows.

"The current workflow is so bad. While it's very common, it's horribly wasteful — and I fought for the last 20 years for companies to realize it," laments ATA Engineering Inc.'s H. Clark Briggs to Senior Editor Kenneth Wong on page 58. "I spend most of my process consulting time trying to get organizations to realize it."

Why, after 20 years, with all of the technological advancements that have been introduced over that time, does Briggs still battle against inefficient workflows? Because the technological tools are not the most significant hurdle.

"Tools only provide a link between your expertise and your ideas for the product you design," Stefano Picinich, founder of space and defense contractor Airworks, tells Contributing Editor Beth Stackpole in her page 64 feature. To make use of those tools, people up and down the corporate ladder have to accept them. C-level executives have to authorize their purchase, engineers have to be trained to use them and managers have to ensure new technology is actually being used effectively.

Millions of dollars of engineering technology investments too often never meet their full potential to shorten the design cycle because people either don't understand the benefit to the company as a whole, or are simply too comfortable doing things the way they've always been done.

"There's always resistance to change. Always," Rod Mach, president of IT service provider TotalCAE tells Contributing Editor Mark Clarkson in a feature article that begins on page 26. "Even if the change is better, people naturally resist change."

Innovation Inertia

Resistance to change is increasingly encountered when companies try to make sense of the massive amounts of data — from consumer preferences to regulatory specifications to simulation and analysis — that is part of the design cycle. To understand that data and make decisions based on it, company leaders need to see a complete picture. One way to paint that picture is for everyone involved to add to it via a centralized system, such as a product lifecycle management platform. This is often where human nature thwarts process innovation.

People accustomed to doing things the way they always have, the way they are sure will work, are reluctant to change their workflow to give someone in another department, possibly on another continent, some additional information that may or may not help them make a decision. Because design engineers are the creators and keepers of so much information that is crucial for making smart business decisions, any such reluctance on their part can magnify workflow inefficiencies.

On the other hand, it's easy to see why design engineers would be reluctant to take on additional responsibilities. You're already being asked to do more complicated work in less time. Efficient collaboration can help decrease time-to-market, but inefficient collaboration takes precious time away from the design engineer.

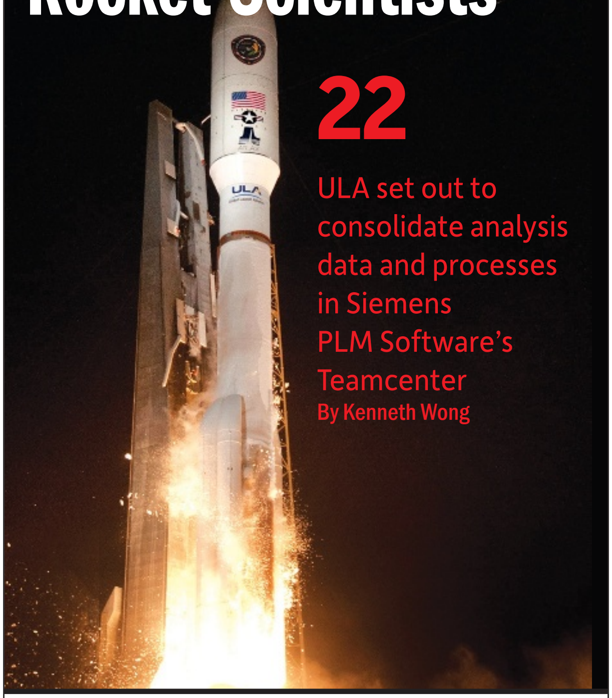
Desktop Engineering's goal in 2014 is to bring you the information you need to break that chain, optimize your workflow, and integrate the best-in-class technologies using best practices. We'll do that by expanding our coverage of process and data management tools, introducing engineering services that can help alleviate roadblocks, and explaining ways to overcome cultural barriers to optimization.

You can help. If you have success stories or lessons learned to share on design cycle optimization, we'd love to hear them. **DE**

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

DE December 2013 VOLUME 19/ISSUE 4

SPECIAL ISSUE: OPTIMIZATION



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ON THE COVER: A rocket prepares for liftoff.
Image courtesy of United Launch Alliance.

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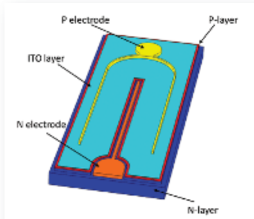

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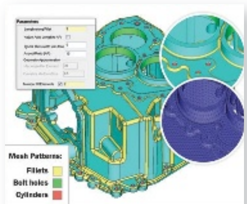

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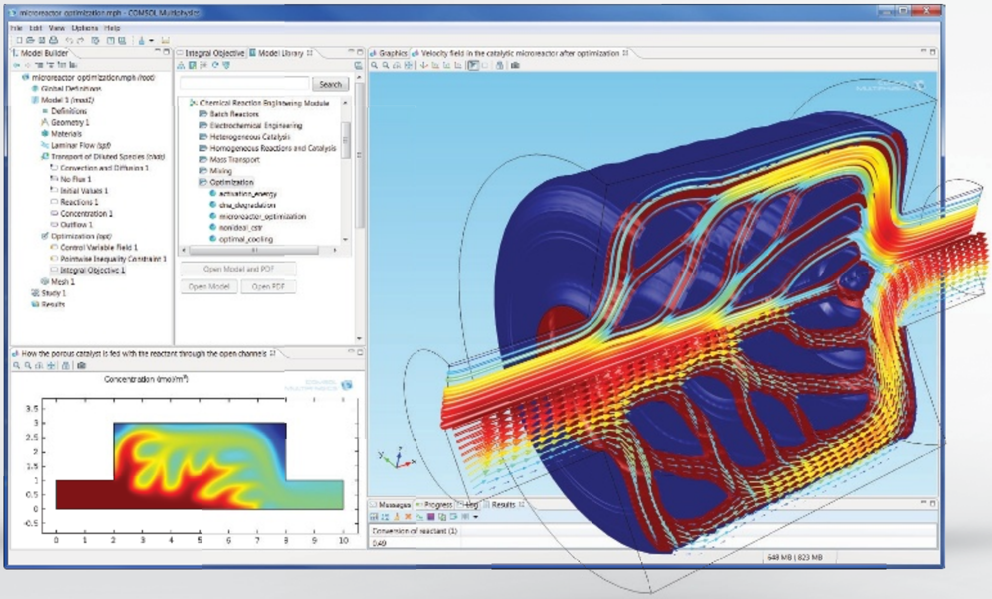
REACTOR OPTIMIZATION: In this model the total reaction rate for a given total pressure difference across the bed is maximized by finding an optimal catalyst distribution.



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December 2013

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by Kenneth Wong & Beth Stackpole

Sunny Forecast for Cloud-based PLM

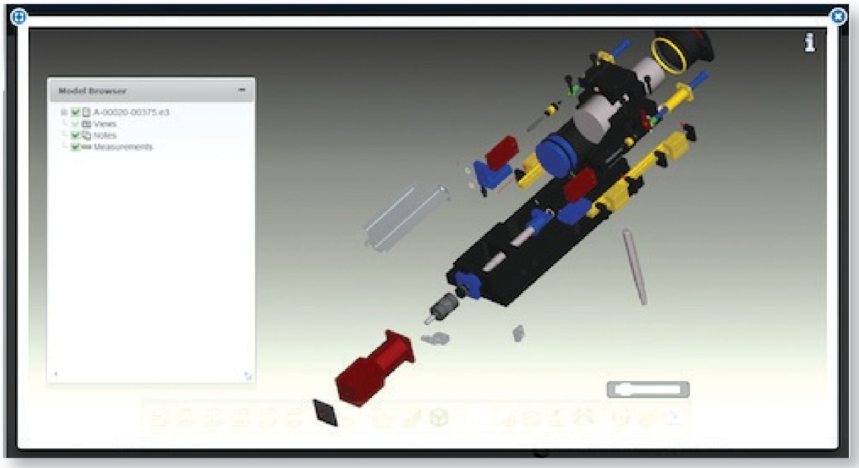
On-premise deployments and traditional-style product lifecycle management (PLM) still comprise the lion's share of the market and user implementations, and likely will for some time. However, interest in cloud-based PLM is definitely picking up.

In addition to the splash made by Autodesk with its expanding family of cloud-based engineering tools, a slew of new cloud-based engineering collaboration platforms and refinements to existing platforms have entered the market. According to research by TechNavio, the PLM market is expected to achieve a 9.7% compound annual growth rate between 2011 and 2015. Cloud-based PLM, in particular, are expected to drive much of this growth.

One of the companies expecting to capitalize on this anticipated growth spurt is Arena, which introduced one of the earliest cloud PLM platforms (they were referred to as "hosted" or "on-demand software" back then) more than a decade ago, and has been at it ever since. Arena settled on what at the time was a disruptive software delivery model because it targeted companies in the electronics sector, which typically rely on contract manufacturers and extended global supply chains while dealing with extremely short product delivery cycles and highly accelerated rates of change.

"The outsourced manufacturing world works well with cloud applications," says Steve Chalgren, Arena's vice president of product management and strategy. "If you have on-premise PLM, everything is behind the firewall, which requires a lot of user provisioning on enterprise applications to give suppliers access. It's a huge IT cost for OEMs."

Instead of spending millions of dollars on an enterprise PLM deployment, electronics original equipment manufacturers (OEMs) can take a couple of hundred thousand dollars annually and get the same capabilities, he explains: "It may not be totally custom, but it solves their problems."



Solair PLM easily integrates with a range of common business systems, including CAD systems and Microsoft Office. *Image courtesy of Solair.*

New Arena Applications Released

In its fall 2013 release, Arena added three new applications designed to give its customers (mostly from outsourced manufacturing) the tools to help transform their manufacturing operations and maximize business results:

- Arena Demand helps OEMs calculate aggregated materials needs across all of their product lines so they can better negotiate with suppliers.
- Arena Projects connects the project schedule directly to the product record, increasing visibility so engineering and manufacturing groups can better facilitate new product introductions and new quality processes, among other processes.
- Arena Exchange is a collaboration environment designed to look and feel more like a social media platform — connecting multiple users at different supplier levels throughout a global supply chain.

A New Contender

Upstart Solair is also upping the ante for cloud-based PLM. The Italy-based newcomer has just released Solair PLM, its Software-as-a-Service (SaaS) PLM offering, to the European market. It has plans to actively jump into the U.S. market by the first quarter of 2014.

Solair PLM was designed as a multi-tenant, cloud-based system with a pay-as-you-go licensing model. It's also designed to be scalable and easy to implement: According to Founder and CEO Tom Davis, the firm has a patent-pending technology that automatically configures the system in the cloud, so users don't have to do any heavy lifting around coding or integration.

Solair PLM covers the usual PLM workflows, from full document management and revisioning to bill of material (BOM) management and integration/visualization of CAD data. Baldi, a Florentine company that makes furniture and accessories for the luxury market, plans to move from a small traditional-style PLM program to Solair PLM in the cloud specifically because of its ease of use.

"Solair PLM allows us to open up our PLM platform to all our suppliers and colleagues that aren't into CAD or technical software," notes Leonardo Boni, Baldi's head of product and R&D. The end game, Boni says, is improved collaboration across dispersed partners, ultimately leading to shorter product development cycles.

— B. Stackpole

by Kenneth Wong & Beth Stackpole

Diverse Multiphysics Modules Help COMSOL Achieve Real-world Accuracy

What do Moore's Law, structural corrosion, and magnetostrictive transducers have in common? Seemingly, not much. Yet at the recent COMSOL 2013 Conference in Boston, they were showcased as three real-world examples of open-ended design challenges being effectively explored in the virtual world using COMSOL multiphysics (MP).

While the three keynote speakers are pursuing design problems that appear to be worlds apart, they are indicative of two big goals among COMSOL's growing user base: an obsession with accuracy and the aspiration to skip or cut back on physical testing, which is far more time-consuming and expensive than virtual prototyping, according to Valerio Marra, Ph.D., COMSOL's technical marketing manager.

If there is any common thread among COMSOL's user base, "it's a desire for real-world accuracy and a chance to mimic real-world results," Marra says. "How many cool ideas don't see the light of day because there is no good tool to test them? This is why we invest in multiphysics — because our customers want to reduce the number of prototypes, and are obsessed with getting good results."

Modeling Enables Moore's Law

Peter Woytowitz, Ph.D., who leads the Computational Modeling and Reliability group in Central Engineering at Lam Research Corp., a supplier of wafer fabrication equipment and services, was first up. He presented on using COMSOL to explore the symbiotic relationship between Moore's Law, which dictates that the number of transistors on integrated circuits (ICs) doubles every 18 months, and computational modeling.

While it's known that Moore's Law is a driver for the use of computational modeling, Woytowitz set out to explore how computational modeling, in turn, enables Moore's Law — helping to promote progressively higher transistor densities, better architectures, and increased reliability and speed. Using COMSOL Multiphysics, he explored wafer fabrication equipment modeling, IC device-level modeling, and eventually molecular dynamics, all in an effort to see how modeling can advance semiconductor design.

When to Stay with Single Physics

As part of her presentation on how MP models are used in magnetostrictive transducer design, Julie Slaughter, Ph.D., a senior engineer at Extrema Products Inc., provided some insight into where different domain models and physics couplings come into play as part of the design process. For example, Slaughter says the team uses single physics modeling during the detailed design stage, but then turns to coupled models as part of the design validation process.

"We don't like to do coupled models during detailed design, because it adds a lot of complexity to the system that you don't need at that point," she explained during her presentation.

Corrosion Modeling

The third COMSOL user presenter was Siddiq Qidwai, Ph.D., a mechanical engineer at the Multifunctional Materials Branch of the U.S. Naval Research Laboratory. Qidwai's research was all about leveraging COMSOL to explore structural corrosion, which he characterized as a formidable problem for both the naval and maritime industries. As part of his presentation, Qidwai said that the cost of corrosion to the general populace constitutes about 2% to 4% of the U.S. gross national product — an astounding figure and a hard one to ignore.

Qidwai said the comprehensive modeling of corrosion requires the coupling of electrochemical relations and balance of mass involving multiple species; constitutive descriptions of reaction rates and species diffusion mechanisms in the electrolyte; and conditions governing the movement of metal-electrolyte interface. Using COMSOL Multiphysics, Qidwai's team takes a gradual approach to this highly complex modeling agenda, going from simpler to complex phenomena, to investigate the effect of microstructure on corrosion pit growth and the subsequent effect on mechanical performance.

COMSOL 4.4 Debuts

While the upgrade adds some user-requested capabilities across many of its modules, there are a couple of major highlights. One is the revamped user interface that delivers a Windows look and feel, including the addition of the Microsoft ribbon for easier and faster access to functionality — and to keep users versed in Microsoft Office products working in a familiar way. COMSOL is retaining its traditional model builder interface for existing users who might be more comfortable with that approach.

The other major addition is the Mixer Module, an add-on to the Computational Fluid Dynamics (CFD) Module designed to help users understand and design the operation of mixers in the pharmaceutical, fine chemical, and food industries. This new module, one of many highly vertical add-ons COMSOL has announced in the last few years, provides full-moving mesh technology, free surface modeling, and a number of ready-made applications to help engineers explore laminar and turbulent reacting flows in rotating machinery.

— B. Stackpole

RTT Buys Bunkspeed, Reaches New Markets

In October, RTT snatched up Los Angeles-based Bunkspeed, a fellow rendering software developer. So why is the company, already well known among automotive manufacturers for its DeltaGen 3D visualization software, buying another renderer? The answer lies with the different markets the products target.

RTT's DeltaGen is a high-end product, by the company's own description. By contrast, Bunkspeed SHOT is an easy-to-use rendering program, targeting CAD users with little or no training in the use of complex rendering applications. RTT's purchase of Bunkspeed gives the company a robust product to sell downmarket.

"The addition of Bunkspeed's specialty services and footprint will allow RTT to provide a broader range of capabilities to our customers," says Peter Stevenson, CEO of RTT USA.

Although they cater to different audiences, both companies share a dedication to the parallel processing potential of graphics processing units (GPUs). When GPU maker NVIDIA began promoting its Maximus technology — a setup that lets you deploy more than one GPU in a workstation — RTT DeltaGen was one of the featured applications. Bunkspeed SHOT was built for GPU acceleration using NVIDIA's compute unified device architecture (CUDA) programming platform.

High-end rendering and visualization software developer RTT snatches up Bunkspeed, another rendering software maker.

According to RTT's press announcement of the acquisition, "Bunkspeed will continue to operate under the same name and is now a wholly owned subsidiary of RTT. The incorporation of Bunkspeed will take place over the upcoming months. During the interim period, clients will receive continued support and the same advanced quality product that they have come to expect from both RTT and Bunkspeed." The company also revealed that Steven Madge, RTT's managing director of the Pasadena office, has been named CEO of Bunkspeed.

— K. Wong

Siemens Dips Its Toe into SaaS with IntoSite

The launch of IntoSite, an addition to Siemens' Tecnomatix suite, marks the company's first steps toward a territory it has so far sidestepped: the public cloud.

Tecnomatix IntoSite, according to the company, is "a cloud-based web application that maintains a 3D representation of a production facility, presents it in its geographical context, and allows you to navigate through the facility in the simple and familiar way you navigate Google Earth. IntoSite supports cooperation and collaboration on the shared information in your enterprise, and harnesses the 'wisdom of the crowd' by enabling the sharing of best practices, tips and tricks."

Tali Segall, a senior product manager at Siemens, clarifies that "the server is hosted and maintained by Siemens." The solution is expected to launch in monthly subscriptions at less than $100 per user per month.

Virtual factory and plant designs stemmed from manufacturers' moves to digitize and simulate every aspect of their workflow. Siemens laid the groundwork for IntoSite when it introduced a Tecnomatix plant simulation solution a year ago. But the latest product, IntoSite, is augmented with location intelligence.

"The system allows anyone in the organization to add and contribute material, tips and tricks, best practices, etc., that will immediately be displayed in the appropriate 3D/Geo context," Segall explains. This social media-inspired feature is expected to offer organizations to harvest the collective wisdom of its staff, possibly even the public, she adds.

3D representation of a production facility shown in Siemens' Tecnomatix IntoSite software. *Image courtesy of Siemens PLM Software.*

The product targets facility owners and operators. The ability to maintain an accurate, up-to-date virtual representation of a plant could be of immense value to automotive manufacturers, oil and gas businesses, and energy producers. With such a solution, Software-as-a-Service (SaaS) deployment makes the most sense, as it's most effective when field workers can remotely access it from a browser. Segall says the current version of IntoSite has no mobile device support, but "it's definitely on the road map."

— K. Wong

Conference Recaps

by Jamie J. Gooch

Toward the Goal of Complete System Simulation

This year's Siemens PLM Software NX CAE Symposium 2013 was held at the University of Cincinnati last month. It featured more than two dozen presentations, roundtables, and panel discussions, as well as two workshop tracks. Siemens PLM Software NX customers explained how they used the software to simulate everything from tiny 0.015mm cardiovascular stents to huge, ship-based cranes and heavy-lift rockets. While the simulation projects were varied, there was a common theme running throughout the symposium: the need to reduce cycle times via collaboration and system-level engineering.

"The rate of innovation and the rate of development ... and bringing (products) to market is speeding along at a rate that most of the people in this room can only imagine," said the opening presenter Dave Shook, senior vice president and managing director, Americas, for Siemens PLM Software. "You can't take weeks or months to go do this. It needs to be done in hours, not days to bring together the mechanics and the software ... It's the whole closed-loop process."

That vision of a closed-loop process — one platform for the entire design cycle, including testing — is what drove the $750 million acquisition of LMS by Siemens that we reported on last year.

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Simulation Data Management is an On-ramp to PLM

Product Innovation Chicago featuring PLM Roadmap was hosted by industry consultants CIMdata and MarketKey Ltd. in October. They assembled experts from engineering, research and development, and information technology to share their experiences implementing product lifecycle management (PLM) solutions.

The Commissioner and CIO of Chicago, Brenna Berman, and Adrian Micu, vice president of Engineering at CES Corp. kicked things off with keynotes in the PI Congress and PLM Roadmap tracks, respectively. Other speakers represented the likes of Boeing, Dow Chemical, Rolls-Royce and Whirlpool.

Keith Meintjes, practice manager, Simulation & Analysis for CIMdata, explained how simulation can be incorporated into a PLM system to help drive business decisions. He said simulation and analysis was a $4 billion industry in 2012, and is projected to grow 15-20% over next few years. But he cautioned companies to look beyond just the technology aspect of building a collaborative system.

As if to illustrate that point, other presenters shared their challenges in implementing PLM. Whirlpool's Senior Engineering Manager, Ken Rashe, said the company is still fighting an engineering culture of working locally, rather than using the PLM system. And, Dow Chemical Senior Asset manager Mike Williams explained how the company's Manufacturing department formed an alliance with Finance and R&D to propose a PLM process to upper management.

Next year's European congress will be held in Berlin, and the U.S. conference will be held in San Diego.

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Stratasys Defines Itself and the 3D Printing Market

A year after the merger of Stratasys and Objet, and just months after its acquisition of MakerBot, the company was ready for its close-up. In October, Stratasys hosted the Manufacturing the Future Summit at its headquarters in Eden Prairie, MN. About a dozen journalists were on hand, and more dialed in, to hear Stratasys executives and customers explain how 3D printing is not only saving them time and money, but enabling new business models and new ways to design products.

The summit kicked off Tuesday night with a dinner and then resumed early yesterday morning with a series of speakers and a tour of RedEye by Stratasys (formerly known as RedEye On Demand). First up was Stratasys CEO David Reis, who answered a question he is routinely asked: Why, after 27 years, is 3D printing suddenly so popular?

"One of the reasons has to do with the improved accessibility and ease of use of the technology that makes it possible for anyone – children, students, and hobbyists or professionals – to use 3D printing for whatever their needs," he said, "whether it's for fun, education, design or manufacturing."

Reis predicted today's students will graduate expecting 3D printing to be used in the workplace, underscoring why education is such a valuable market for the company. Outside of education, Stratasys breaks down the markets it now serves into personal, augmented and alternative manufacturing sectors.

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Can You Afford **NOT** To Do Simulation Based Design

Shorter design cycles and multiple iterations are within reach via simulation and professional workstations.

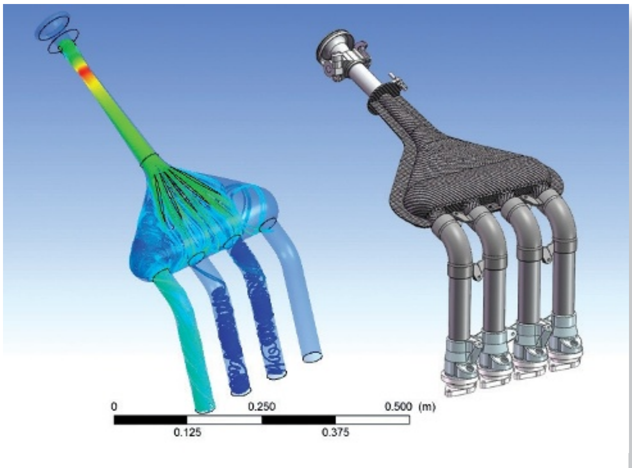

Image courtesy of ANSYS, Inc.

You've heard all the talk about simulation-based design. You've listened to colleagues—maybe even some of your competitors—wax on about how doing robust simulation studies early on in the design cycle leads to more and better product ideas while also optimizing use of materials. In fact, you're sold on the need to embrace advanced analysis, but you just don't see how it's feasible given the complexity and high cost of the simulation software — not to mention, the high-powered workstation gear.

It's time to put those preconceptions aside and look at the reality of just how accessible and affordable both high-powered workstations and advanced analysis software have become. Today, any design and engineering professional can easily trade up a mid- or even high-end desktop computer for an Intel Xeon-based workstation that fits within the parameters of the average budget. In fact, a dual processor Intel Xeon-based workstation with up to 24 cores is far more affordable than ever before and it can deliver the desktop computing power necessary for running the robust parametric design studies and advanced analysis so crucial to modern-day product development.

The Right-Sized System

Why is it so important to invest in a system that is right-sized for parametric design studies and analysis? As business pressures continue to mount, studies show companies taking a simulation-driven design approach are far more likely to be leaders in their markets. Not only can simulation-based design replace or reduce physical prototyping as a cost-saving measure, the approach can also inspire a completely new style of experimentation designed to spark innovation and spur development of best-in-class products, experts say.

Consider research from Aberdeen Group. The firm found that the top 20% best-in-class companies pursuing a robust design approach, including widespread use of simulation, were more likely to meet product launch dates, hit product revenue, cost, and quality targets, and reduce development cycles. Not only do Intel Xeon processor-based workstations and HPC clusters help drive significant time and cost out of the development process, they can also ensure design robustness and ultimate product integrity, Aberdeen analysts say.

Putting an affordable simulation-based design engine within close reach will also empower engineers to embrace new kinds of innovation workflows. For example, such a setup would allow for the iteration of more ideas and testing of coarse-grain models on the local workstation, utilizing the more expensive local or scalable cloud-based HPC resources more cost-effectively for higher fidelity modeling of the optimized model at a critical point in the design cycle. In addition, a research project conducted by Sandia National Laboratories showcases how the new wave of affordable Intel Xeon-based workstations and HPC clusters can be used to enable stochastic modeling, enabling simulations to be used not just for single-point predictions, but also for automated determination of system performance improvements throughout a product life cycle.

Before closing the door on simulation-based design because it's too costly or complex, consider how the world of high-powered computing has changed. Thanks to the accessibility of affordable analysis software and workstations based on Intel Xeon processors, professional-grade simulation capabilities are well within reach of engineering organizations, both large and small. To find out more about Intel's Xeon-based workstation products, go to www.intel.com/workstation

Bionic Man Shows Off Advanced Prosthetics

A "bionic man" developed at the University of Zurich paid a visit to the U.S. capital in October, displaying some of the most advanced prosthetics technology available.

The international team that built the robot has recreated more than 50% of the human body — including limbs and a complete circulatory system — in the remote-controlled humanoid contraption.

Shadow Robot Co. spearheaded the assembly using donated components, including a Touch Bionics i-limb prosthetic hand, a device also worn by Bertolt Meyer, Ph.D., who designed the robot. The bionic man includes 200 processors and nearly 1 million sensors, along with 26 individual motors and 70 circuit boards.

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Army Looking for a Few Good Helicopter Designs

The U.S. Army has signed technology investment agreements with Bell and Lockheed Martin, Boeing and Sikorsky, Karem Aircraft and AVX Aviation to develop prototypes for next-generation light- and medium-sized helicopters. The four teams will compete for the business as part of the Joint Multi-Role (JMR) Technology Demonstrator Phase 1 program. Two prototypes will be chosen to be built by 2018, with full deployment by 2030.

The helicopters must be able to travel at 265 mph (double current speeds); be able to hover at altitudes of 6,000 ft.; and must be quieter than current models.

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Ship Uses Internal Waves for Stability

Designers and researchers at Marintek (a division of SINTEF) are testing a ship design that can generate waves inside its own hull to stabilize the vessel while docked next to an oil rig.

The Offshore Accommodation Vessel has water tanks in its hull formed into the shape of a U. Air valves control the direction of the water as it moves in the tanks. By counteracting the motion of the external waves with artificially generated internal waves, the designers believe they can reduce the motion of the ship. The ship will also have azimuth thrusters that will be used to hold the ship's position next to the rig. The crew will be able to move from the vessel to the drilling rig via a telescoping 182-ft. gangway. Ship owner Østensjø contracted design company SALT to develop the ship. Hoppe Marine came up with the internal wave system, which has been modeled and tested by Marintek.

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Team Wins Solar Challenge

Delft University of Technology in The Netherlands won the 2013 World Solar Challenge, making a 1,864-mile trip across the Australian outback in about 33 hours, with an average speed of about 56 mph.

The Nuna7 vehicle's shell was made using DSM's Daron resins, optimized for use with TeXtreme carbon fiber. The team used DSM's Somos stereolithography materials for prototyping. Nuon also used a lightweight version of Semprius' high-concentration solar photovoltaic modules (NCPV) to power the vehicle. The modules were less than 2.75 in. thick, and were able to deliver about 13.6 watts per lb.

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'Jumping' Water Droplets Could Produce Electricity

Researchers at MIT have stumbled across a potential source of energy: condensation in the air. While investigating how water droplets interact with superhydrophobic surfaces, they discovered that the repelled droplets produce a net positive electrical charge as they jump from the surface.

These jumping droplets enhance the efficiency of heat transfer on condensers, potentially improving power plant efficiency. By applying a charge to a nearby metal plate, the droplets can be pulled away from the surface, reducing the likelihood of their being pushed back onto the condenser. The findings also suggest that power could be generated via condensation in the air. By placing two water-repellent metal plates outside, energy could theoretically be produced by the water droplets jumping from one to the other.

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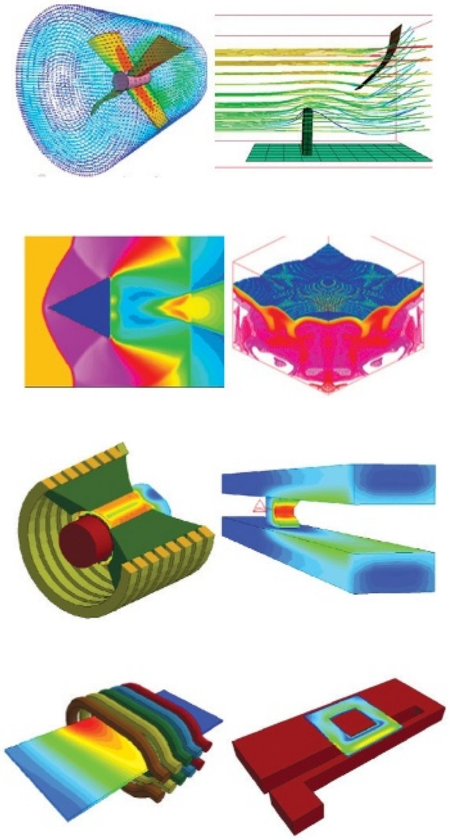
13th LS-DYNA® U.S. & International Users Conference



June 8th - 10th, 2014
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Welcome and Call for Papers

Livermore Software Technology Corporation (LSTC) and **DYNAmore Germany** are pleased to bring engineers, professors, students, consultants, industry leaders and interested parties together at the 13th International LS-DYNA® Users Conference to be held at the Adoba Hotel (formerly the Hyatt Regency) Dearborn, MI.

Important Dates:

Abstract Deadline: Nov 30, 2013
Email Your Abstract to: papers@lstc.com
Notification: No later than Dec 15, 2013
Paper Deadline: Mar 5, 2014.
Papers are being reviewed upon receipt, with immediate notifiction of acceptance.

The presenter of each accepted paper will receive free admission to the conference, provided that the presenter registers for a room at the Adoba Hotel under the LSTC Conference registration.

Application Areas Being Accepted for Paper Submission:

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Microsoft Prepares AM for Internet of Things

Microsoft Research is just as interested in the Internet of Things (IoT) as other tech companies, and has been quietly working on ways to include the technology in a number of objects via a variety of different sensor types. Most of this research uses radio frequency identification (RFID) chips for tracking purposes, but new research has developed a method of using terahertz (THz) imaging to read specially designed structures within objects built with additive manufacturing (AM).

The system is called InfraStructs, and is the brainchild of Karl Willis, Ph.D., from Carnegie Mellon University, and Andrew Wilson, Ph.D., from Microsoft. The basic premise of InfraStructs is to use the capability of AM to build complex internal geometries to self-embed three-dimensional codes into objects that have been wholly or partially built using a 3D printer. These codes are then read by a THz scanning device and used for everything from simple identification to actual programming code that allows objects to connect with outside systems.

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Latest DLP Systems: the ULTRA 3SP and 3SP HD

EnvisionTEC's Digital Light Processing (DLP) uses a vat of photocurable resin and a DLP projector to produce a 3D object. The object is built in chunks, called voxels, which means no strata lines. EnvisionTEC's latest offerings using DLP are the ULTRA 3SP and 3SP HD.

The main difference between the two products is resolution. The 3SP offers 100μ, while the 3SP HD is capable of up to 50μ.

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HP Indicates Plans to Enter AM Market by 2014

With the rapid growth of additive manufacturing (AM), it's easy to forget the market is still relatively small when compared to big business. Even the largest AM manufacturers, 3D Systems and Stratasys, aren't large when compared to giants of industry like Apple or GE.

At the Canalys Channels Forum in Bangkok, HP CEO Meg Whitman announced the company's intention to build 3D printers, entering the market in 2014.

"We are excited about 3D printing," said Whitman. "We want to lead this business. HP Labs is looking at it. 3D printing is in its infancy. It is a big opportunity and we are all over it. We will have something by the middle of next year."

Whitman added that HP's main concerns with the technology at its current state are build speeds and the cost associated with buying a top-of-the-line AM system. She also insisted that when HP launches a product, it will be something new. That likely means HP won't be partnering with existing manufacturers the way it did with Stratasys in the past.

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Arburg Unveils freeformer System

Arburg represents one of the first established businesses to wade into the additive manufacturing (AM) fray with its freeformer 3D printer.

Arburg's AM process is based on plastic, but differs from the material extrusion printers that have become generally available. In place of plastic filament, the freeformer uses plastic beads, which are melted inside the system. The melted plastic is forced out the nozzle in the form of plastic droplets, which build up an object over time. According to the company, its process doesn't require support materials, and uses less materials overall.

Another difference is the printhead. Instead of the nozzle moving over the surface of the build area, the build area moves around the nozzle utilizing 5-axis movement to complete a build.

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Lockheed Martin Steps Up Digital Manufacturing

Lockheed Martin envisions a "digital tapestry" of production in which every step of the process of creating new goods is a single strand. Its tool of choice is model-based engineering (MBE), an integrated toolset that updates and maintains digital data from start to finish.

Lockheed Martin's Collaborative Human Immersive Laboratory (CHIL) is a part of the MBE. CHIL is a virtual reality (VR) design and simulation laboratory that can be used to optimize designs and help ensure a finished product will meet optimal specifications. The VR lab can also identify potential problems in the flow of production before they become an issue.

On the AM front, the company has stepped away from traditional manufacturing techniques for the construction of parts with complex internal geometries, or that must be built from expensive materials, such as titanium. AM not only reduces the production time of these items, but offers substantial savings.

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by Anthony J. Lockwood

Editor's Picks

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

Maple IDE Reduces Development Time

New development environment can manage projects in Maple language.

Maplesoft's Maple technical computing and documentation environment is one of the handful of engineering, scientific, and research tool suites that resides on a different plane than the rest. Part of the reason for this is its great depth and breadth, and part of it is because you can access the Maple language and develop your own algorithms, scripts, and extensions. With the recent introduction of Maple IDE, making your own Maple code sounds like it just got a lot easier

Maple IDE is a new integrated development environment for the Maple programming language. So, what does Maple IDE have in it for you?

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Altium, Desktop EDA Partner for ECAD, MCAD Integration

Integration synchronizes capabilities between applications.

We're living in an electro-mechanical world. The mechanisms get their smarts from embedded electronics and the electronics need the mechanism and hardware to have a reason for being. Yet sometimes you'd think that ECAD and MCAD have nothing to do with each other. This is why the announcement from Altium and Desktop EDA about their working together to bring top-end ECAD and top-end MCAD together grabbed my attention.

The Altium and Desktop EDA announcement really is a two-part affair, but both parts target greater productivity in the ECAD and MCAD design environments by making them work together more tightly.

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HP Unveils New Z Workstations

Also introduces new Z-series displays optimized for professional use.

HP's recent announcement of its new Z230 Workstation caught my eye because they say flat out that it's engineered for professional use 24/7/365.

The Z230 comes in traditional tower and small form factor (SFF) versions. The tower unit measures 15.7 x 6.7 x 17.4 in. (H x W x D) and the SFF comes in at 3.95 x 13.3 x 15.0 in. Both workstations pack a lot of punch: quad core Intel CPUs running 3.20GHz Core i5 processors with 6MB of cache up to 3.60GHz Xeon processors with 8MB of cache. They can house up to 32GB memory, and storage options will take you well into terabyte territory.

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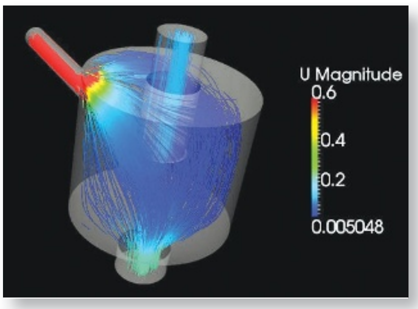

Simulate On-Demand

Browser-based online platform provides access to on-demand computing for simulation.

The SimScale Platform is an online, on-demand, and scalable system for engineering simulation. Specific CAE (computer-aided engineering) tools target structural mechanics, fluid dynamics, and thermodynamics analyses. For structural mechanics, you can do things like modal/frequency analysis and nonlinear and dynamic simulations. Fluid mechanics simulation capabilities include laminar and turbulent modeling and mass transport within fluid flows. You can use SimScale Platform's thermodynamic analysis tools to conjugate heat flows or use its steady state and transient solvers with time-dependent processes.

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Winning the Hearts and Minds of Rocket Scientists

ULA set out to consolidate analysis data and processes in Siemens PLM Software's Teamcenter.

BY KENNETH WONG

When Michael Gass, president and CEO of United Launch Alliance (ULA), sat down for an on-camera interview with Siemens Product Lifecycle Management (PLM) Software's public relations department, he revealed something about engineers that might seem counterintuitive to many. "Engineers are not the most flexible people, especially when they have a process that works," he observed. "In our culture, we kind of resist change … Anytime you introduce a new process, there's a bit of resistance."

That culture is bound to test the massive data-and-process consolidation initiative at ULA.

As the science of rocket building gets more sophisticated, the types of analysis and simulation possible to predict and perfect the rocket's performance also grow. "What is necessary to [analyze a rocket] evolved over time," says Marc Solomon, ULA's PLM chief engineer and engineering systems architect. "We kept saying, 'Let's go try this' or 'Let's make sure this doesn't happen.' We're constantly learning. So we end up where we are today — hundreds of tools, and a chain of analysis in multiple steps, each one feeding into the next."

It wouldn't surprise anyone that ULA relies on digital simulation using industry-accepted CAE software to verify the integrity of its product concepts. But what's lesser known is its reliance on non-geometric analysis. Solomon describes them as large-scale calculations related to "mass, moments of inertia, control dynamics, and angle of attack, for example." These are, he says, "non-geometric analysis parameters that affect the basic plan of flight."


United Launch Alliance's engineering workflow is designed to minimize human error via automation.

ULA's ambitious plan is to bring hundreds of simulation tools — a mix of homegrown, commercial and hybrid codes — under a single environment. As its data-management hub, ULA chose Siemens PLM Software's Teamcenter. Solomon predicts that the team will "probably learn more about ourselves than we do about Teamcenter" in the process.

The Data Mound

In the past, ULA had to cope with disconnected systems and manual processes. To keep product development from different disciplines in sync, the staff resorted to labor-intensive data re-entry.

"How we melded data was measured in meetings and meeting time," Gass explains. "It was brute force to get everyone to share information and check through the data to verify an analysis translated to a physical design. To have the most up-to-date data, we relied on manual processes — and obviously that led to errors."

The data syncing difficulty was made more complex by ULA's use of multidisciplinary optimization (MDO), an approach in which various simulation and analysis tasks undertaken by different departments must come together.

"Our designs are essentially larger than their parts," explains Solomon. "In most cases, we're analyzing a large chunk of the system or the whole thing. It seems the rest of the world is focused on design management. That's not enough for us. We must manage our design, but the world we work in demands a comprehensive engineering approach."

Because ULA is one of a handful of companies building rockets, the company had to develop in-house tools to tackle the tasks commercial software couldn't address.

"In the rocket world, there aren't too many things you can buy off the shelf," Solomon quips. "We use lots of commercial tools, tools we've developed in-house, and hybrid tools that have home-developed extensions on commercial tools. A big part of our Teamcenter integration is looking at how to integrate our non-commercial software tools."

Big Bang Not Recommended

Like any large institution, ULA has built up the equivalent of muscle memory in its processes over the years. To persuade its staff to abandon the familiar routines, even for more efficient ones, wouldn't be easy.

"I knew it was going to be hard, and it continues to be hard from the social perspective," Solomon admits.

If the current system isn't broken, why fix it? "We also wanted to break the mold of being tied to our roots to go on to doing something new," Gass says, adding that he also recognized change is not ULA's forte. Thus, he hedged on an incremental deployment strategy: Instead of the all-at-once Big Bang approach, which would have likely been disruptive and resistance-prone, the company launched a pilot program that would serve as a template.

As its first priority, ULA singled out requirements and analytical systems, the sectors that involve a high number of homegrown tools with different characters.

"Every [launch] mission has its own series of analyses," Gass says. "Not only

LEFT: ULA measures launch success by its analysis work, even more so than its design work.

BELOW: ULA is integrating its simulation tools via Siemens PLM Software's Teamcenter.

do we manufacture the rocket, but we also manufacture the mission design, and our ability to predict and model the mission, and deliver it to customers so they can use it, is critical."

Gass had another reason for starting with analysis: Simulation analysts comprised the biggest skeptics who believed they could do everything themselves. At the same time, he also recognized they had the skills to embrace a project of this magnitude. Getting early buy-in from this group, then, would set the tone for the rest of the enterprise.

"We're at the beginning stage. We've done all the homework. We've built the railroad tracks [for integration]," he says. "So as we move from group to group, we don't need to start all over. We pick a solution of ours, figure out the manner in which we'd like to integrate it, capture that very quickly, and then move on to the next group. It's important to do this on an incremental basis, because we cannot destabilize the business as we move [our tools] into Teamcenter."

Laying Down the Tracks for the Future

When fully implemented, ULA's Teamcenter deployment will oversee a mix of intertwining analysis activities, spanning from stability calculations in MathWorks MATLAB to structural analyses in Siemens' NX CAE. The success of the implementation might be difficult to quantify, but Solomon has a specific yardstick in mind: "We want to see radical improvement in our ability to move information through the business."

There is also the issue of the retiring workforce. ULA's current simulation expertise is confined to a small group, a "special tribe." Therefore, in Gass' words, "the transfer of tribal knowledge to the next generation and [to] do so as fast as possible using tools that appeal to the next-generation's skill set" has taken on new urgency.

ULA runs two distinct rocket product lines, dubbed Atlas V and Delta IV. Each system, according to Solomon, has its own rich history and enterprise knowledge.

"In the process of integrating the two businesses, with lots of different ideas from each, we have to make sure we incorporate everything we know about each, and not lose any knowledge," he explains. With Teamcenter as its consolidated data and process hub, he says, ULA hopes to retain its institutional wisdom.

ULA engineers are used to relying on a rigorous checklist of questions to conduct their analyses. The data from the checklists will now be mapped into Teamcenter, so most handoffs are automated, with a series of dashboards that reveal hiccups.

The most immediate benefit from the project so far, Solomon observes, is a "reduction in overhead of documenting analysis assumptions, processes and outputs. These tasks used to be repetitive manual data-entry tasks; today, they're to be captured by the system." As a consequence, Solomon points out, "someone downstream should be able to follow a chain of analysis all the way back to the start, so he or she can confirm or challenge the assumptions."

Another advantage introduced by Teamcenter is easier change management in the analysis chain.

"[Engineering] assumptions cascade through one group to the next," Solomon says. "If there's a change, new assumptions move downstream. So whenever there's a change injected into the process, the groups have to reassess the assumptions."

With manual data entry, there was always a risk that altered assumptions might not properly be communicated to the rest of the analysis tree. The automated process ensures changes are flagged with alerts, along with dashboards providing a transparent view of how the change affects the rest of the operations.

“We tend to be overly cautious, because our mistakes are highly visible,” Solomon notes. “If we don’t truly understand a change’s impact, we might possibly — and certainly have in the past — redo the work we’ve done, just to be sure. If we understand the changes, we save cycles by reducing — in classic Lean manufacturing terms — overproduction.”

Hands-free Flight

Even among devout fans of rocket science, there may be a common misconception that unmanned rockets launched into space are meticulously shepherded by a team at Mission Control, perhaps using a sophisticated steering device to drive them through asteroid fields like you might do in a video game. But that is not the case, Solomon says.

“The launch vehicles are truly autonomous,” he explains. “When we designed them, we gave them structure, capability and power. We also gave them autopilot. We tell them, ‘Your job is to get from here to there. Whatever you may encounter in space, your job is to get this [payload] to this point and drop it off without breaking it.’ At a certain point, we say goodbye to them; they’re on their own. There’s nobody with a joystick driving them.”

To be able to travel through space autonomously, the rocket’s internal infrastructure must facilitate automatic flight data assessment, with no manual intervention from Mission Control. There’s a certain parallel to this hands-free approach to be found in what ULA has set out to accomplish with Teamcenter.

“We’re not research scientists tackling open-ended questions. We’re trying to solve engineering problems within set schedules and costs,” Solomon concludes. “We want to let our engineers be part of an integrated system that stays in lockstep with the business, but we don’t want to tell them how to do analysis.”

Gass echoed the sentiment while talking about the project at Siemens’ analyst event in September: “It’s all about winning the hearts and minds of people. Introducing Teamcenter is more about people change management than about IT connectivity.” **DE**

Kenneth Wong *is* Desktop Engineering’s *resident blogger and senior editor. Email him at kennethwong@deskeng.com or share your thoughts on this article at deskeng.com/facebook. Additional reporting by* Desktop Engineering *Contributing Editor* **Beth Stackpole**.

INFO ➜ MathWorks: MathWorks.com

➜ **Siemens PLM Software’s interview with ULA CEO Michael Gass:** youtu.be/RUX6pSB941A

➜ **Siemens PLM Software:** PLM.automation.siemens.com/en_us

➜ **United Launch Alliance:** ULALaunch.com

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As an engineer, you know that sometimes you have to take work home or to the client. You dread it because your home system and your business notebook are not up for the job. Introducing the all-new MSI GT70 and GT60 Mobile Workstations from MSI Computer Corp. With the power and flexibility to serve as a multi-monitor desktop workstation running compute-intensive engineering applications, the GT70 and GT60 Mobile Workstations are built and designed so that you can take your engineering workstation with you wherever you need to go.

Based on the award-winning GT Series notebooks, the GT70 and GT60 next generation workstations are fueled by NVIDIA Quadro K3100M and K2100M mobile graphics cards and Intel Core i7-4700MQ processors. Fully certified and optimized for such industry-leading applications as Autodesk, SolidWorks, and Adobe, the GT70 and GT60 leverage NVIDIA Quadro technology empowering you to run design and rendering, structural analysis, or fluid analysis without any downtime or delays.

The GT70 and GT60’s Matrix Display technology lets you switch from a mobile workstation to a multi-monitor desktop workstation easily and efficiently. Matrix Display supports up to 3 external independent displays simultaneously, enabling you to render 3D images, design, and check your reference files at the same time.

Engineers and designers looking for a mobile workstation with higher resolutions, sharper images, and an precisely calibrated display will appreciate the 3K monitor versions of the GT60. The GT60’s maximum 2880 by 1620 display output ensures that your designs are represented the way they were meant to be.

The GT70 and GT60 Mobile Workstations are also designed with exclusive networking optimizations – the Killer DoubleShot high-performance Ethernet and Wi-Fi networking solution from Qualcomm Atheros. Offering up to 5x better latency than similar solutions, Killer DoubleShot gives you the horsepower to handle multiple in-coming and out-going data streams at once. For superior bandwidth control, Killer DoubleShot’s Visual Bandwidth Control lets you see and manage your data streams in real-time.

To learn more about the MSI GT70 and GT60 Mobile Workstations for engineers, go to: www.msimobile.com/workstation.

Overcoming Corporate Culture to Make a Change

Looking to change things for the better? Don't be surprised to find all manner of obstacles in your path.

BY MARK CLARKSON

"About 15 years ago, we developed a product called Virtual Proving Ground," recalls Abe Keisoglou, president of Engineering Technology Associates (ETA). "It was a unique product, and we really thought that the auto industry would accept it."

Virtual Proving Ground, however, was not a success.

At the time, says Keisoglou, a rigid body kinematics program called Adams (now owned by MSC) was the predominant product in the auto industry for doing load simulations. "A whole car was about 60 points," he says. "It's a very simple model to build, and runs very quickly."

But to create that model, you first had to build an actual car. "You'd build a prototype," says Keisoglou. "It costs $1 million, and takes six to nine months. Then you instrument that car, and run through different road conditions at the proving grounds while you capture data on all the loads. You take those loads and build an Adams model, and tune it to match the experimental data from the car. Then you've got a model you can use to start making design changes for the car."

"You can't do any design for at least a year," he adds. "So we came up with Virtual Proving Ground. You build a finite element (FE) model of the whole car — instead of having 60 points, you have millions of elements: elements that describe the body, the suspension, the chassis and the road surfaces. You can get results within 10% to 15% of experimental results up front, without building a million-dollar prototype. You save six to nine months in your design cycle up front."

Keisoglou and his team completed several successful projects with Ford, GM and Chrysler. Top management was excited, each time enthusing "This is a great idea. Let's do it!"

So how, exactly, did Virtual Proving Ground fail? Top management.

"They didn't want to make enemies of middle management by forcing things down their throat," Keisoglou explains. "So they would say, 'You need to talk to so-and-so middle manager. He needs to implement this himself, so he needs to feel comfortable with it.' This middle manager's career is based on a legacy of success with [Adams]. They had a lot of money invested in the software and the training. They would do everything possible to kill the implementation of our new process. And politically, it became impossible to break through and implement our technology. This was almost across the board in the U.S. auto industry."

It's not just management who's resistant to change, of course. Bill Zavadil, senior vice president at IMAGINiT Technologies, recalls a project with a major equipment manufacturer who had spent millions of dollars to migrate from CADAM to Autodesk.

"Two years later, we walked into the place and the guys were still using CADAM," he says. "It's what they were used to. They were getting the job done. One day, [the company] took that desktop away, and forced them to make the change.

"You're always going to have people who aren't going to buy into change," Zavadil continues. "But the company didn't try to understand where these guys were coming from. They didn't explain the logic behind the change, didn't articulate the objectives behind it. That has to come from the top."

Until Now, Everything Was Fine

Sometimes, the problem lies in convincing management that potential problems even exist when everything seems to be going swimmingly. Companies often make the mistake of assuming that, since they have created a process that consistently produces good quality products, they understand how that process works.

Nicholas Veikos, Ph.D., president of CAE Associates, poses some key questions: "Do you really understand how your product works? Do you really understand what will happen when you change things? I can't tell you how many companies we've walked into that have changed something in their product and now it didn't work anymore. They didn't know what to do."

Veikos recalls one such company whose business was making foam mattresses. "They had a very old process that had developed over time," he says. "It worked just fine, and then something forced them to make a change and it stopped working. The one guy who knew how to tweak the thing was long gone and retired. All the company did was make these mattresses, and they had no insight into what was going on. They thought they knew how it worked, but that wasn't how it worked at all."

Segregation

"Sometimes," notes Rod Mach, president of TotalCAE, "the company is segmented in a way that creates these islands of engineering. There's a CAE group and an FEA group. Or they'll segment groups by product. That might look good on an org chart, but groups don't speak to each other and aren't learning from each other. They each only have a small pool of money. They can't pool licensing or hardware or brains."

For example, Mach continues, he was consulting on a project that several different groups within one company were trying to do independently: "They were all going to the same vendors and getting quotes they couldn't afford. We said, 'Did you know there are other people at your company doing the same thing? Why don't you all work together and pool the money to get the tools you all need?' They were all starving, whereas if they'd pooled their money together, they could have gotten a steak dinner."

You Want What?

Another big impediment, says Mach, is that management views engineering technology the same way they view a file print resource. They don't understand why engineers need so many expensive resources: "Engineers just want better toys. Why can't they run on their laptops like everybody else does?"

"In most companies, IT will try to shoehorn you into [hardware] they've already picked," he continues. "But these are scientific instruments that take special skills and are solving special problems. Your IT department might not be your best leader to decide what your engineers need to get their job done."

> **"There's always resistance to change. Always. Even if the change is better, people naturally resist change."**
>
> ***— Rod Mach, president of TotalCAE***

In addition, management may not always recognize expenses. "A lot of the focus at companies is on the spending side," says Mach. "The ROI calculations often don't consider labor and time to market."

Take simulation run times, for example. "People get accustomed to engineers sitting around for a week waiting for an answer," says Mach. "They see the capital expenditure of getting a better resource in place — a cluster or what-have-you — as an immediate expense, but they don't see the value of getting the results faster, of the engineers not sitting around waiting. If you're paying 10 engineers $100,000 each, you're paying $1 million to have those engineers idle in order to avoid a $100,000 capital expenditure."

To get management's attention, says Mach, you need to quantify the improvement. Maybe the engineer won't be sitting and waiting for results as often, but what are you going to do with the time that you freed up? What are the benefits? Because the costs — the software, the hardware, the process, the consultants — are all too visible.

"Engineer-speak doesn't always translate up the food chain to the people who sign the checks to fund these initiatives," says Mach. "Don't say, 'I can do 1,000 runs.' Say, 'We can make our product X percent lighter than the competition if we have this tool,' or 'We'll get the answer 10 times faster, which will impact design and save money on testing.' That seems to be a better understood metric."

That can be hard to do, he admits: "You're setting yourself up for more work."

Be a Champion

"There's always resistance to change," says Mach. "Always. Even if the change is better, people naturally resist change."

Mach adds that for big companies especially, it's not usually one person's decision to adopt something new. If you can't find a champion, somebody who's really going to lead, then it takes just one person to negate the idea for it to completely disappear.

"You need someone with enough political capital to take a few bruises. Without that champion, without having someone who's really invested and can make other people believe in the change, it's very different to get things changed internally," he says.

To get management buy-in, says CAE Associates' Veikos, you have to be able to quantify the benefits. "There's no better way than some kind of pilot project," he says. "Find something that's not going to take the company down if it goes wrong, so nobody gets nervous, and then go through the process. Develop metrics for what success is, before you start, and then measure everything. At the end of the day, you'll have a very good comparison: Here are the quantifiable benefits that you've achieved, how much money you saved in the design process, how much time you've saved. Many times, that's sufficient to change the mindset."

"You have to stick your neck out and be proactive," agrees ETA's Abe Keisoglou. "You've got to take the lead. You have to take chances. Find out what the new technology is, and how to bring it into the organization with the intent of helping the company be more efficient and more profitable.

"Be a visionary. If you see something that needs to be done, go out there and make it happen." **DE**

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

INFO → **CAE Associates:** CAEai.com

→ **Dassault Systèmes CADAM:** CADAM.com

→ **Engineering Technology Associates:** ETA.com

→ **IMAGINiT Technologies:** IMAGINiT.com

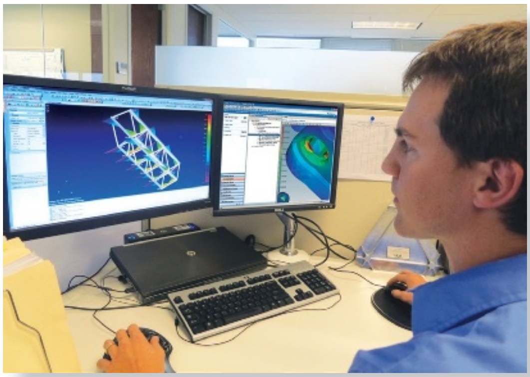
→ **MSC Software:** MSCSoftware.com/product/adams

→ **TotalCAE:** TotalCAE.com

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

Rocket Scientists Unite Simulation Data to Go Beyond

Teamcenter Simulation Process Management from Siemens PLM Software gives United Launch Alliance truly integrated simulation data.



United Launch Alliance (ULA) is the leader in designing and building vehicles to launch critical spacecraft for the U.S. Government, including the Department of Defense, NASA, the National Reconnaissance Office, and other commercial customers. As the science of rocket building becomes more sophisticated, the need for more complex, comprehensive simulation models evolves. With this evolution comes a need to unify and integrate data from a wide range of sources and align it to mission objectives.

It IS rocket science

To achieve its goal of 100 percent mission success, ULA has come to rely on a vast array of simulation solutions – both off-the-shelf and custom – and a chain of analysis in which one step feeds the next. This demands labor intensive repetitive manual data management. The result? An overwhelming mountain of data. ULA needed a better way to harness simulation data to speed launch timeframes and ensure quality.

Teamcenter – a powerful solution to a complex problem

Teamcenter Simulation Process Management was developed for exactly these types of challenges that need to integrate and leverage complex simulation data from a multitude of sources across the enterprise. Teamcenter Simulation Process Management provides data, workflow, and process management across departments and functions to streamline collaboration. ULA, a longtime user of Siemens PLM Software's NX CAE and Teamcenter products, saw the potential of extending its use of Teamcenter to address the simulation data management challenge.

A rational implementation path

Engineers are an inherently conservative group, especially in an industry where mistakes are highly visible. ULA management knew it needed to demonstrate early advantages on a controlled scale to fuel adoption. Teamcenter Simulation Process Management enables exactly the incremental roll-out they wanted. ULA could select a process to optimize, configure Teamcenter to address the challenge, and then move on to the next group. Although ULA is only beginning to implement this new approach, the early results are already paying dividends.

SIEMENS

About Siemens PLM Software

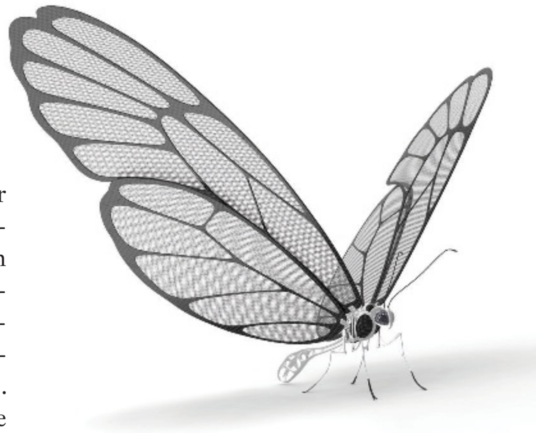
Siemens PLM Software is a leading global provider of product lifecycle management (PLM) software and services with seven million licensed seats and more than 71,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with companies to deliver open solutions to help them make smarter decisions that result in better products. For more information on Siemens PLM Software simulation products, please visit: www.siemens.com/plm/nxcae.

For more information visit:
www.siemens.com/plm/nxcae

Contact Information:
5800 Granite Parkway, Suite 600, Plano TX 75024
Phone: 1-800-498-5351 • Email: info.plm@siemens.com

Innovative Design Can Make Anything Lighter

Altair's technologies and expertise change the way organizations design products.



Altair develops and implements intelligent simulation technologies that allow you to significantly reduce the weight of your products, saving cost, fuel and CO_2 emissions, but how do we do it?

Instead of taking a product that's already been designed and just try to shave off material, we take a different approach, which we call 'simulation-driven design' where CAD and CAE are deployed in parallel.

Using our optimization technologies our clients can define a design space, an area where the component must fit in the structure, including data of any holes or access points required. Loads are applied to the design space along with manufacturing constraints and other variables, allowing our technology to suggest the best possible material layout, which meets the predetermined performance targets.

Over the last two decades, Altair has pioneered simulation-driven design to generate innovative design solutions for its clients. This has resulted in products that exhibit minimum weight and outstanding performance in industry leading timescales.

Altair's software solutions enable users to design high performance, weight efficient structures, starting in the concept design phase. Designers and architects can use solidThinking Inspire to generate and explore structurally efficient concepts in a friendly and intuitive environment.

Moving to product engineers and analysts, HyperWorks offers optimization solutions for both concept studies and design fine-tuning stages. OptiStruct, Altair's award-winning integrated analysis and optimization tool, along with HyperStudy, Altair's design exploration software, enable a multi-disciplinary product design cycle even for the most complex structures.

But we're not just another software developer. Altair began life as a product design services company and the knowledge of real world product development and understanding of manufacturing processes and constraints has never been lost. Our team works across industries, allowing us to use processes and techniques from one industry and apply them to another.

Altair

About Altair

A Culture of Innovation

Our vision is to radically change the way organizations design products and make decisions, developing and applying simulation technology to synthesize and optimize designs, processes and decisions for improved business performance. Privately held, with offices in 20 countries, Altair provides Innovation Intelligence® to thousands of customers worldwide.

For more information visit:
www.altair.com

Contact Information:

World Headquarters

1820 East Big Beaver Rd., Troy, MI 48083
Phone: (248) 614-2400 • Fax: (248) 614-2411
e-mail: info@altair.com

Replace Legacy PLM to Optimize and Accelerate Performance for Large-Scale Multi-CAD Management

Independent Testing Verifies Aras Next Generation PLM Outperforms Leading Legacy PLM and Loads CATIA 81% Faster.

If you're looking to optimize performance across the enterprise, there's no better place to focus than PLM starting with CAD file management. And if you are a CATIA user, you've likely experienced the frustration of slow performance when managing these large, complex files on a daily basis. You are not alone.

Performance is a very real challenge that global companies face with legacy PLM systems. Organizations are frequently forced to spend valuable resources and time to improve PLM performance, and are often unable to achieve meaningful improvements. Performance issues become particularly acute when a business has complex processes and is using a legacy PLM system for CAD data management, as the total size of files and metadata continue to increase exponentially.

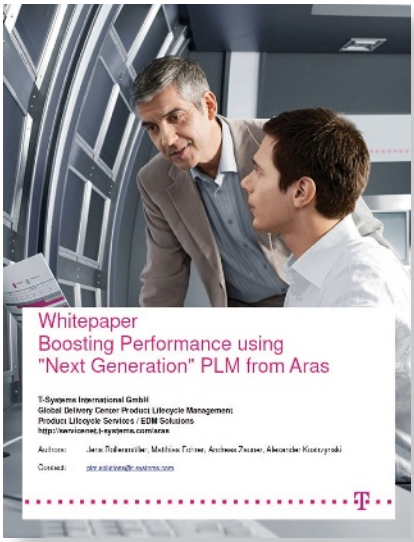
> **"Global companies should consider the performance characteristics of Aras comparable or better than other PLM software solutions currently available on the market, particularly for large complex CAD data management workloads."**
> ***T-Systems International***

A recent independent report by T-Systems International documents the actual, validated performance improvements achieved when a legacy PLM system for managing CATIA was replaced with Aras.

During a client project, a series of different real world assembly structures were identified, analyzed and used as reference cases. The file size of the CAD data varied between 50 and 450 MB — depending on the volume and complexity of the CAD structure — including test scenarios focused on the loading procedure of large assembly structures (with over 1000 CAD objects) into the design mode of CATIA V5.

Aras Innovator outperformed the legacy PLM system in every test.

Aras's speed ranged from 41% to 81% faster, performing better on larger assemblies. On the two largest assemblies, the legacy system failed to load the files even after several attempts while Aras loaded the assemblies quickly. What's more, Aras achieved these results with 1/3 the IT hardware resources of the legacy PLM system.



Read the full report at
www.aras.com/OPTIMIZE
BOOSTING PERFORMANCE USING "NEXT GENERATION" PLM FROM ARAS
by T-Systems International

About Aras

Aras provides powerful PLM technology to leading companies around the world. Only Aras offers a highly scalable, flexible and secure PLM platform with an open architecture designed specifically for tomorrow's complex global product development environments. Discover your next PLM solution at www.aras.com

aras corp®

For more information visit:
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300 Brickstone Square, Suite 700
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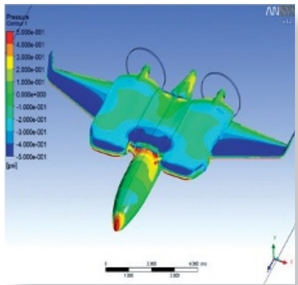
Phone: 978-691-8940

Pervasive Simulation is the Key to Optimized Products



CAE Associates helps companies succeed through automation of CAE processes.

In today's competitive business environment, the traditional product development paradigm cannot produce designs with enough speed or robustness to ensure market dominance. Multiple iterations of design-build-test are not acceptable from a time and cost perspective. As a result, market leaders in all major industries, having adopted engineering simulation a long time ago, are at the next stage and employ simulation as an inherent part of all phases of the product development process. From preliminary design through manufacturing, simulation plays a key role in how they develop better quality, lower cost products and get them to market first.

The infusion of computer modeling and simulation throughout the design process cannot be successful without development of automated analysis methods which are scalable and persistent throughout. There is insufficient time for manual creation and rework of FEA and CFD models as the design progresses from concept to production. This must happen automatically and in real-time. Also, to be truly predictive of product behavior in the field, and to ensure that the optimal design is chosen, hundreds, perhaps thousands of variations must be investigated. This is not feasible without an integrated, automated process. To be successful, optimization first requires automation.

For over 30 years, CAE Associates has been helping technology leaders integrate automated, customized, FEA and CFD solutions into their process. We work closely with clients to understand how they design products, make recommendations for how they can most benefit from simulation at various stages, and implement the resulting plan. The result is a streamlined simulation workflow which can be leveraged to produce an optimal design.

Automation and customization projects at CAE Associates range from the development of simple scripts for automating a repetitive task, to creating entire simulation processes, driven from beginning to end with no user intervention, or even any knowledge of how to use the underlying analysis software. The complexity of the project is not important; we remain focused on the benefits to our clients. Past projects include:

- Process to automatically predict fatigue life in ball grid arrays.
- Automated procedures to configure and optimize medical stents.
- CFD-based electric motor optimization to minimize windage losses.
- Automated spline-coupling modeling system for gas turbine engines.
- Comprehensive customization process for optimization of air conditioning compressors.

All of these examples began with simulations that required many man-weeks or months to complete manually, and reduced the process to a few simple mouse-clicks. We enabled our clients to move from using simulation as a last resort to the new paradigm of using it in a systematic, predictive fashion for the development of optimized products.

For more information visit:

www.caeai.com

About CAE Associates, Inc.

As an engineering consulting firm founded in 1981, CAE Associates guides leading organizations through simulation solutions for structural, thermal and fluid design challenges. We offer straight advice and expert consulting to help both large and small companies maximize the value from engineering simulation. Our solutions are tailored to the unique needs of each client, helping to quickly meet near-term requirements, while positioning for long-term success.

Contact Information:
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Breaking Down the Barriers of Design Exploration and Optimization

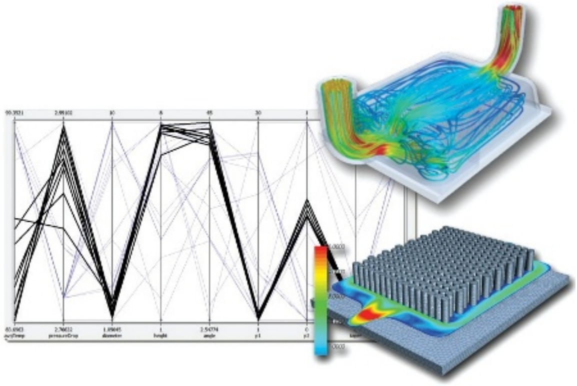
Bringing High Fidelity Engineering Simulation into the Design Loop

As organizations realize the value of design optimization studies to gain competitive advantage, it is a natural desire to have the process driven by the most accurate simulations possible. Otherwise there is a significant risk that the design space established will be a false "virtual design space" that does not correspond to the "actual design space", leading to designs that do not meet expectations when they are put to the test in the real world, thus the need to bring high fidelity CAE simulations into the automated design loop.

Traditionally, however, there have been several significant challenges that have kept high-end CAE technology from being implemented within design optimization: commercial licensing, accuracy, robustness, efficiency, and coupling with optimization technology.

Power Token Licensing

One of the most common barriers to using high-fidelity CAE simulation is the cost of traditional CAE licensing. The use of high performance computing and parallel optimization algorithms are a practical must-have for automated design studies. Historically this would have meant purchasing many expensive software licenses.



But with the new Power Token license system, engineers have full access to affordable license tokens that provide the flexibility to minimize the cost of their optimization process for each individual project.

Accuracy, Robustness and Efficiency

Accuracy, robustness and efficiency are fundamental requirements for point evaluations in a design study. A simulation code must be valid for the entire design space otherwise the optimization algorithm will be lost. It is akin to the old adage "garbage in — garbage out." An invalid design space, whether due to code crashes or inaccuracy, will lead to an invalid design optimization result. CD-adapco employs an army of software developers and physics modeling experts from around the globe with a singular purpose to make STAR-CCM+ the most accurate, robust, and efficient CAE software on the market.

State-of-the-art Optimization Technology

Finally, the simulation software must be coupled with design optimization technology such as with STAR-CCM+ and the SHERPA algorithm from Red Cedar Technology. The Optimate+ add-on for STAR-CCM+ gives engineers direct access to the most powerful and effortless optimization algorithm on the market.

CD-adapco
www.cd-adapco.com

About CD-adapco

CD-adapco is the world's largest independent CFD-focused CAE provider. Our singular purpose is to inspire innovation with our customers while reducing their costs through the application of engineering simulation. A key to achieving this purpose is providing access to advanced physics models during conceptual and preliminary design phases, and innovative licensing models for design exploration and optimization.

For more information visit:
www.cd-adapco.com

60 Broadhollow Road, Melville
NY 11747 USA
Phone: (+1) 631 549 2300

Optimization of Sophisticated Materials Made Simpler

HyperSizer V7 from Collier Research has been fundamentally reconfigured for ease of use by the skilled non-expert.

Composite materials have reached the engineering mainstream. They are in wide use in aerospace, windpower, transportation and a variety of other industries. In most of these settings, optimization traditionally has been the domain of technical specialists.

But now there is a sophisticated, easy-to-use composites (and metal) optimization tool that simplifies the process and can be trusted in the hands of the general engineer. The V7 release of HyperSizer® structural sizing and analysis software has a new interface and other enhanced usability features. These empower the engineers responsible for primary design and analysis of structures in their day-to-day work by delivering consistent, reliable and robust solutions.

To identify optimal lightweight and fuel-efficient designs, HyperSizer V7 self-configures for different loading scenarios, requiring less input from engineers. This added "intelligence," along with quick, detailed sizing that increases analysis speeds up to 1000X, allows for design decisions to be made in real time throughout the design/analysis workflow. A HyperSizer optimization typically yields weight savings from 20-40%.

Automatically iterating in a continuous loop with finite element analysis (FEA) solvers, HyperSizer software can optimize millions of design candidates while visualizing composite details to the ply, even element, level. The tool defines laminate zones and provides precise details about ply coverage and ply drops, improving manufacturability. Serving as an independent and neutral hub for industry-accepted CAD, FEA, and composites software, HyperSizer automates project data flow from early conceptual design through final certification.

Originally developed at NASA, HyperSizer was the first software allowed to be commercialized and ha seen ongoing use at the agency on high-profile, zero-failure-tolerance programs. It is also employed by leading companies involved in commercial aircraft, UAV, space launch, and wind energy projects.

With its new ease-of-use capabilities, HyperSizer V7 puts the power of optimization within the reach of the everyday engineer—and every engineering organization.

Convergent Science Optimizes CFD by Automating the Meshing Process

Never make a mesh again.

As organizations sprint at a breakneck pace toward product innovation and improvement, they often run into a hurdle in their CAE toolchain…Meshing. Meshing can be one of the most time consuming processes in the entire CAE procedure. With inconsistencies between different meshes, diffusion due to mesh stretching, and trying to guess where to put more mesh for increased accuracy, the list of meshing issues is long. Add to that a complicated or moving geometry and the complexity of the mesh can increase exponentially.

Optimized Meshing

Convergent Science, Inc. has optimized the CFD lifecycle by removing the user defined meshing process with CONVERGE™ CFD Software. CONVERGE™ automates the entire meshing process at runtime. The mesh is re-created for each time step with the addition of Adaptive Mesh Refinement (AMR). AMR adds increased meshing resolution where and when it is needed automatically. This new and innovative approach uses a completely stationary orthogonal Cartesian mesh. The ability to simulate complex moving geometries is handled just as easily as stationary geometries.

Optimized Detailed Chemistry

The automated meshing in CONVERGE™ not only optimizes your CFD lifecycle, it also allows engineers to accurately solve combustion analyses with detailed chemistry. Solving detailed chemistry with CONVERGE™'s AMR technology will reduce runtimes and increase accuracy by dynamically adding mesh resolution at runtime when and where it is needed, effectively optimizing the mesh for combustion during runtime.

Optimized Designs

CONVERGE™ comes fully equipped with a genetic algorithm optimization model. To put it simply, CONVERGE™ takes a "survival of the fittest" approach to design optimization and automatically initiates CONVERGE™ CFD simulations in search of an optimum product design. Utilizing this approach, the manual user interaction inherent in traditional design optimization is effectively removed.

CONVERGENT SCIENCE

About Convergent Science, Inc.

Convergent Science, Inc. is a world leader in Computational Fluid Dynamics (CFD) software. Our flagship product, CONVERGE™, is a CFD software package that is revolutionizing how fluid dynamics modeling is being used by engineers, researchers and designers. With CONVERGE™, traditional CFD bottlenecks (namely grid generation) have been removed from the modeling process, allowing users to spend more time analyzing their simulations and no time generating grids.

For more information visit:
www.convergecfd.com

Contact Information:
info@convergecfd.com
830.625.5005

Optimize Refinery and Chemical Plant Processes with Accurate CPFD Models

Models help operators to improve plant reliability, reduce costs, and minimize emissions.

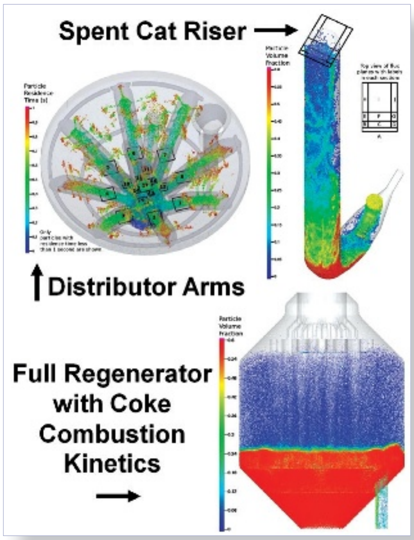
CPFD Software is revolutionizing the design and operation of fluidized catalytic cracking (FCC) units, chemical-plant fluidized reactors, power plants, gasifiers, cyclones and other fluidized systems by providing a means to "see inside" reacting fluidized systems. CPFD's solutions are built on their Computational Particle Fluid Dynamics (CPFD®) method, which is specifically designed for modeling reacting gas-particle systems.

Plant Operators Face Challenges

Refinery and CPI plant operators face numerous challenges. Plants range in age from a few years to decades. Building new plants is difficult and expensive, so operators are looking to uprate and improve their existing plants wherever possible. Feedstock prices are volatile, so feed flexibility improves profitability. Operating cycles have been extended to 5 years or more but operators would like to extend them even further, though units can be limited by erosion and its impact on mechanical reliability. Emissions standards are increasing year-by-year and new ways of meeting these regulatory requirements cost effectively are needed.

Reactor Models Enable Solutions

CPFD has become a leader in this field by offering an enabling technology, Barracuda Virtual Reactor®, now available in a massively parallel version designed to run on low-cost GPU cards, giving every user the option of a "desk-side supercomputer." Barracuda VR helps meet these important challenges by enabling process engineers and equipment designers to model even the most complex, 3D reacting fluidized systems accurately, predicting both the hydrodynamic behavior and the chemical kinetics. Models allow users to view their mixing, temperature distribution, conversion, oxygen usage, emissions, catalyst carryover, and more. The insights gained are

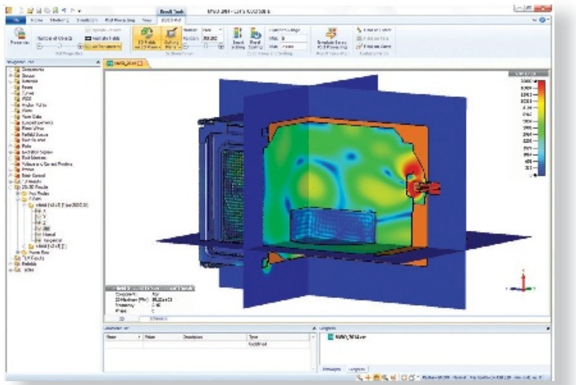


helping engineers right now to optimize their processes while minimizing capital expenditures, outage time, and business risk.

By providing both detailed models and the software to run them, CPFD has become a leader in the effort to make refinery, chemical and power plant processes both greener and more profitable at the same time.

Optimization in Electromagnetic Design

By integrating optimizers in its EM simulation tools, CST streamlines the development process.



The potential applications for optimization in electrical engineering are plentiful. Tuning filters and antennas, placing decoupling capacitors, maximizing shielding efficiency, improving connector performance, calculating useful input signals, increasing manufacturing yield; these are all tasks in which optimization is invaluable.

CST knows that engineers want a palette of powerful, versatile optimization tools at their disposal, but equally importantly, they want to be able to use these tools as part of their familiar workflow.

CST STUDIO SUITE®, CST's flagship product, comprises a range of electromagnetic solver technologies, variously suitable for high-frequency, low-frequency, static, transient, charged particle and multiphysics problems. To make it easier for designers to supplement the simulation process with optimization, CST embedded both local and global optimization tools into the foundations of their software.

Local optimizers are suitable for problems where the initial values are reasonably close to the optimum, and offer quick performance at the risk of finding only a local optimum. The local optimizers provided by CST include Interpolated Quasi Newton, Nelder-Mead Simplex Algorithm, and Trust Region Framework. The latter can use sensitivity information — an estimation of how the structure will behave under small geometric changes — to speed up the optimization process further.

Global optimizers on the other hand search the entire parameter space to find the optimum. This is a somewhat slower process, although the ability to distribute simulations across a cluster means that these optimizations can be sped up significantly. CST offers Genetic, Particle Swarm and CMA-ES global optimizers, each well suited for certain applications.

Because these tools are a fundamental part of CST STUDIO SUITE, they are compatible with all solver types and there is no need to set up complex links between simulation tool and optimizer. Geometries, material properties and waveforms can all be optimized according to goals drawn from numerous different types of result data, allowing engineers to design, simulate and tune their devices in a single workspace.

CST

For more information visit:
www.cst.com/optimization

About CST

CST develops and markets high-performance software for the simulation of electromagnetic fields in all frequency bands. Our advanced simulation solutions help companies increase profitability and engineers to minimize costs by reducing the design risk and improving the overall performance of devices, especially for new or cutting-edge products.

CST – Computer Simulation Technology AG HQ:
Darmstadt, Germany

CST of America, Inc. US Headquarters:
Framingham, MA 01701

For other locations in the Americas, Asia and Europe, please check the CST website at www.cst.com/Locations

The Quest for the 'Best'

3DEXPERIENCE is about optimizing a company's business and products.

Quickly creating the best design for performance, weight, cost and other mission-critical factors is increasingly important in launching market-winning products. Finding the best option requires a multidisciplinary approach with multiple trade-off studies. To reduce physical testing, companies are expanding the use of virtual testing and design optimization technology.

Dassault Systèmes, the world-leader in developing 3D software applications, is delivering on a long-term strategy to provide the most powerful solutions for design optimization. Its SIMULIA realistic simulation applications provide the most complete, open and robust toolset available on the market.

> **"The 3DEXPERIENCE platform is all about optimizing a company's business and the products it offers. Is it what customers want? Can we produce it quickly? Is it right for a sustainable future? These are the questions industry must ask to harmonize products, nature and life. And these are the questions our 3DEXPERIENCE platform answers."**
> *Bernard Charlès, President and CEO, Dassault Systèmes.*

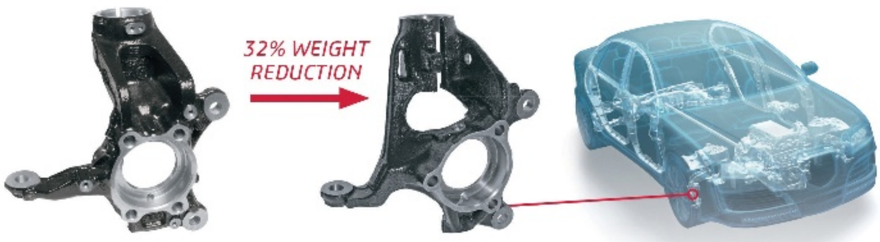


Image courtesy of GF Automotive

Leading Technology:

SIMULIA Isight is used to integrate multiple cross-disciplinary models and applications together in a simulation process flow, automate their execution across distributed compute resources, explore the resulting design space, and identify optimal designs based on user-defined parameters.

SIMULIA Tosca is the leading technology for non-parametric structural and fluid flow optimization. It delivers powerful optimization technology for design of lightweight, stiff, and durable parts and assemblies. With Tosca, product designs are created solely on a given design space and a defined optimization task. Innovative design proposals can be optimized earlier in the design process, reducing the number of physical tests.

The business value of these applications is significant and will increase dramatically as capabilities within Dassault Systèmes' 3DEXPERIENCE platform. This will provide easier access to these powerful capabilities for users of CAD, FEA, and CFD technologies—not only from Dassault Systèmes, but also from its software partners. This openness ensures that manufacturing companies can leverage their current design and engineering software investments.

When applied as an integral part of the product development process, Dassault Systèmes' optimization technology will further enable companies to accelerate and achieve their quest for the best.

About Dassault Systèmes SIMULIA

As an integral part of the Dassault Systèmes 3DEXPERIENCE platform, SIMULIA applications, including Abaqus, fe-safe, Isight, Tosca and Simulation Lifecycle Management, enable users to leverage physics-based simulation and high-performance computing to accelerate the evaluation and optimization of product performance, reliability and safety—before committing to costly and time-consuming physical prototypes.

For more information visit:
www.3ds.com/simulia

Contact Information:
166 Valley St.
Providence, RI 02909
Phone: +1 401-276-4400

Following Nature's Lead for Ultimate Design Efficiency

Optimization-led Engineering Service Enables Over 40% Mass Reduction.

The shapes and configurations of nature are wildly complicated, non-intuitive and completely amazing. The shapes and forms found in nature in the structure of a tree, a human skeleton, insects and animals are truly the most efficient designs imaginable. By mimicking the flawless balance between structure and strength of nature's most efficient shapes, ETA engineers incorporate similar balance to product structural design for any complex structure, such as automobiles, aircraft and other systems.

The Accelerated Concept to Product® (ACP) Process is a holistic cost reduction methodology which enables the structure of a product, such as the vehicle's body-in-white, to mimic "Nature's Way". Doing so creates the ultimate design efficiency, where structure, stiffness and strength are perfectly balanced for the intended multidisciplinary function. As a Product Design Engineering Consultant, ETA provides this service to companies looking to improve efficiency and performance at the component, sub-system and/or full-system level in a wide variety of industries.

ACP is a performance-driven product design development engine based on design optimization and incorporates the use of multiple CAD, CAE and CAO tools in a systematic approach to find the optimal design solution. This methodology provides solutions, which address the conflicting challenges facing the modern product development environment. It achieves this by synchronizing the individual facets of the product development process, resulting in an overall cost reduction (material, manufacturing, tools and design time), in development costs and time to market.

Material selection and utilization, product performance, manufacturing requirements and assembly processes are all considered as early as possible in the design cycle. The resulting design offers a robust and highly efficient solution; which when combined with the strength and design flexibility of materials; facilitates significant mass reduction (40% or more) for the final design, while realizing and even exceeding performance requirements.

The ACP Process has been applied to many structural systems in its entirety, including World Auto Steel's FutureSteelVehicle (FSV) Program, which was completed last year. During the final phase of program, FSV achieved 39% mass reduction and the new mass target was achieved in the design. The program incorporated weight reduction, from vehicle baseline to detailing the steel body structure concepts for the vehicles to meet aggressive mass targets of 177.6 kg, while meeting 2015-2020 performance objectives.

Modularity to Master Complexity

ESTECO technology evolves to a new paradigm, extending modeFRONTIER capabilities to a collaborative and flexible environment.

With an accelerating pace of request for innovation and steady increase in competition, companies today face product complexity as the next challenge. Time to market and effective life cycle management are the drivers to leverage for higher levels of profitability, inducing, however, a further increase in complexity. All along the value chain, from concept design to manufacturing and maintenance, specialists from different disciplines are summoned to make critical decisions with paramount impact on product quality. And quality, with speed of decision, often determines the market success of a product.

Engineers and designers need to master such complexity, and technology comes in aid. Software companies have often looked to nature to get inspiration for solutions to engineering problems, and once again nature provides the inspiration to resolve the complexity of modern products manufacturing.

In nature, organisms' complexity grows with the natural selection, and so does the modularity and specialization of biological systems and units, which in turn increases the organism's efficiency and chances of survival. Take the human brain as an example: dealing with an immense number of complex tasks, the brain has different modules specialized in individual cognitive functions, but highly interconnected and collaborative, allowing the human being to achieve sophisticated tasks.

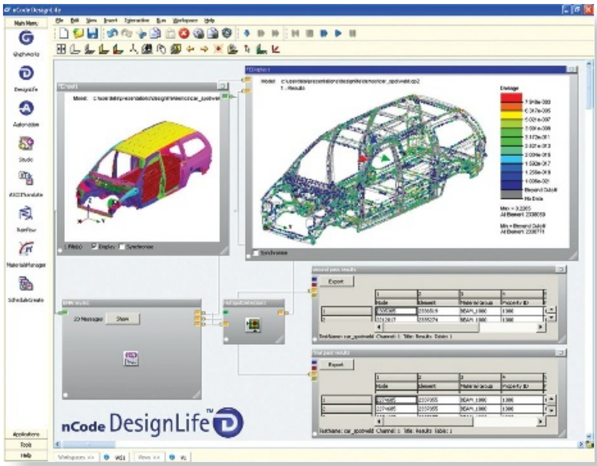
With this in mind ESTECO has developed the software package ESTECO Enterprise Suite (EES) extending its established modeFRONTIER desktop paradigm to a web-based collaborative environment. EES combines the advanced capabilities of the optimization platform modeFRONTIER 4.5 with SOMO, the new distributed execution framework, for managing collaborative design processes. The solution empowers design teams with a sharing platform for models, workflows, simulations, optimizations and results analisys. EES, inspired by modularity, is capable of efficiently handling all stages of the product design process, with the SOMO framework. Domain experts, optimization and integration specialists and decision makers join forces and build advanced multidisciplinary optimization (MDO) frameworks and workflows, reaching a better control over the design of complex systems. Just like the brain drives the body, EES drives product development by enabling engineers to understand the complexity behind it and turn it into innovation.

Reduce Product Development Time with nCode

Achieve new standards through finite element based analysis.

Advanced technologies developed over the past decade have enabled automotive engineers to design products to meet current and future fuel economy standards. As new fuel economy standards have been set, automakers must now meet a federal Corporate Average Fuel Economy (CAFE) of 54.5 mpg by 2025. This means that engineers are now faced with one of the biggest engineering challenges in decades, a 5 percent increase in fuel economy per year. These new fuel economy demands require automakers to reshape their engineering process without compromising the reliability and durability of their designs.

New materials such as ultra-high-strength steels are being used in body structures, as are aluminum and magnesium alloys for structural components. The use of lightweight material such as composites also presents significant benefits for some automotive components. As these new materials and increasingly radical solutions are required in more engineering applications, the need to simulate and optimize designs prior to physical prototyping will increase.



Flexible, Powerful, Up-front Design

Up-front design tools such as nCode DesignLife™ enables engineers to gain insight into new material performance and reduce product development time. With this CAE-based tool, fatigue and durability may be calculated from FEA results, identifying critical locations and calculating fatigue lives for both metals and composites. DesignLife users also benefit from advanced technology for virtual shaker testing simulation, welds, vibration, crack growth, and thermo-mechanical fatigue analysis.

Rapidly Improve Designs

As finite element models increase in size and fidelity, HPC environments are being used to improve simulation throughput. The largest computational problems can be broken down and solved many times quicker, but hardware is not the only requirement. DesignLife can take advantage of existing hardware scalability by distributing fatigue analysis tasks to open up the possibility of more robust, up-front design through simulation.

nCode ...an HBM brand

For more information visit:
www.ncode.com

About HBM-nCode

With over 30 years of expertise in durability and data analysis solutions, nCode enables customers to understand product performance, accelerate product development and improve design. The power and scalability of nCode software is a direct result of its expertise and in-depth experience in a broad range of industries.

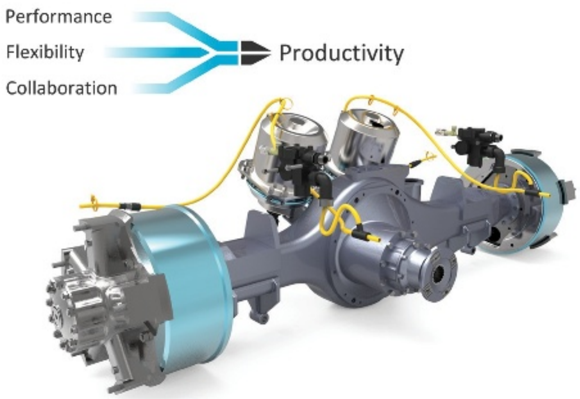
Sales, Training, and Support

HBM-nCode sales and support is available through local offices in Europe, North America and Asia.

Contact: info@hbmncode.com to reach an office near you.

Minimize Risks in the Transition From 2D to 3D Design

Using innovative new technology, designers can safely transition to 3D by reducing training and learning times while leveraging 2D in the Design and Communication Processes.



Designing in 3D can improve design accuracy, efficiency, and make it easier to collaborate through manufacturing processes. However, most people familiar with 2D are reluctant to make this move and here's why:

- It requires a commitment to learning 3D.
- Designers fear rules and restrictions imposed on them from 3D.
- Compatibility with their legacy 2D data needs to be maintained.
- Communication with both 2D and 3D is still required.

IronCAD's Design Solutions minimizes these risks by providing a flexible and easy to use 3D design solution allowing you to become proficient in 3D within a matter of days. Its integrated 2D Mechanical design environment enables reuse of legacy 2D data and allows design modifications to be updated and easily shared in both 3D and 2D formats.

Here's how we minimize the risks in transitioning from 2D to 3D design:

Quickly Learn

Due to IronCAD's unique drag & drop catalogs, push & pull handle design, patented TriBall positioning tool, and its flexible design environment, you can quickly become productive in 3D. In addition, the integration of a familiar 2D mechanical design interface avoids learning a new 2D.

Design the Way You Want in 3D

IronCAD's innovative design technology allows you to design in 3D freely with or without design rules. Consequently, you can make both planned and unexpected changes at any stage of the design.

Leverage and Use Legacy 2D

The integrated, DWG compatible, 2D environment allows you to maintain and reuse your legacy 2D data in 3D Design. Thus, it preserves your previous investment.

Collaboration

Easily import and edit 3D data from all major CAD formats. Automatically update changes in the 2D through the associative 2D/3D. Share the updated 2D and 3D design data throughout the collaboration process.

About IronCAD

IronCAD is a leading provider of 3D Design Productivity Solutions that deliver the highest levels of customer satisfaction and productivity. Individual components of this solution can be used standalone, complementary within an existing design environment, or can be used together to collaborate effectively throughout the enterprise to extend productivity.

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IronCAD

For more information visit:
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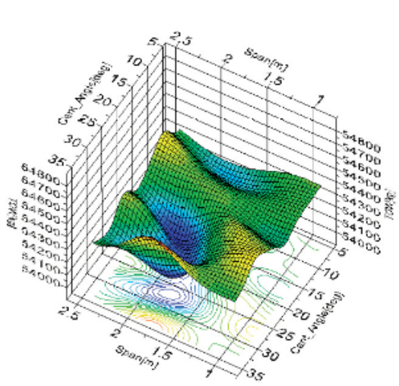
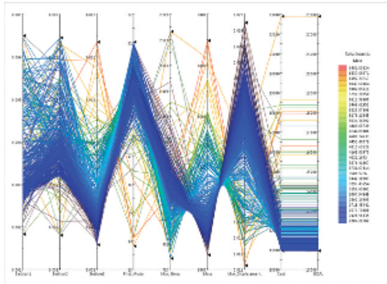
Top Brands Secure Competitive Edge



Optimus from Noesis Solutions helps manufacturers design benchmark products.



Premium manufacturers rely on high quality and clear differentiation to ensure new products excel in today's competitive market. They must do this in a lean environment with intense pressure to reduce time to market and development costs. Noesis Solutions' flagship software Optimus empowers companies to explore the design space and adopt an 'Engineer by Objective' development strategy. This enables them to design benchmark products 'right first time'.

A solution for today's lean staffed engineering design teams

Optimus today helps numerous leading companies in engineering-intense industries worldwide

- Automate simulation processes
- Increase simulation throughput
- Simplify the decision process
- Consolidate corporate simulation knowledge
- Deliver optimized, robust product designs

At the latest Optimus World Conference, Audi, BMW, Snecma, Thales Alenia Space, Tyco Electronics, Volkswagen, among others, presented how they use Optimus to stay ahead of competition.

Combining faster development with superior design performance?

On average, Optimus users achieve 10% or more design performance improvements and over 30% design time reduction. Optimus frees users from repetitive manual model changes and data processing, while efficiently identifying design space regions containing leading candidate designs. These designs meet a combination of objectives set by multiple (often competing) performance targets as well as design constraints imposed by manufacturing realities, stringent regulatory and standardization requirements.

Implementation is key, and Optimus' unique customization capability coupled with an exceptionally skilled technical support team enable tailoring, when needed, to match the user's design process, software, and IT.

Ease and speed of use are often cited as major factors in the adoption of Optimus, along with capabilities including:

- Process integration and automation
- Integration with the vast majority of CAE and mathematical modeling software
- Design of experiments (DOE)
- Surrogate modeling (or response surface modeling)
- Single and multiple objective optimization
- Statistical data mining and analysis
- Robust design

Are Your Business Processes Helping or Hurting You?

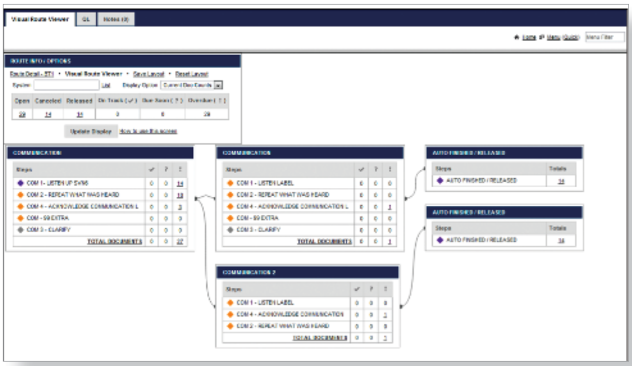
In order to gain efficiencies through product lifecycle management, your business processes must be defined.

Business processes play a major role in how efficiently and effectively products can be engineered, manufactured, delivered, and maintained. According to *CMII for Business Process Infrastructure*, "Deficient requirements are a by-product of deficient processes."[1]

In order to gain efficiency through product lifecycle management, your business processes must be well defined and continuously maintained as your business evolves. CMPRO is the product lifecycle management software with a Process Workflow Engine (PWE) that helps you optimize your business processes.

How does CMPRO Help Organizations Optimize Processes?

CMPRO helps organizations optimize productivity by providing a vehicle to record internal processes. Often times, people go through daily activities without defined processes. The electronic workflow enabled forms inside CMPRO provide a framework to document business processes.



Once the processes are defined, you can use the CMPRO Process Workflow Engine (PWE) to help flush out the details and make sure all of the steps are clearly established. Some items to consider are:

- What is going on at each point in the process?
- Who is responsible for this?
- Who has the ability to authorize activity and assure that the work is completed?

The CMPRO PWE also allows you to identify the kind of information that needs to be captured at each point in a process.

- Who supplies this information?
- Where does it come from?
- What are the requirements?
- Are there fields that need to be updated automatically based on other values?
- Are there things that need to be done before we move forward in the process?

CMPRO empowers businesses to control processes by offering polls, checklists, and discussions that can be added to each step of the process based on the business requirements.

Source [1]: Guess, V. C. (2006). CMII for Business Process Infrastructure. Pheonix, AZ: CMII Research Institute.

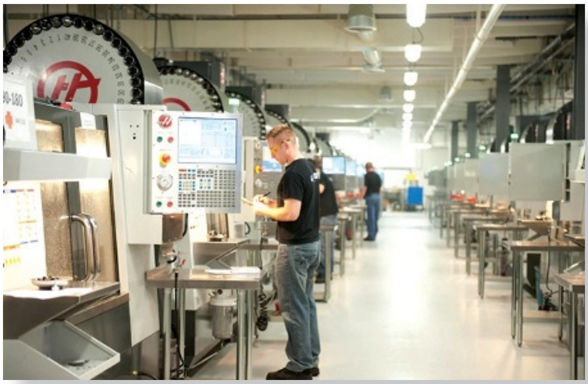
A Company Bred for Speed

Proto Labs accelerates innovation with its quick-turn manufacturing services for prototypes.

Proto Labs, through its Firstcut CNC Machining and Protomold Injection Molding services, manufactures custom parts for designers and engineers around the world. Its proprietary software and automated manufacturing processes allow for quick-turn prototyping and fast low- to mid-volume production of real plastic and metal parts in days.

Product designers and engineers upload a 3D CAD model online and receive an interactive quote with free design analysis, full pricing information and quick-turn options, generally within hours. The manufacturability analysis and quote feedback helps customers potentially eliminate problems, like sink or internal undercuts. The free design analysis can aid designers early in the prototyping process and help them get real parts faster. Once a part design is ready and a quote approved, production begins and parts are shipped in one to 15 business days.

Through a subtractive manufacturing process, Firstcut uses three-axis milling from up to six sides to machine low volumes of parts from about 40 available plastic and metal materials including ABS, Nylon, PC, Delrin, PEEK, Ultem®, aluminum, magnesium, steel, stainless steel and more. The result is functional parts made from real materials for prototype testing, jigs, fixtures or one-off projects.



For customers that need low-volume production or bridge tooling, Protomold can injection mold up to 10,000+ parts from hundreds of different stocked resins in three weeks or less. The injection-molding service machines aluminum or steel molds, in a fraction of the time and cost in comparison to traditional mold manufacturers, to produce custom parts for all industries.

By providing timely design feedback on 3D CAD models followed by quick-turn production of prototypes, modifications can be made fast and often. It's iterative product development that allows designers and engineers to optimize their own processes and ultimately get their product to market faster.

Optimization Leader /// Red Cedar Technology

Discover Better Designs, Faster

Drive Product Innovation through Simulation and Optimization.

Organizations have invested millions of dollars in constructing validated 3D simulation models to predict complex physical behaviors of their products. Naturally, they want to leverage this investment to widely explore the limits of their design envelopes in order to identify truly innovative product designs. The HEEDS parametric design exploration software from Red Cedar Technology makes this possible by providing four key capabilities:

CAD & CAE Process Automation

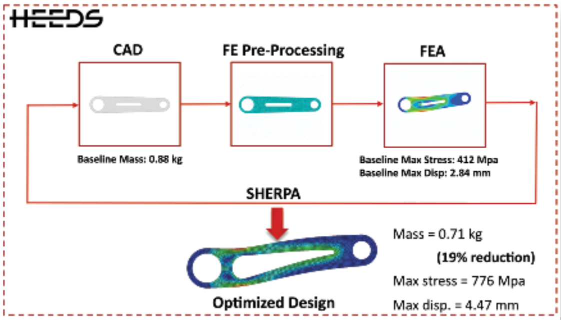
HEEDS provides an environment to easily link together various commercial and legacy software tools and simulation tasks to allow engineers to fully and automatically evaluate design alternatives with one-button ease.

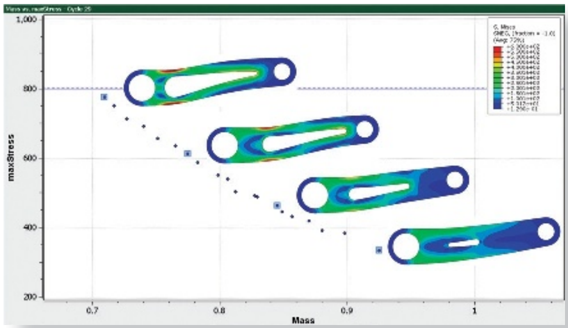
Scalable Computation

Once an evaluation process is automated, HEEDS makes it simple to harness the power of all available software licenses and hardware compute resources to cost-effectively and simultaneously explore many design variations of a product. By leveraging available token licensing systems, high performance computing clusters, heterogeneous environments, and cloud resources, HEEDS radically simplifies network computing.

Efficient Design Exploration

Historically, CAE engineers were forced to simplify their complex CAE models and build surrogate representations using DOE and response surface methods prior to optimization. But, the proprietary SHERPA search strategy inside of HEEDS makes it possible to efficiently explore the entire design space with direct optimization on detailed process models, with no simplification. It just works, and works quickly!





Sensitivity & Robustness Evaluation

Finally, HEEDS not only presents the engineer with a small number of attractive design concepts that satisfy requirements, but also provides sensitivity and robustness information to ensure stellar product performance across the range of material and manufacturing tolerance variations.

HEEDS is available as a standalone software product to address multi-disciplinary optimization. The underlying technology is also embedded in leading FEA, CFD, MBD, and CAM simulation environments from a variety of vendors, including CD-adapco, Ricardo, ETA, and others.

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A CD-adapco company

For more information visit:
www.redcedartech.com

About Red Cedar Technology

Red Cedar Technology improves and accelerates design processes for companies facing complex product design challenges. Our design optimization software and services provide engineers with the expertise and technology to reduce product development time and achieve significant productivity gains during the design process. Product development teams worldwide use our expertise to design safer cars, engineer life-saving biomedical devices, and develop innovative structures for air travel and space exploration, among many other groundbreaking applications.

Contact Information:

Red Cedar Technology is a wholly owned subsidiary of CD-adapco, with headquarters at 4572 S. Hagadorn Rd., East Lansing, MI 48823.

Optimizing a Product's Lifecycle from End-to-End

RTT's integrated approach to visualization enables companies to maximize their workflows and reduce time-to-market.

RTT's expertise, coupled with acquired, high-level project experience, positions the company as a driving force in solution development and process integration across the automotive, aerospace, apparel, lifestyle, heavy equipment and white goods industries.

Applying a comprehensive approach, RTT combines technologies, processes and creative services to form a unique portfolio: with end-to-end services in the software, solutions and CGI areas. The entire value chain spanning development, design, sales, marketing, and distribution benefits from this digital approach.

RTT assists customers from the concept preparation stages, in adopting and implementing project management, and finally in testing, quality assurance and roll out. RTT also offers medium to long-term support in order to provide sustainable backup for the implemented solutions.

As a strategic partner, the RTT visualization platform offers software solutions that simplify workflows and foster synergies in order to structure collaboration between globally networked users more efficiently. Generic software modules intermesh intelligently to enable seamless visualization workflows. The primary aim of RTT is to support product development by mapping the complete process chain in order to enable the utilization of 3D models from concept to consumer. In 2012, RTT focused on developing its range of technology and product offerings further with respect to visual quality, performance and the breadth of observation and analysis capabilities.

The product offerings in the Computer Generated Imagery (CGI) area are split into the categories of Stills, Films & Animations, Realtime Interactive and Data Preparation. This approach allows all services to be delivered at once. Beginning with the initial idea, on to the preparation of CAD data, viz production, and finally through to on-brand sales promotional activities – the circle is complete. As a result, RTT's clients can consequently address all media and communications channels in a specific demographic at once. Whether in print, film, and interactive-realtime applications for the Internet or for stationary and mobile devices – creativity knows no bounds.

Prototype Faster, More Affordably with Personal CNC

Move quickly through design iterations and reduce outsourcing costs with Tormach PCNC Mills.

Most product development firms outsource everything that needs machining, from prototypes, to jigs and test fixtures, and even the manufacturing run itself. This approach works, but it can be slow and expensive. In today's competitive landscape, successful design teams need to be responsive and agile.

That's where a Tormach PCNC mill can help. Tormach's Personal series of CNC mills are unique in the CNC machining world. They are positioned at a price point and performance level that makes in-house CNC a realistic option for engineers and product designers looking for affordable prototyping capabilities or low-volume manufacturing solutions.

Tormach PCNC: The right size for Product Design

Tormach's PCNC mills are used widely in all facets of product development: prototyping, niche and specialized manufacturing, customization and personalization, and testing and manufacturing equipment support. Customers run the gamut from product design teams in large corporations to small engineering firms and even individual design engineers. PCNC mills are enabling these groups to bring their ideas to market quickly and affordably in a way that wasn't possible before.

Tormach PCNC mills are designed to be easy to use and easy to learn; a skilled operator is not necessary. Starting at under $10,000, Tormach PCNC mills have a large array of options available for customizing to suit particular needs: Automatic Tool Changer, Digitizing Probe, Reverse Engineering Software, and more. Total cost of ownership is also low: recurring annual maintenance costs are less than $500, on average.

TORMACH®
PERSONAL CNC

For more information visit:

www.tormach.com/desktop

About Tormach

The people at Tormach are dedicated to enabling your ideas by delivering tools, accessories, and components of unprecedented value in the world of CNC. Whether you are involved in R&D, education, short-run production, or simply entrepreneurs with new ideas, Tormach products allow you to make what you need easier, quicker, and more affordably.

Our flagship products include the Tormach PCNC 1100 and PCNC CNC Milling Machines, affordable CNC mills that are configurable with options such as 4th Axis, Automatic Tool Changer, Digitizing Probe, and other options. All Tormach products are easy to maintain, easy to service, and have a low cost of ownership.

Contact Information: info@tormach.com

Extreme Hydrofoiling, **Powered by Simulation**

ANSYS CFD analysis software helped Emirates Team New Zealand bring new speed to the world's oldest trophy event.

BY PAMELA J. WATERMAN

Wing sail and mast structure being mounted between the dual hulls of the ETNZ trimaran America's Cup 2013 boat. A central pivot structure allows added control in a manner similar to the ailerons of an aircraft wing. *Images courtesy of ANSYS.*

If the America's Cup races make you envision the (so-called) 12-meter craft that rode the waves from 1958 to 1987, or even the glorious J-boats of the 1930s, you need a radical mind-shift to appreciate the current look and feel. Lift, drag and thrust — the vocabulary of aircraft, not boats — most aptly describe the performance of the 2013 America's Cup racers. Yet for Emirates Team New Zealand (ETNZ), ANSYS computational fluid dynamics (CFD) simulation software handled the transition with grace and speed.

The sailing competition, begun in 1851, has seen periodic rule changes that push each new generation to sail faster than before. The latest rules gave way to increased speed and spectator excitement at this past September's unprecedented series of 19 races over two-and-a-half weeks.

From Wind Tunnels to Workstations

ETNZ's experience with ANSYS goes way back, with the team initially using FLUENT CFD software in 1998 and then expanding to tap ANSYS CFD software for the boat design of both the 2007 and 2010 cup races.

The 2007 boats were a more traditional yacht design; the 2010 Volvo Cup (America's Cup Challenger face-off) trimaran boats were a completely different design, notes Gilles Eggenspieler, Ph.D., ANSYS senior fluids product line manager: "And now the 2013 versions are yet a third."

The trimarans and "hard" (non-fabric) wing sails that first debuted in the 2010 America's Cup races had hardly been hauled out of the water when the rules were being modified yet again to set the tone for the 2013 competition. Past rules had been formula-based — resulting, for example, in the 12-meter boats, where 12 meters is the maximum value of a formula that combines such design specifications as load, waterline length and area of the sails. This time, the committee opted for a Box Rule, the spirit of which is "as long as it fits inside the box, it can race." All designs were catamaran-based; hulls became 72 ft. long by 48 ft. wide, and the massive wing sails rose to 134 ft. tall.

For all its copious details, the updated Class Rule, known as the AC72, contained a loophole permitting the use of movable, shaped "daggerboards" or foils that protrude into the water from each hull. Such a feature effectively converts a catamaran into a hydrofoil — elevating the hull out of the water so that the craft "flies" on upwind and downwind parts of the racing route. Supported only by the foils and rudders, and without the drag of water on the hulls, it achieved speeds approaching 51 mph.

With the design crew free to capitalize on the maximum airflow past its sails, both foil and wing design became critical design elements for successful tacking, foiling or rounding of racecourse marks. From the moment this was acknowledged, ETNZ knew their catchphrase would be "controlled flying."

Design Versatility with ANSYS

The 38-member ETNZ started working on the design of a scaled-down prototype boat in October 2010, in preparation for the July 2013 Louis Vuitton Cup Challenger elimination series.

"The first six months of the project were totally simulation-driven and all our initial concepts were evaluated through ANSYS CFD," recalls Steve Collie, Ph.D., ETNZ design team member for aerodynamic CFD (sail design). "At that stage, we built small 33-ft. catamarans — the largest prototype allowed under the rules — through which we tested concepts. By October 2011, we launched two identical scale wings for these test yachts, very similar in shape and design to the full-scale AC72 wings we ended up with."

"Wings" are the best way to describe the curved, carbon-fiber-ribbed 3D sail-structures that are skinned with conformal, nearly plastic sheeting. Think of an airplane wing turned vertical and pivoting about a mast, with the added sophistication of a full-length controllable aileron.

To evaluate hundreds of variables determining the possible wing shape, the design team looked at a wide range of wind conditions. Critical to boat speed is minimizing the drag of the air coming off the headsail (the more-traditional fabric sail in the forward section) as well as from the mast. In addition, when the craft is sailing at a large angle to the wind, stalling is a real possibility. Modeling all the variations of wing geometry vs. operational conditions presented a big challenge in itself, yet Collie knew that this would still only include part of the problem.

"There is no point in analyzing the wing by itself," he notes, "as its aerodynamic performance is dramatically influenced by the headsail and the hulls, crossbeams and fairings. With ANSYS, we've modeled the aerodynamics of the yacht, in its entirety, through a massive range of situations that we call the aerometrics. This involves up to 750 different simulations per design of the wing and sails."

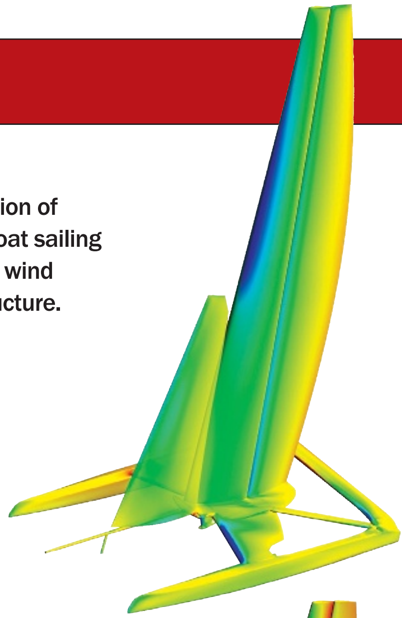
ANSYS CFD software was up to the task of evaluating design improvements with short turnarounds, generally two to three weeks. Inputs included trim parameters for the wing and sails and apparent wind angle. For each iteration, the meshing was 100% automated — which was absolutely key to getting fast results.

"After a matrix of new geometries is transferred to the cluster, a Perl script would automatically mesh, solve and post-process the results," Collie says. "The output was a text file describing the

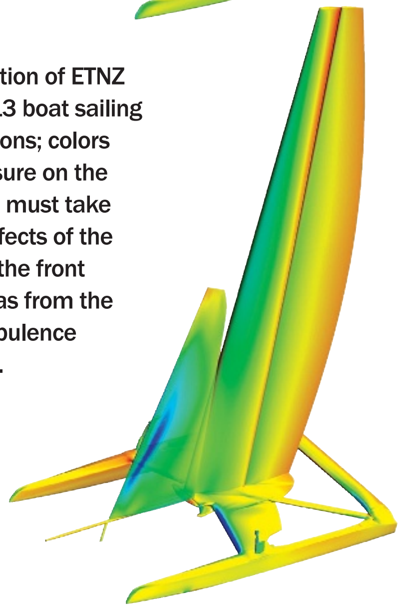
Rules and the Need for Speed

Starting with the 1907 race, America's Cup rules were developed to ensure both safety and competitive racing. They governed boat size and shape, plus the materials and approaches allowed in support of perfecting a design. They have actually been revised for every one of the 34 Cup races, with just two exceptions. From the moment the U.S. entered a catamaran model (not expressly forbidden), the face of the race changed dramatically. From the trimarans of the 2010 competition to the "flying boats" of this past September's race, it's clear that engineering-based ingenuity, including software simulation such as powered by ANSYS CFD analyses, will continue to help Cup sailors rule the waves.

— *PJW*

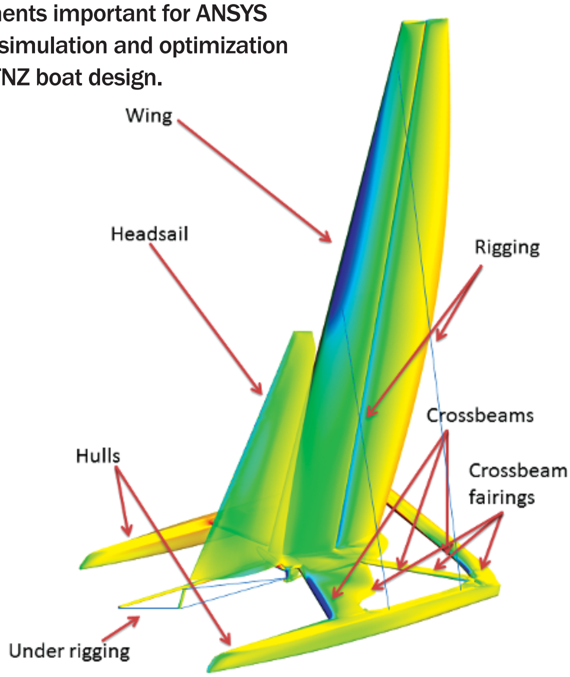


ANSYS CFD simulation of ETNZ's Cup 2013 boat sailing downwind, showing wind pressure on the structure.



ANSYS CFD simulation of ETNZ America's Cup 2013 boat sailing into upwind conditions; colors indicate wind pressure on the structure. Analyses must take into account the effects of the airflow coming off the front (head) sail as well as from the mast. Accurate turbulence modeling is critical.

Diagram of primary structural elements important for ANSYS CFD simulation and optimization of ETNZ boat design.



View of the "hard" wing, 134-ft.-tall sail of the ETNZ trimaran boat from the 2013 America's Cup race, fully simulated with ANSYS CFD simulation software prior to building. The wing is split in two vertical sections, each of which can be trimmed on the fly. Note steps to right for scale.

relevant forces and moments for each point of the matrix. Images were also automatically generated."

Simulations showed when the flow was attached to the wing, and where there was a great deal of interaction with the headsail and the hull, notes Nick Hutchins, ETNZ CFD engineer (wing design). "ANSYS is easy software to use quickly," he adds. "It's easy to get good, reliable answers, and from an aerodynamics perspective, the really key technical thing we're looking for is good turbulence modeling."

With the earlier, 33-ft. simulated design concepts proven on the water (netting ETNZ the single Cup challenger slot), the design team had the confidence to use 100% simulation for the full 72-ft. craft design. Simulations began Aug. 5, and the boat was built within a month. Further hardware modifications were made in just two days based on additional performance testing, and the craft was ready for racing on Sept. 7.

ETNZ Technical Director Nick Holroyd sums up the power of simulation: "In 16 years, we've seen the transition from physical testing, where almost everything we did was done in the wind tunnel or the towing tank, through to this Cup cycle, where we've finally managed to get to 100% numerical analysis and digital prototyping. The productivity gains and the extra insight it's offering us are extremely valuable."

In spite of this year's Cup being won by Oracle Team USA in a come from behind victory (see "The Winning Edge," page 53) that was ultimately based on a combination of many factors in addition to boat design, ETNZ say they will stay the course on using ANSYS CFD analysis in the future. **DE**

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

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The Winning Edge

STAR-CCM+ CFD Software helps guide Oracle Team USA Hydrofoil to victory.

BY *DE* EDITORS

Oracle Team USA won the 2013 Cup by combining elements of its winning 2010 trimaran design with insight gained from simulations done in CD-adapco's STAR-CCM+ computational fluid dynamics (CFD) analysis software.

Mario Caponnetto, Oracle Team USA's design executive for wing sail design and head of CFD analyses, points out that, from the beginning, the 34th America's Cup competitors worked with extreme parameters — the brand-new AC72 class rule defining a high-performance, 72-ft. catamaran running under a semi-rigid wing sail. From a performance optimization point of view, every part of a high-speed catamaran boat (below or above the water) is equally important. But the 131-ft.-tall wing sail was a particular challenge: "Although water is 800 times denser than air, there is a lot more yacht surface moving in the wind than in the sea, especially for a foiling AC72 catamaran," Caponnetto explains.

Knowing that aerodynamic drag would be critical to operating speed (expected to reach more than 53mph), the team applied STAR-CCM+ from the beginning to evaluate and optimize hydrodynamic and aerodynamic performance. Caponnetto's analysts used Reynolds-averaged Navier-Stokes (RANS) equations to obtain time-averaged behavior during turbulent flow; they also applied large eddy simulations (LES) to some detailed areas.

"Most of the simulations were pure CFD analysis, steady or unsteady, with multiple degrees of freedom and fluids, capturing the air/water interface and cavitation effects," he says. "Sometimes we had to test each candidate geometry for hundreds of different combinations of speed and trim."

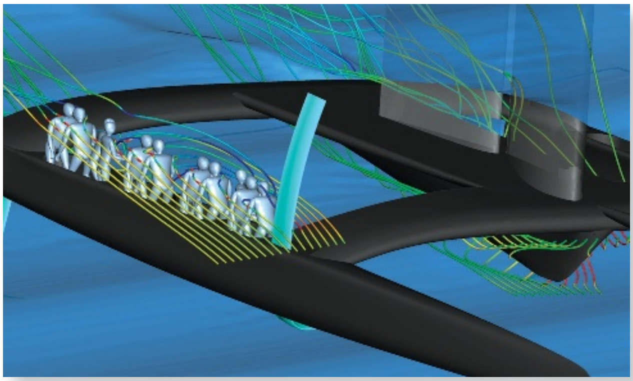
The only way to avoid mistakes in comparing so many tiny differences among shapes was to maintain the consistency of the mesh and the physical model as much as possible. The STAR-CCM+ solution was to automate the simulation process.

During the previous America's Cup, the team used structured meshes for most of the computations, Caponnetto explains. This time, they switched to automatically trimmed, polyhedral cells.

CFD on the Fly

Anyone watching the 2013 America's Cup races saw the drama unfold as Oracle Team USA worked to come back at the 1-8 point in the event. Caponnetto describes three ways that CFD calculations were involved even then, supporting decisions for critical modifications to the boat's structure and operation.

The first step involved reducing the safety margin when trimming the wing sail; simulations convinced the sailing crew to increase the load on the lowest flap, pushing the safety margin. Increased aerodynamic efficiency — plus reduced overall hydrodynamic drag — was the positive result.



CFD-simulated airflow across structure and crew. Analysis done with CD-adapco STAR CCM+ software. (Image courtesy Oracle Team USA and CD-adapco)

The second improvement produced a faster maneuver when making the upwind transition between low-speed (hull in the water) sailing to high-speed (hydrofoiling) mode. According to Caponnetto, the stern "wasn't producing enough lift, so we decided to modify it with a device we have CFD-tested many times. A small fixed wedge glued below the transom greatly increased the local pressure and lift with only minor drag."

Third, the design team worked with the cavitation module of STAR-CCM+ through the final race day, confident enough in the CFD simulation results to physically modify the rudder/elevator junction, reducing cavitation over these appendages and increasing the top speed for the first leg of each race.

Oracle Team USA also investigated fluid-structure interactions (FSI) on the appendages and the wing sail by using the STAR CCM+ built-in finite volume stress solver as well as performing co-simulation with Dassault Systèmes SIMULIA Abaqus finite element analysis software.

Caponnetto was in on the ground floor betting on CFD vs. physical experiments for boat design. "Now I can say for the first time all fluid dynamic design during America's Cup has been carried out with the use of CFD only," he says. "Some of the insights we obtained were unthinkable even 10 years ago, such as the modification of boat features during the last week of races. It is fascinating to think what will happen in the future." DE

INFO ➜ **CD-adapco:** CD-adapco.com

➜ **Dassault Systèmes:** 3ds.com

➜ **Oracle Team USA:** Oracle-team-usa.americascup.com

Big Data: DON'T PANIC

Fight the data explosion with smart FEA.

BY TONY ABBEY

Editor's Note: Tony Abbey teaches live NAFEMS FEA classes in the US, Europe and Asia. He also teaches NAFEMS e-learning classes globally. Contact tony.abbey@nafems.org for details.

Many simulation technologies have been restricted until now by the granularity of the solution that can be employed. For example, in computational fluid dynamics (CFD), desired accuracy has been compromised by the physical size of the mesh and the time steps achievable.

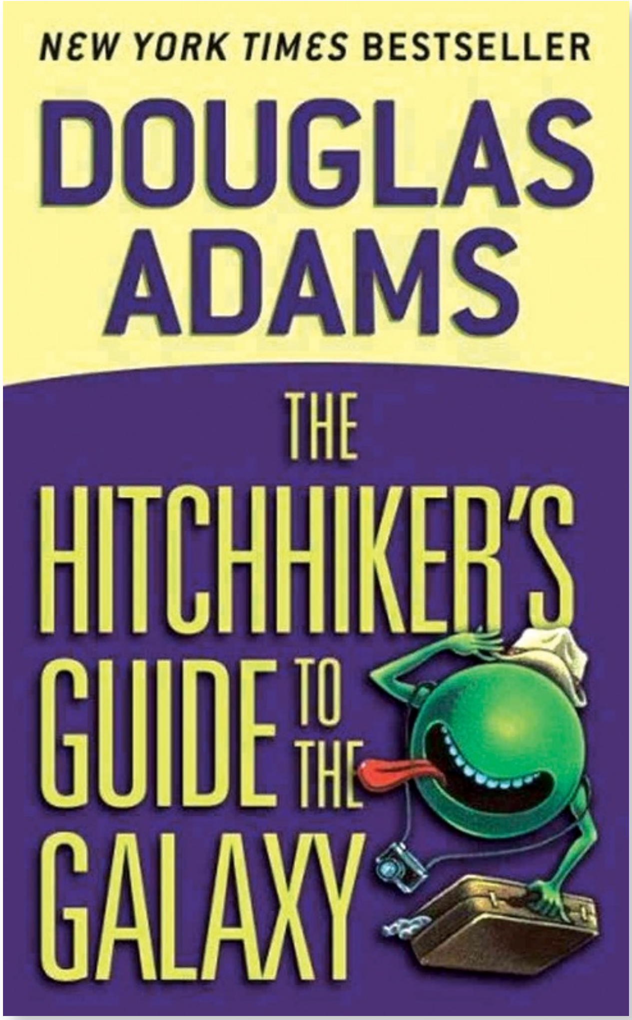
To capture phenomena such as chaotic vortex patterns in highly turbulent flow demands a very high level of fidelity. Computing power has been a limiting factor in achieving the extreme level of simulation required in this case. It may be several years before sufficiently powerful computing is available to achieve the required granularity for the average user. The important point is that the baseline we are seeking is an accurate high-fidelity representation of the physics involved.

Other simulation areas in a similar position are combustion technology and climate modeling. Indeed, it could be argued that climate modeling is so chaotic that there will never be adequate fidelity in the simulation process. Many claim that weather forecasting will always be at least one day out of date!

Structural analysis at a macro level, however, is not usually that chaotic. We are able to predict the response of components to many loading phenomena very accurately with a modest mesh density. In other words, we've reached the ideal point where we have sufficient model fidelity easily achievable with average computing resource.

Most static, dynamic and mildly nonlinear analyses fall into this category. If we move beyond this into impact, low cycle fatigue and micro-mechanical response of composites, then we have not reached that required fidelity using typical computing resource. However, this discussion relates to the more mundane, but vital categories of analysis that most of us are involved with from day-to-day.

Over the past five years, I've watched with great interest as basic structural finite element analysis (FEA) has moved to an ever-greater element count for quite simple models. Much of this is premature, given the state of FEA pre- and post-processing technology. My fundamental questions are: What is driving analysts to this "big data" trend, and how can we avoid it until we are really ready for it?



Not to spoil it for you, but the ultimate answer to the Great Question of Life, the Universe and Everything is 42, according to Douglas Adams' *Hitchhiker's Guide to the Galaxy*. The answer is a great illustration of the need to frame the right questions to get the answers you need from the deluge of engineering data. *Image courtesy of Del Rey.*

Making Big Data

There is an enormous excitement in many areas over the concept and promise of big data. Many feel that there is a virtual explosion of big data about to hit us. The essence of the paradigm is that dramatically increasing the fidelity, scope and interchangeability of data will allow higher levels of productivity and competitiveness in industry as we understand better what that data is telling us.

Mainstream examples of data captured at ever-faster rates include:

- Indirect and direct tracking of human opinions, habits and responses on the Internet;
- GPS information linked to activities on smartphones and other mobile devices; and
- Sensor information fed to the central computer on modern cars.

The McKinsey Global Institute (MGI) paper[1] on big data predicts that we will all be immersed its creation and influence over the next few years. The researchers cite five main areas where industries will benefit:

1. Creating exhaustive data sets will mean that all data is readily available and less time will be wasted in searching for it. The data will be more naturally integrated between R&D and manufacturing, for example.
2. Increased experimentation and variability in simulation models, combined with efficient data mining, will allow increases in product performance.
3. Increasing the granularity of research or simulation data will improve the modeling by allowing greater accuracy and better targeting. This includes anything from FEA to consumer marketing.
4. Replacing and/or supporting human decision-making by automated risk engines will improve product performance, as is done in financial and insurance circles now.
5. New business or operational models will emerge, such as assessing driver insurance risk by monitoring actual behavior.

Now some of these sound downright scary, but with a bit of imagination we can see many of these points resonating in a design, analysis and production environment. I will talk about some FEA areas where I think we can see real benefits.

The Caveat

For this explosion of data to mean anything, of course, we need technologies that can actually deal with its volume and interpretation. How and where do we store it? How do we retrieve it, and how do we figure out what it is telling us?

The MGI paper has a very important section on this. It emphasizes that disciplines such as ours that consist of a large amount of legacy data and disparate systems will need the development of new and innovative systems to deal with big data.

That really is the basis of my argument: I feel we are nowhere near having these types of systems in place in a general sense. There is a strong growth in the areas of simulation data management (SDM) and simulation process data management (SPDM), and that is bringing big benefits. However, that is not the full story, as it is essentially managing the data flow. What is missing is the technology to be able to interpret what that data means — or as the MGI paper puts it, the ability to "integrate, analyze, visualize and consume the growing torrent of big data."

Without additional interpretation of the results, what is the point of increasing the fidelity of an FEA mesh? We converge to an accurate stress solution at a very specific mesh density; beyond that, we are just wasting computing power and our own time. If the increased fidelity can actually tell us something more useful, that's great. But we don't have tools to enable that as yet. I will discuss later what these tools might be.

Our Future Role with Big Data

The MGI paper defines three categories of people who will be involved with Big Data, and whose skills will be increasingly needed:

- Deep Analytical
- Big Data Savvy
- Supporting Technology

After looking carefully at the MGI data matrix that supports this, I came to the conclusion that most of us fit into the appropriate "Big Data Savvy" occupation described there as "engineer." That requires us to have some knowledge of data technology, but the vital ingredient is the ability to "define key questions data can answer." If you remember *The Hitchhikers Guide to the Galaxy*, the answer to the Question of the Universe is given[2]:

"All right," said Deep Thought. "The Answer to the Great Question..."
"Yes..!"
"Of Life, the Universe and Everything..." said Deep Thought.
"Yes...!"
"Is..." said Deep Thought, and paused.
"Yes...!"
"Is..."
"Yes...!!!...?"
"Forty-two," said Deep Thought, with infinite majesty and calm.

The quote really sums it up well — how to pose the right question and not to just accept a deluge of data as being the "answer."

Let's Go Green

At an FEA conference two years ago, I first heard of the term *petabyte* in relation to data size. It means 1,000 terabytes. That was the volume of data being considered for a fairly average analysis.

I don't actually know of a post-processor that can handle output of that quantity. So we have a disconnect — careless meshing or idealization will generate huge numbers of elements (the solvers are now reaching the stage where they can generate huge volumes of result data with average computing resource). However, we can't handle that amount of data; in many cases, it adds nothing to our understanding of the results.

Let's keep our model size down. Don't fill up the computing resource just because it's there. Think of the challenge as a green element footprint instead of a green carbon footprint!

If we keep model size modest for "normal" analyses, it opens up the possibility of running more analyses rather than bigger analyses. This means we can follow a couple of interesting paths:

- **Optimization:** Modern optimization techniques have an inexhaustible appetite for numbers of analyses. To be most efficient and effective, genetic algorithm, artificial intelligence (AI) and design of experiment (DOE) methods really need analysis counts in the thousands. Software that is capable of spawning FEA analysis vari-

Terabytes Terrify me and Petabytes Petrify me!

To get a handle on the size of data we are discussing, the amount of data stored in the US Library of Congress is sometimes used as a yardstick. As of 2007 it was estimated there are 10 Terabytes of data in the written works collection. The current storage of all US Academic research libraries runs at 2 Petabytes. Storing all the words ever spoken in the world is commonly assessed at 5 Exabytes. There is no warranty on the accuracy of the numbers, but they are indicative!

Data Definitions:

- One Megabyte is 1,000 Kilobytes
- One Gigabyte is 1,000 Megabytes
- One Terabyte is 1,000 Gigabytes
- One Petabyte is 1,000 Terabytes
- One Exabyte is 1,000 Petabytes

To remind ourselves:

- The old 3 ½ inch floppy held about 1 Megabyte
- A CD-ROM holds 500 to 700 Megabytes
- A DVD holds 4.7 to 9.4 Gigabytes
- A Blu-Ray disc can hold 50 Gigabytes

A 4 Terabyte External Hard drive has a low-end street price of $200. You can pay much more for faster data transfer rate, but it clearly shows the trend in data storage for the average user.

ants, retrieving the data and presenting it in a meaningful way is quite mature. The best visualization tools enable the engineer to try to understand why a particular configuration has evolved, and what the key drivers are. This enables a direct relationship to be made to practical design insights. This is the best example I see today of the use of big data in FEA.

- **Stochastics:** The very term of stochastics scares most engineers, including me until a few years ago. But all it basically means is throwing some variability into the modeling. Much traditional focus is on variations in material properties, etc. I am more interested, however, in the idea of automatically generating a range of mesh densities, boundary conditions and loading conditions to see how robust a particular solution is. I think this has tremendous potential in supplementing, to some extent, the skill and experience needed in FEA. The ability to assess risk of inaccurate analyses dovetails very nicely with some of the risk assessment models described in the MGI paper. The data mining tools to explore this type of analysis results are quite mature, and this is where I see a place for expanding big data in FEA right now.

At some point in the history of idealization, it will become common to model fabricated structures such as ships and aircraft with solid elements, rather than shells and beams. This will be an enormous extrapolation of data, and will require a total rethink of how we store, manipulate and interrogate structural analysis results. The challenge will be to have a process that will add to our understanding of structural load paths and stress patterns in complex structures. The danger will be in producing vast quantities of data that defy interrogation as to which structural responses are critical and why. This will require software developers to push the innovation aspects discussed in the MGI paper to the max. **DE**

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References

[1] The McKinsey Global Institute 2011. Big data: *The next frontier for innovation, competition, and productivity*. James Manyika, Michael Chui, Brad Brown, et al.

[2] *The Hitchhiker's Guide to the Galaxy*. Douglas Adams. 1979. Harmony Publishing.

The Cleanup Headache

CAD geometry cleanup stirs workflow questions in quest to quell CAD-to-CAE issues.

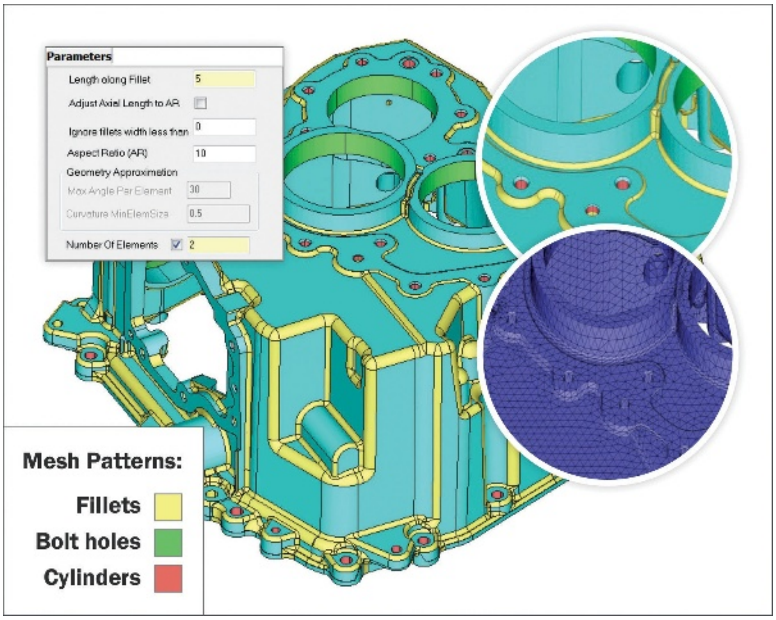
BY KENNETH WONG

CAD and CAE have existed in parallel for decades. Even if there were wrinkles in their data exchange before, by now the combined will of the software developers and users has solved the most severe issues, right?

Wrong, according to H. Clark Briggs, Ph.D., from ATA Engineering Inc. ATA supplies design analysis and testing services to major manufacturers. Briggs, vice president of aerospace and defense business development, estimates his staff spends between 30% and 50% of the project time repairing their clients' geometry.

Indrakanti Chakravarthy, Siemens PLM Software's director of simulation marketing for the Americas, has a higher estimate: "Up to 70% of an analyst's time is spent searching for data and preparing a model for analysis."

But what's the cure: simulation-led design or adopting a standardized design toolset for both CAD and CAE?



With Altair's software, you can automatically single out the minor features that fall within a range to decide whether they should be disregarded in the simulation. ***Image courtesy of Altair.***

Design-led vs. Analysis-driven Workflow

"The current workflow is so bad. While it's very common, it's horribly wasteful — and I fought for the last 20 years for companies to realize it," Briggs laments. "I spend most of my process consulting time trying to get organizations to realize it."

In the current product development roadmap, simulation and analysis experts typically receive 3D geometry constructed in mechanical design programs by design engineers, often in a finalized, fully detailed form. Because the typical design department is less knowledgeable about digital simulation, CAE software users often have to repair or refine the 3D model before they can run a simulation.

Some advocate reversing the process: Let simulation and analysis define the initial design's shape. Briggs, however, is more cautious. He recommends a workflow in which "the evolving design is regularly and actively shaped by inputs derived from performance analyses." He also recommends working in a toolset that accommodates both design and analysis — in ATA's case, NX — to reduce data exchange headaches.

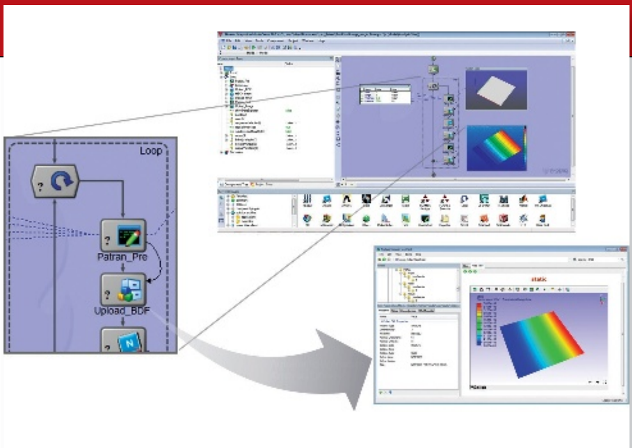
Analyze or Optimize?

Previously, the CAE software users' prep work primarily consisted of identifying and (in most cases) removing features too small to make a difference in simulation. Today, the rise of computer-driven optimization adds a new twist.

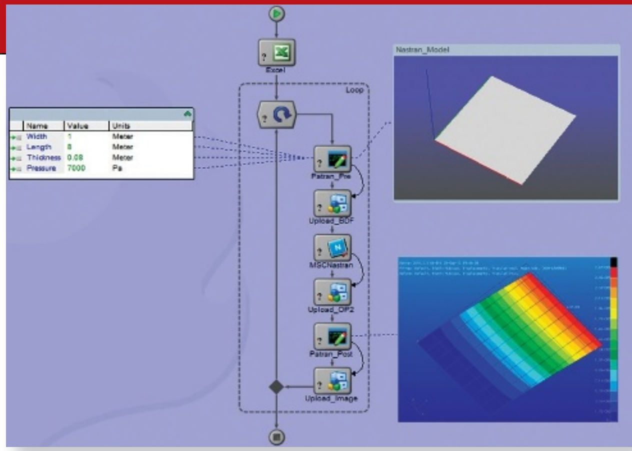
Analysis involves subjecting a 3D digital replica of your product to simulated loads and stresses to predict how it would perform under real-world usage. A typical analysis might be something like simulating the drop of a cellphone at a specific height and angle to determine whether it can withstand such an accident.

By comparison, topology optimization, a more recent practice made possible by increased computing power, uses sophisticated algorithms to seek the best possible shape or parameters for a product. For example, it might be used to identify the leanest airplane wing based on manufacturing material properties and anticipated loads.

In the past, a team of experts would have reviewed the results from digital simulations to determine how to refine the original design. With optimization, the computer steps in to do the lion's share of the job human experts once did. The algorithm-driven



With Phoenix Integration, users can iteratively run analyses and then automatically upload results into PHX AnalysisLibrary for data capture. *Image courtesy of Phoenix Integration.*



Automating the data exchange between CAD to CAE is part of Phoenix Integration's service offerings. Shown here is the analysis view in PHX ModelCenter. *Image courtesy of Phoenix Integration.*

method can also provide designers and engineers with unconventional solutions seldom explored if executed manually.

"The key in developing the geometry parameters for optimization is to control the design space," notes David Vaughn, simulation software maker CD-adapco's vice president of worldwide marketing.

For instance, if you plan to run an optimization study on the best possible shape for an airfoil, he says, the key is to limit the shape parameterization to feasible airfoil shapes. If you put a bunch of non-uniform rational basis spline (NURBS) control points into the mix, you'll end up with possibly hundreds of variables. That's overdesigning for optimization, Vaughn says, "because the objective is to minimize the number of simulations required to get to the optimal answer."

S. Ravi Shankar, Ph.D., Siemens PLM Software's global director of simulation product marketing, agrees: "If you start out with geometry that's too detailed, if you were to mesh that without any simplification, if would be a large mesh model. Then each iteration would take much longer."

Considering the number of variations the computer would need to generate before arriving at the answer, the computing time could increase exponentially, Shankar adds.

Defeaturing Makes Way for Shrink-wrapping

Several direct-editing programs also serve the CAD-to-CAE data exchange. Without the restrictions and learning curve of history-based CAD, these programs were able to capture a portion of the analysts looking for an easy way to edit 3D geometry. (*Editor's Note: For more, read "Direct Modelers as FEA Pre-Processors," Part I & II, April and May 2012.*) But the CAE vendors soon struck back, by introducing their own geometry cleanup functions and tools.

"I'm sure [direct modelers] help," says Simone Bonino, Altair's marketing director for HyperWorks. "But the question is, do you really need another tool between CAD and CAE? Now, you can skip that step."

One of the shortcuts is known as shrink-wrapping or surface-wrapping, a method that's quickly becoming the standard approach in dealing with pesky features. Another is the automatic detection of features.

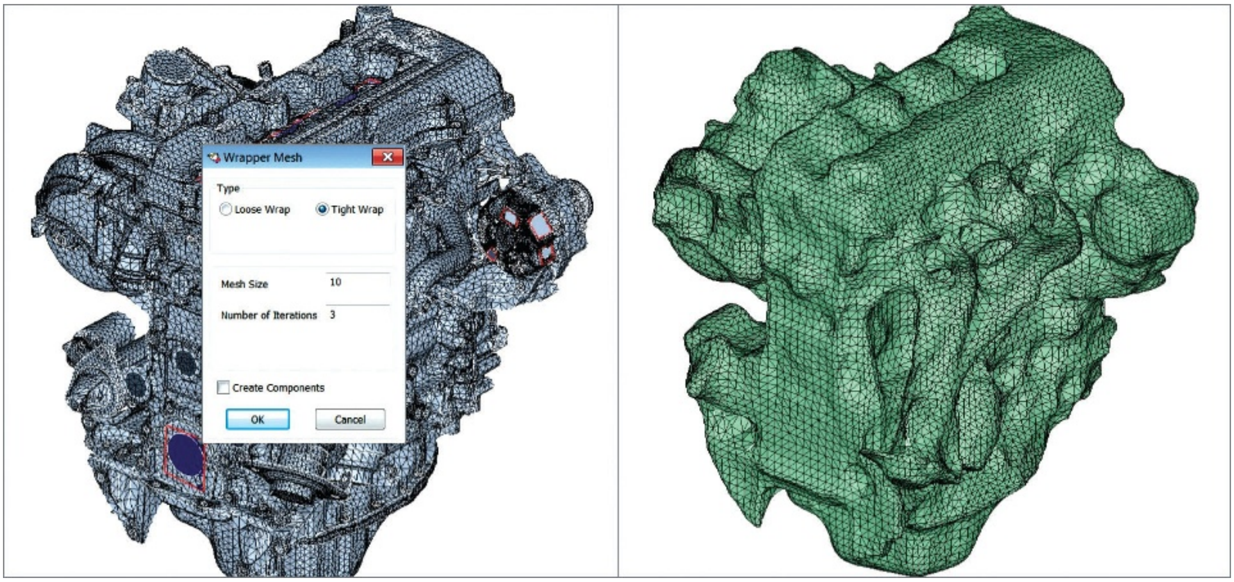
CD-adapco's Vaughn says, "The feature that we pioneered for that purpose is surface wrapping." The tool lets CAE users shrink-wrap imperfect CAD geometry to prevent holes, gaps and overlapped surfaces from compromising the analysis. "The benefit of that is, you can use the most complex CAD model you've got for optimization and can still mesh it very quickly — and it's automated," he adds.

Siemens' Shankar points out that NX also has a surface-wrapping tool. "For example, if you're trying to study the cooling under the hood of a car, you'll need to specify the flow volume," he says, referring to the enclosed space under the hood with the mechanical components excluded. "We have tools that let you create that volume based on the solid models you have. In the past, that volume could only be defined in the preset global resolution. In NX 9, you now have the option to specify a finer resolution in certain regions to capture necessary detail."

Altair HyperWorks CAE suite takes a similar approach with its shrink-wrap feature, described as a way "to generate an enclosed volume or solid mesh, and is typically used to approximate and simplify an existing model." With the option to specify whether you want a loose or tight wrapping, you can speedily create the general shape of the geometry with the desired mesh resolution.

Another alternative comes from Altair's SimLab (acquired by Altair in 2010). Ulrich Gollwitzer, Altair's marketing manager for modeling and visualization products, notes that SimLab "reads native geometry, along with the CAD parameters. It specializes in solid-meshing technology —for example, powertrain and [computational fluid dynamics, or CFD] applications. The software can automatically recognize parametric features. But in SimLab, instead of simplifying the geometry, you identify regions and set local or global mesh parameters."

Once the software has identified features that are problem-



In Altair's software, you have to option to shrink-wrap a complex model. The dialog box lets you choose a tight wrap or a loose wrap. *Image courtesy of Altair.*

prone in simulation, SimLab offers you the choice to disregard them, or treat them a certain way during meshing. If you have gone through this process, you can save the treatment as a template, so SimLab knows how to address future CAD geometry that involves the same type of features — for instance, using a specific mesh pattern for holes in-between certain ranges.

What's Important? Who's Asking?

As president and CEO of the multi-disciplinary optimization specialist Phoenix Integration, Scott Woyak, Ph.D., has seen both sides of the design-simulation division. Phoenix Integration's expertise is workflow automation, including the common CAD-to-simulation workflow. Sometimes the project involves custom application programming interface (API) development.

"We've seen some customers who develop their own system to clean up CAD geometry for optimization," Woyak says. "Some use specialized tools like Sculptor [from Optimal Solutions Software]."

Sculptor lets you deform and adjust your mesh models in optimization runs. It uses what the company describes as "Arbitrary Shape Deformation (ASD) technology and can be linked to existing fluid-flow (CFD) and/or structural (FEA) analysis tools to accelerate CAE design optimization efforts."

The key to eliminating the wrinkles in CAD-to-simulation is to figure out "the best way to construct your geometry so you won't encounter problems in simulation when you try to solve," says Woyak.

The discussion, therefore, raises a question: Is it fair to put the burden on the designer?

Reshuffling the Order

"People are beginning to realize that, to lower cost and shorten cycles, they've got to use simulation more, earlier in the process," Woyak observes. "When we work with a customer, we try to explain to them about these geometry-related issues and guide them toward simulation-driven design."

ATA's Briggs says he's a "big fan of putting the whole organization on a homogenous toolset. I guarantee that you'll make one-and-a-half or two times' improvement in productivity and in reducing technical errors."

Gollwitzer asserts that Altair is preaching simulation-led design. "If you start out with optimization, it might even give you a completely new idea of how your structure should look like," he adds. "Then you're not just replicating similar design patterns over and over again."

Gollwitzer suggests that it would be "smart to establish a workflow where the designers hand over the geometry at the level of details sufficient for an analysis. Once simulation has proven that the design works, designers can add additional details to that design. It would take a little bit of education."

Either way, the design process is iterative, so CAD to CAE or CAE to CAD will always require communication and collaboration. **DE**

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

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Pulling Double Duty

COMSOL Multiphysics Software offers simulation and modeling for Sharp Corp.'s research and product development.

BY JIM ROMEO

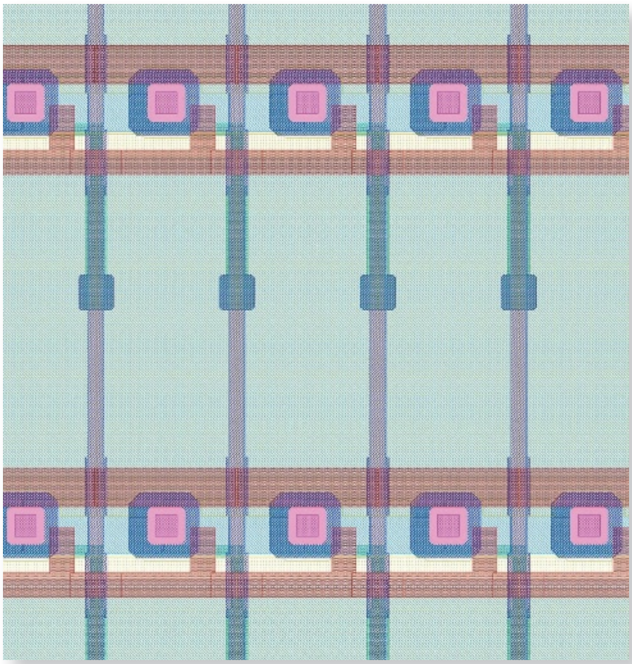
Optimizing digital engineering design and optimizing finite attributes of components is the goal of many global technology companies, particularly at the research and development stages. Today's electronic products contain many sophisticated components including processors, communication chips, analog and passive components, light and power sources, as well as displays, imagers and micro-electromechanical systems (MEMS). Such component technologies require complex scientific and engineering demands.

Simulation and modeling software becomes an asset to the intellectual prowess of researchers as they seek the most accurate prediction of the performance and reliability in a very competitive environment. Such is the case for researchers in Sharp Corp.'s R&D laboratories.

According to Valerio Marra, Ph.D., technical marketing manager for COMSOL, Sharp found that COMSOL Multiphysics software was very helpful to its research efforts. As the model grew, Sharp became more familiar with various applications that COMSOL offered in its software.

"You can start with structural mechanics," says Marra, "and then add heat transfer and other physics in order to accurately represent, thanks to multiphysics, the behavior of your applications. Sharp took advantage of the fact that they can let the model grow accordingly to their simulation needs."

Once one department learned the software, regardless of the physics used, they were able to train colleagues of other departments in its use and applications. He explains that Sharp was attracted to COMSOL's "real-world accuracy" simulation approach, meaning they got better and better as they built simulations and models — and at a certain point, they reduced testing significantly and kept optimizing the designs with the software.



LCD: Structure of LCD pixel as drawn in ECAD software. ***Images courtesy of Sharp Corp.***

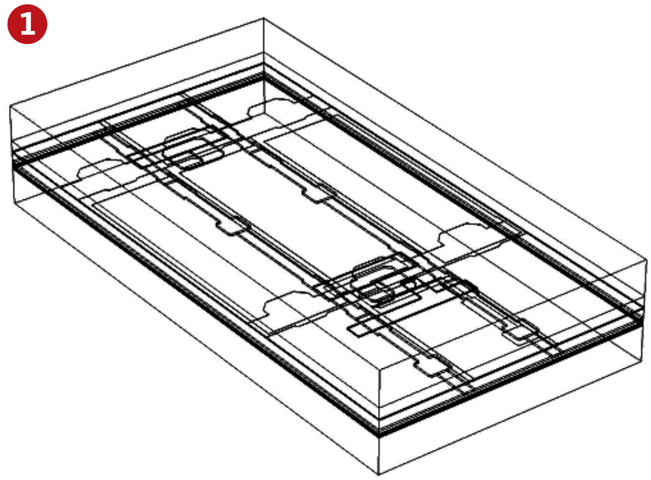
Diverse Technology Development

Sharp's global R&D presence includes laboratories in Japan, which is the global headquarters for R&D, as well as in Oxford, England; Camas, WA; and Shanghai, China. The mission of each laboratory is to develop technology that can be used in Sharp products, and while each lab works on roughly the same research themes — displays, health, energy and lighting — each has its own unique capability to tailor activities to support Sharp's regional businesses.

Sharp Laboratories of Europe (SLE), located in Oxford, has about 100 employees engaged in the R&D of electronic hardware and devices. Chris Brown, Ph.D., is SLE's research manager for the Health and Medical Devices Group. According to Brown, the multidisciplinary trend is quite compatible with changes in the type of R&D done in the lab.

"Ten years ago, our main research themes were based on improving component technologies — in particular, displays and optoelectronic devices such as semiconductor lasers," he says. "Activities tended to be driven by depth of knowledge in just one technical specialty, such as optics or electronic circuit design. More recently, though, there has been a shift in focus to systems or products as a whole, such as health systems and energy systems. By their nature, these activities are broader, and the research is driven by understanding how all the parts fit together."

SLE uses COMSOL Multiphysics in a number of projects across the lab, for purposes ranging from early-stage research to product development in areas such as light-emitting diode (LED) devices, displays, labs-on-a-chip, and energy systems.



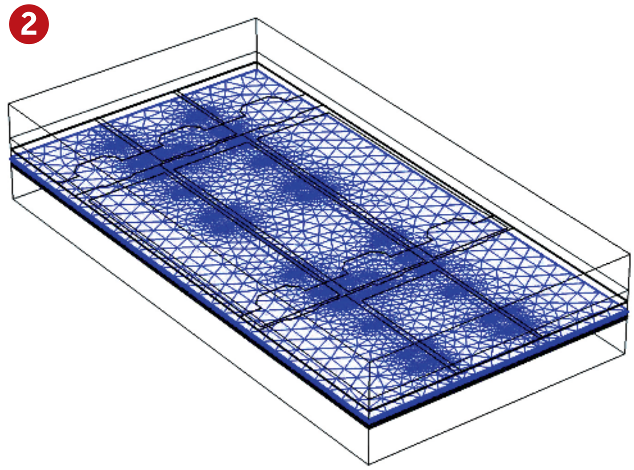


FIG. 1: Imported LCD pixel geometry in COMSOL. **FIG. 2:** COMSOL mesh of thin-film high aspect ratio structures.

LED and LCD Development

SLE's use of COMSOL has grown over the last five years, having begun in LED research and expanded to other themes by way of internal recommendations. SLE supports Sharp's LED business by providing technical analysis and design modifications to improve the performance of LED devices.

One example is optimization of LED electrode designs for improved wall-plug efficiency. A major issue with LED devices is that high operating temperatures can cause a reduction in efficiency in the conversion of electricity to light. The relationship between optical efficiency and temperature in an LED is not linear; any hot spots in the LED chip will disproportionately reduce the efficiency of the entire device.

Sharp's goal was to create a uniform temperature distribution. This is accomplished by designing the LED's electrodes so that no hot spots appeared. The resulting uniform temperature distribution also tends to maximize heat dissipation from the LED and lower average temperature.

COMSOL software also helps support Sharp's displays business. Sharp's objective is to improve image quality while reducing liquid-crystal display (LCD) power consumption in Sharp products, such as smartphones and TVs. A detailed understanding of the electrical and optical performance of the LCD displays — particularly the electrical characteristics of the LCD pixels — goes a long way toward achieving these goals.

Overall, Sharp's design and simulation environment for electronic circuit design uses the AC/DC Module found in the COMSOL product suite to extract the parasitic resistances and capacitances of the electrical wiring inside the LCD. Specifically, it capitalizes on the meshing capabilities available in COMSOL Multiphysics to achieve the desired accuracy.

Healthcare Product Development

In the healthcare market, Sharp sought to develop palm-sized diagnostic tools for doctors, nurses and other healthcare professionals to allow blood testing in a matter of minutes, compared with the hours or days it ordinarily takes. Sharp used COMSOL Multiphysics to investigate the interactions between the fluid layer and the electronics.

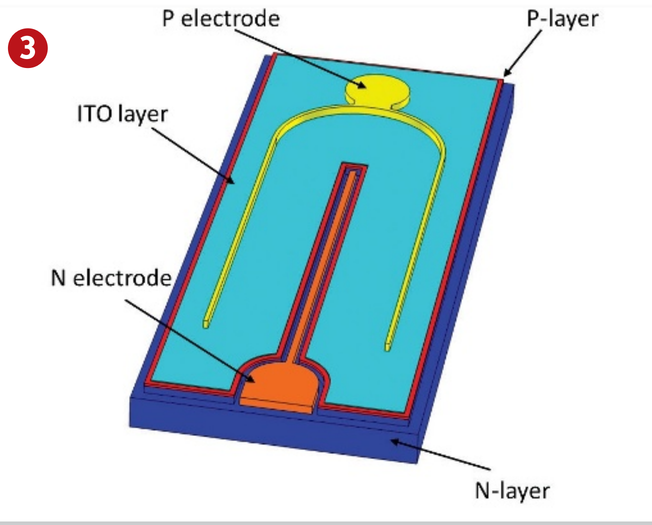
"We have modeled fluid flow at the input ports of the array, enabling us to design fluid-input structures to get the droplets onto the array in the right place with minimum fluid-input volumes," says Brown. "This modeling ability gives us a more accurate starting point for experimental work, hence reducing the number of design iterations required, which in turn helps us to reduce R&D prototyping time and cost compared with simple hand calculations."

The software also allowed them to model interactions between the droplets or particles in the fluid, and the electronic sensors in the array. "In this case, we were interested in investigating impedance changes as droplets or particles in the fluid pass between a pair of electrodes," Brown says. "The simulation output is a range of likely impedance values, and this can be used as the basis of a specification for designing sensor circuits to detect the presence of the droplets or particles."

Compatibility and Versatility

COMSOL is compatible with other software tools that Sharp uses, such as CAD programs, Brown notes. The versatility of the software fit nicely in its portfolio, strengthening its overall toolkit for cutting edge research.

According to Brown, Sharp attempted the use of parasitic extraction tools from several traditional ECAD software packages, but none were able to successfully cope with the large aspect ratio of the thin-film, large-area structures used in LCDs. For Sharp, the COMSOL software provided the first opportu-



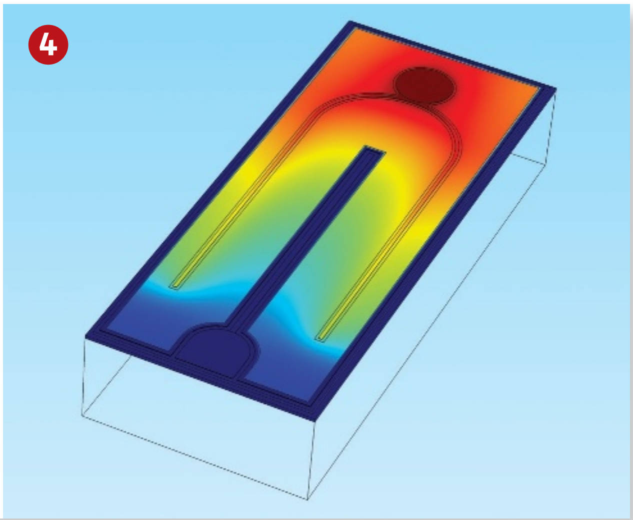


FIG. 3: Structure of an LED chip. **FIG. 4:** COMSOL simulation output of an LED structure showing surface electric potential.

nity to enable versatility and degree of control over the meshing procedure. Ultimately, it allowed them to thoroughly explore such structures.

Brown also says the software's ECAD Import Module lets researchers transfer layout designs from ECAD software quickly and without error — enabling them to explore the effects of design modifications to a degree not possible otherwise. That's because the only alternative is to hand-calculate the capacitances between wires using simple linear design equations. The shape of the wiring in the LCD makes this quite complicated, however. In the past, SLE's researchers made a number of simplifications when using this method. "Hand calculations of capacitance are correct to a first order, but aren't really of any use when trying to optimize or improve designs," Brown says.

Cross-pollination and Knowledge Transfer

The software's versatility was key for Sharp, as they used their models and simulations in multiple applications across their R&D efforts. The key advantage of this "cross-pollination" is that a technical solution can be transferred from one application or market area to another, developing solutions that would be otherwise hard to find.

For example, Sharp used COMSOL for its development of new energy storage systems and sustainable heating and cooling. An important R&D target is to optimize the performance of heat exchanger components so as to achieve high heat-transfer efficiency and minimize system size and weight. This work has involved both the optimization of existing heat exchange components and the design of new ones.

"We have simulated the fluid dynamics of cooling fluids in air-conditioning systems and achieved an efficiency improvement of 30 percent with a new system," Brown reports. "We use COMSOL because this is inherently a multiphysics problem, given the need to link the gas and liquid flows in the system to thermal transfer in the solid components."

Besides providing technical support for existing products, SLE is also engaged in creating business opportunities for Sharp to enter new markets. Specifically, in the health care arena, SLE led to the development of so-called lab-on-a-chip systems. This demonstrated how COMSOL's value to Sharp in one application gave way to similar value in another: Sharp was able to leverage manufacturing expertise with the thin-film transistors traditionally used in the LCD market.

For Sharp, COMSOL software parallels the same rigorous approach it uses in R&D explorations. Given the diverse range of projects for which COMSOL Multiphysics is used, each research group has its own license and add-on products. A member of the research staff in each group is responsible for the maintenance of that group's license.

Ten research staff members across the lab are now trained in its use. Projects and teams are structured to enable flexibility for several researchers across the lab to use the software simultaneously. As team usage of COMSOL grew, they began to dedicate a stand-alone workstation within each group just for COMSOL.

"The multidisciplinary nature of our research activities at SLE will continue in the future," Brown says. "As such, we expect COMSOL Multiphysics to continue to play an important role, both as a research tool and as a product development tool." **DE**

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Making Optimization a Shared Experience

Enterprise Suite allows teams to build the advanced multidisciplinary optimization workflows that are critical to complex system design.

BY BETH STACKPOLE

No longer an oddity or curious interloper, wind turbines are settling in as a familiar part of both urban and rural landscapes. Yet beneath their simple and majestic stature belies a design complexity that tests even the most technically astute engineering organizations.

Just ask Airworks, a contractor for advanced projects in the space and defense industries, which is refining a long-term strategy for wind energy with a pilot project for wind turbine rotor blade design. To ensure a proper concept for a certified rotor blade, the Airworks team needs to balance a variety of multidisciplinary optimizations (MDOs) — for example, creating models that couple aero-structural blade properties with wind flows and possible failure scenarios — in addition to performing stability analysis and evaluating materials and manufacturing time costs.

On top of the sheer complexity of the blade design, there is the collaborative nature of the engineering process. It's made all the more challenging given that Airworks' aerodynamics, load and mold design experts are based in Rome, and the system-level architecture, structure, manufacturing and project management domain experts reside more than 400 miles away in Trieste, Italy.

"When a wind energy project launches, we always have problems," admits Stefano Picinich, Airworks' founder and managing director. "Normally, we move three or four key people from Rome to Trieste for a couple of months to enable a smooth design start, but this took engineers away from routine support, which was far more costly."

The solution to both the design complexity and collaboration problem arrived in the form of Enterprise Suite, a new platform from ESTECO, which aims to simplify some of the challenges around MDO and multi-objective optimization.

Launched mid-year, Enterprise Suite combines the advanced capabilities of the modeFRONTIER 4.5 multi-objective and MDO platform, with SOMO, ESTECO's new framework for distributed execution and collaboration. The duo is designed to give engineering groups better control over the design of complex systems by helping them more effectively organize and manage critical simulation data — all while allowing a dispersed and varied team of domain experts and optimization and integration specialists to join forces to build advanced MDO workflows.

The Power of the Web

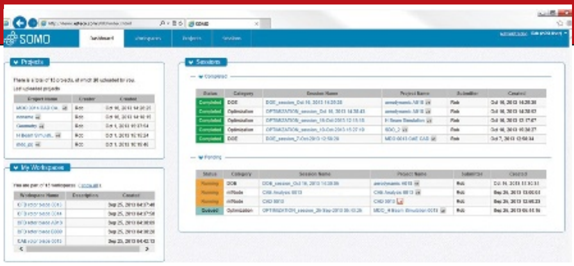
Key to the pair's power is a complete redesign that extends the modeFRONTIER desktop paradigm to a Web-based collaborative environment. The new approach means that multiple users, with different competencies and located at different sites, can more easily participate in the MDO process. They can share models and optimization strategies via a shared repository that can be accessed anywhere, anytime, with only a Web browser.

"Today, all companies are working in scenarios where different people work together; there are few instances of single engineers doing all the work on their own from design to detailed modeling," notes Matteo Nicolich, ESTECO's product manager for SOMO. "Rather, you have different groups with different expertise working together, and they need a tool to integrate the different levels of knowledge in the same environment. The Web provides the classic answer for this type of framework."

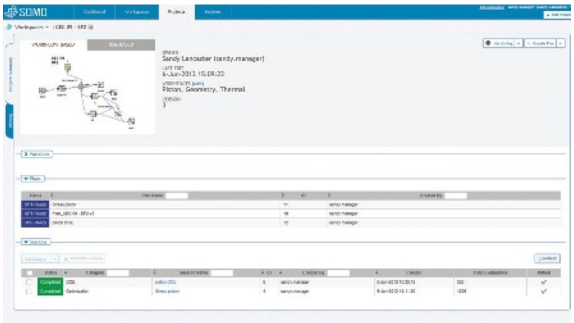
Consider a scenario where an aerodynamics specialist and a structural expert need to collaborate on the same design, but are located in different venues. They're performing their individual modeling and optimization routines using siloed tools and with very disconnected workflows. Traditionally, these two would have to manually trade their different model files to work together — raising the risk of one party being saddled with incomplete data if a particular type of simulation or MDO changed along the way. Moreover, domain experts unfamiliar with how to create specific design of experiments (DOE) or optimization strategies in modeFRONTIER were shut out of the workflow, unable to contribute models to the greater cause or to reuse other experts' MDO work because it was not easily accessible.

With Enterprise Suite's Web-based approach, however, project experts can participate in MDOs without knowing the details of that other discipline, and without the skills to create the integration and workflows. Moreover, by storing specialists' optimization and design space exploration strategies in a single, structured database, companies protect their intellectual property, nurture a shared knowledgebase, and promote MDO reuse.

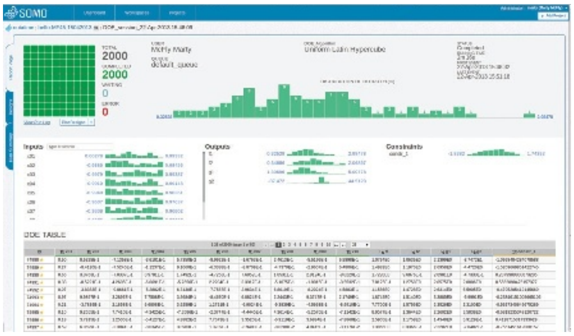
While the ability to share optimization plans is intriguing, SOMO's potential to facilitate collaboration and help multidisciplinary engineering teams easily create and modify optimization



SOMO's Dashboard page lets users find information about their work, as well as direct links to the most recent resources. *Images courtesy of ESTECO.*



Users can organize their work and data inside the SOMO shared repository using projects and workspaces. Users associate projects with one or more workspaces to control how project resources are shared among other users.



With SOMO, users can create a DOE or optimization plan for a given project, while having direct visibility to the most meaningful information from the generated session.

Visualization and analytical post-processing tools like this scatter bubble chart help users glean an understanding of complex datasets.

workflows is its strongest selling point, according to Marc Halpern, Ph.D., research vice president at Gartner. Workflow is generally difficult to change in typical product data management (PDM), product lifecycle management (PLM), and service lifecycle management (SLM) offerings, Halpern says, so SOMO's "flexibility of workflow and collaboration functionality will be key to its acceptance."

Freedom to Innovate

Enterprise Suite also delivers innovations in the areas of distributed execution and post-processing analysis capabilities. With simulation and optimization continually hungry for additional compute power, ESTECO designed SOMO to support high-performance computing (HPC) systems and cloud environments so engineering groups can easily add more horsepower when needed.

In addition, SOMO will automatically execute simulations and optimizations across a number of nodes in a distributed fashion. It's a process that is transparent to the user, thereby reducing the burden on IT, Nicolich says. Users can select where they want their task to be executed based on their role and privileges, or the software will automatically queue up and distribute jobs based on the requirements of the software, as well as the availability of computing resources.

On the post-processing front, Enterprise Suite is stocked with an array of tools, including new data visualization capabilities and statistical analysis reports to help domain experts and other engineering collaborators make sense of the DOE and optimization findings. Because the Web-based system supports HTML5, users can access the charts and report capabilities on an array of devices, from laptops to tablets.

While Airworks is still getting its feet wet with Enterprise Suite's new capabilities, Picinich says the Web-based interfaces align perfectly with the firm's working style and is likely to make the collaboration process a lot easier. More to the point, though, he sees Enterprise Suite opening doors to new design innovations, whether related to wind turbine blade design or in Airworks' other core areas of focus.

"The platform gives our people the freedom to think about how to improve the product, rather than occupy their minds with issues that have more to do with logistics like relocating from one office to another or checking an FTP for new data," he explains.

Nevertheless, even the best engineering tools can't cover for a lack of design expertise and well-defined goals, he cautions. "Sharing optimization data, accessing HPC resources, and having a smarter, faster platform doesn't mean people can relax on the engineering side," he says. "Tools only provide a link between your expertise and your ideas for the product you design." **DE**

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The Coming Impact of CPS on Design

What does the future hold for design methodology in the face of technology?

BY RANDY FRANK

The convergence of design methodologies has been an ongoing work-in-progress for decades. In 1969, Tetsuro Mori of Yaskawa coined the term mechatronics for combining the aspects of mechanical and electronic design. It evolved to include computing, as well. Today, with technology terms such as the Internet of Things (IoT), cloud computing and others, cyber-physical systems (CPSs) seek to define the next-generation approach for the design of complex systems.

Differentiating themselves from previous design approaches, CPS designs are coordinated, distributed and connected. Their goals include the ability to far exceed the systems of today in capability, adaptability, resiliency, safety, security and usability. The key to their success is connectivity between the cyber-world of computing and communications with the physical world.

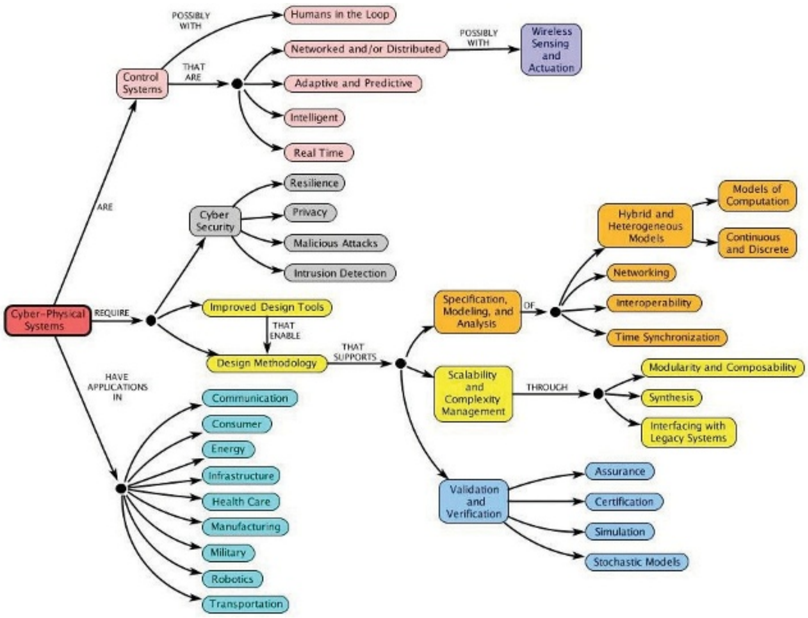

FIG. 1: The CPS concept map embraces control systems, cyber security and advanced design methodologies, including validation and verification. *Image courtesy of CyberPhysicalSystems.org.*

Potential application areas for CPS include a smart electric grid, smart transportation, smart buildings, smart medical technologies, and essentially any of the smart-prefixed, next-generation physical systems — including smart manufacturing and smart factories. (*See Fig. 1.*)

Industry 4.0

Smarter factories with increased automation that include intelligent monitoring and autonomous decision-making processes will require new business models. Recognizing that the areas of production and logistics are prime candidates for optimization, Industry 4.0 was conceived in 2011 as a forward-looking project under the Germany government's "High-Tech Strategy" initiative. A Working Group was initiated later that year to draft comprehensive strategic recommendations for implementing Industry 4.0, which is based on the use of cyber-physical systems to accomplish its goals.

In his keynote presentation at NIWeek 2013 in August, James Truchard, Ph.D., president, CEO and co-founder of National Instruments, discussed CPS, Industry 4.0 and the transformation of tools. He provided greater insight into CPS' impact on the design process in an exclusive interview with *DE*.

Truchard acknowledges the continuous nature of im-

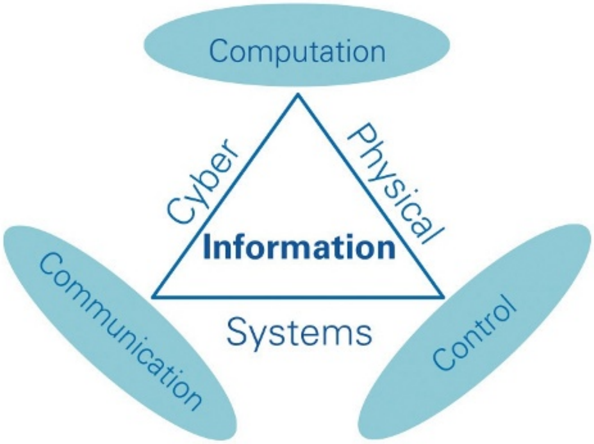

FIG. 2: A concise view of CPS shows three Cs for ubiquitous information. *Image courtesy of National Instruments*

proved design methodologies, and the relationship of CPS to well-accepted approaches such as mechatronics, model-based design and other recent design methodologies.

"Every now and then, another piece of the puzzle comes together," he says. "When you step back a few steps and look at the whole process, things have just changed."

National Instruments recognized the value of CPS more than seven years ago. The iPhone, for example, shows how the right graphical user interface (GUI), several sensing technologies and the resulting measurements can significantly change consumer products. Truchard says he sees the same thing occurring in industrial systems for large-scale physical problems.

"For the first time in history, you can have advanced measurements in the same platform you have advanced control," he explains. "That's one aspect of the whole. Then you have this ubiquitous capability that combines measurements — it combines control, it combines advanced analysis — all being done in real-time, with the ability to interface the computing world to the physical world."

In fact, machine-to-machine (M2M) communications and control, the IoT, cloud computing and just about everything "smart" can all fall under the CPS design umbrella, he points out.

"And there is one more sort of consolidating perspective on it, and that's the ubiquitous nature of information or data being converted into information, top to bottom in the decision process," adds Truchard. (*See Fig. 2.*)

Because of CPS, Truchard notes, people are using data in ways that were not previously imagined. One example is the Dresden light rail system in Germany. With seven years of data collection and consolidation, researchers at

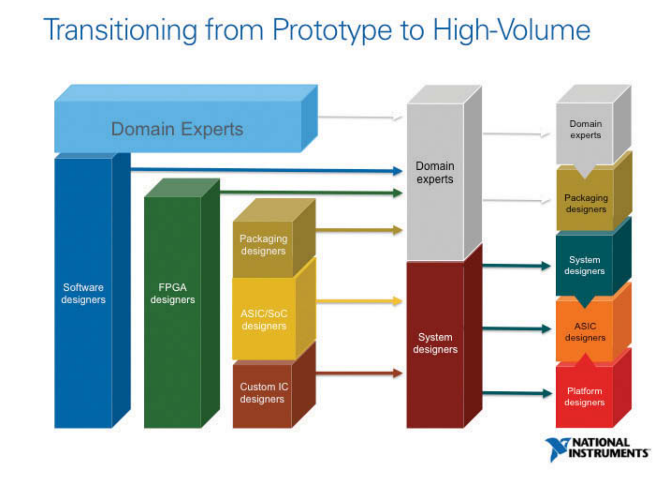

FIG. 3: Transitioning from prototype to high volume. *Image courtesy of National Instruments.*

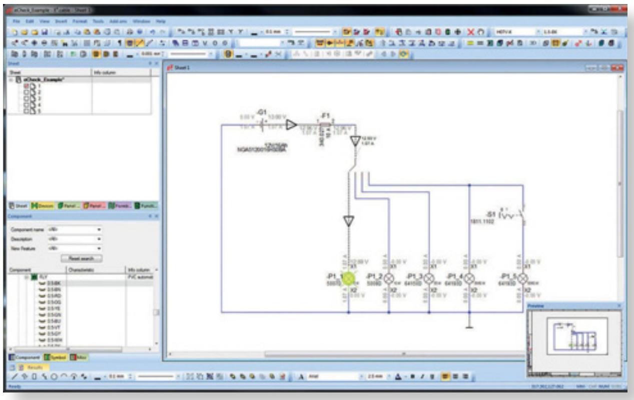

FIG. 5: E3.eCheck provides a circuit test showing an active lamp, current flow, voltage and current. *Image courtesy of Zuken.*

the university published 19 papers demonstrating several ideas they were able to implement to improve the efficiency of the system, from effective use of electricity to vehicle maintenance.

"Another piece of the puzzle is what we call 'big analog data,'" says Truchard. "You have this data that is a variable — accessible across the network, across the activities and whatever dimension you want to go. These things on their own are isolated facts, but when you pull them together in an aggregated way, they change your ability to understand use-related information."

With CPS in mind, NI has implemented advancements in its tools and software to provide a unified platform for designing, prototyping and deploying applications. Graphical system design allows designers to integrate real-world signals sooner in the design process,

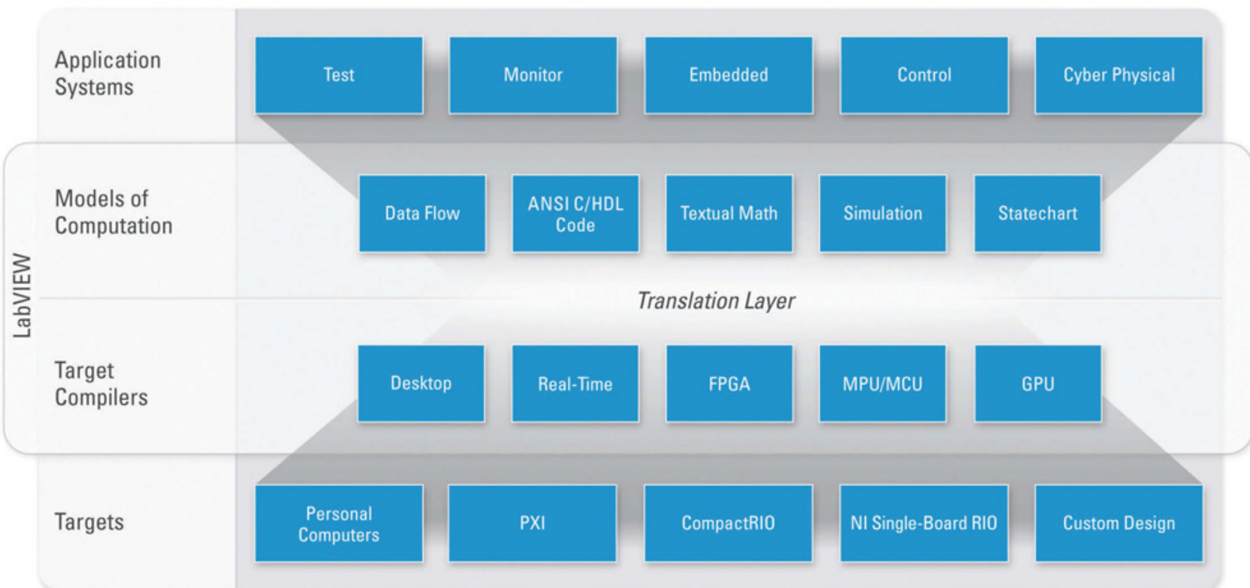

FIG. 4: National Instruments' LabVIEW and other hardware provide solutions for different application systems, including CPS. *Image courtesy of National Instruments.*

for earlier error detection and reuse code for maximum efficiency. By taking advantage of the latest advances in computing technology, this approach can optimize system performance more quickly than traditional design methodologies, Truchard says. (*See Fig. 3.*)

"What makes that possible for us is we combine the processing, distributed processing and the [field-programmable gate array] FPGA that lets us go the last mile for the high speed that's needed in some cases, so it becomes a software problem in that space," he continues. While sensor integration is still a physical system problem, he says, other design aspects would become a software problem where re-use of work plays a critical role. *(See Fig. 4.)*

Additional Tools

Other companies have recognized the importance of CPS thinking, but may not use that terminology. Zuken, a software and services company, has tackled design complexity system cost reduction with E3.eCheck. As part of its E3 series of electrical and fluid CAD software, E3.eCheck identifies errors at the development stage. Running in real-time, the software automatically ensures the functional accuracy of a schematic and verifies that wires and fuses are within acceptable tolerances.

"E3.eCheck represents an advancement in the tools available for electrical engineering of harnesses and control systems," says Steve Chidester, head of international marketing at Zuken. "The days of prototyping and then documenting afterward are on their way out. Today, it is important to engineer products from concept through manufacturing. E3.eCheck not only makes design analysis faster and more accurate, but it also identifies design flaws early — saving time and cost by eliminating prototype iterations." (*See Fig. 5.*)

Evolving Design Methodology

While many of the enhanced capabilities from CPS are reality, some of the pieces are still falling into place. "There are some components that depend on some new standards that are coming out," says Truchard. "One is [Practical Software and Systems Measurement, or PSM] time-synchronized networks, for example, that we're active in committee form, driving the components that are needed to make this happen."

The time-synchronized aspect is required to take CPS to the next level. One of the primary goals of the PSM project is to transition the issue-drive measurement process into everyday practice. With its role in measurement technology, NI has interest in both of these areas.

To deliver on the vision of cyber-physical systems, NI is involved in driving the standards and developing tools needed so that users can implement the latest technologies. Truchard says he also wants to educate and prepare designers for the future of engineering.

"You have all these things that are combining, and the key is to be a player, to be a part of that ecosystem in a way that your information and your [technology] — in our case, measurements and systems that are being built with our technology — can integrate into this bigger picture … with things like the cloud included," he concludes. **DE**

Randy Frank *is a contributor to* DE. *Send e-mail about this article to DE-Editors@deskeng.com*

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➜ **Industry 4.0:** BMBF.de/en/19955.php

➜ **National Instruments:** NI.com

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SPEED UP Engineering IT

Virtualization promises a solution to the budget constraints and challenges associated with deploying new engineering computing hardware.

FRANK J. OHLHORST

Virtualization has been the buzzword in IT circles for several years now. After all, what's not to like? Simply put, virtualization allows IT managers to more efficiently use their existing resources, maximizing CPU utilization and abstracting compute, storage and infrastructure from the physical realm while easing management at the same time.

However, there are those looking to extend the promise of virtualization, and pushing the envelope, at least when it comes to high performance computing (HPC), remote computing and the maximizing of simulation resources.

Virtual, High-Powered Machines

Vendors and developers have come to the realization that virtual representations of HPC systems can be deployed rapidly and offer remote access, without the need for HPC resources located at the customer's site. That has created a boon for high performance virtualization, where expensive HPC systems can be remotely accessed and custom configured for a short period of time, making it much more affordable, yet still offering needed compute resources on demand.

Ultimately, virtualization promises to lower the entry point into HPC utilization, bringing the technology to a vast array of businesses, which previously did not have the financial resources to invest in the needed hardware. Nowhere in engineering will that benefit be realized more than in advanced simulation chores, where grids of systems were often required to perform tasks in a timely manner.

However, the benefits offered by virtualization do not end with remote HPC, several other use cases prove the technology offers value for engineering and design firms, where stretching the performance of systems and doing more with less are the orders of the day. Virtualization can be used to maximize CPU utilization by running several virtual machines on a single high performance system. In effect, doing more with less, while utilizing those normally discarded CPU cycles.

An entire market segment has become devoted to virtualization, with dozens of vendors offering hundreds of products and services designed to bring the technology to most any business. However, that cornucopia of virtualization variety creates another problem: What technology to use?

Each vendor will tout its own virtualization platforms and subsequent ecosystems — some will leverage the service/hosted model, while others will associate virtualization with the cloud, and others may push the on-sight ideology. Yet, different solutions are designed to handle different problems, so the first step on the path to virtualization is to ask what problem needs to be solved. That fragments the market into three distinct segments, each with its own capabilities, needs and solutions.

The NVIDIA GRID Visual Computing Appliance (VCA) allows users to create virtual machines called workspaces, which NVIDIA says are effectively dedicated high-performance, GPU-based systems.

1 Access HPC on Demand

Take for example companies that need part time access to HPC offerings. Those companies will be looking for a pay-as-you-go offering that minimizes costs, yet scales up to meet demands of individual projects. Those businesses are best served by cloud/hosted offerings that can offer remote access in to virtualized infrastructures/compute farms/storage subsystems and so on.

The needs of those businesses may be met by service vendors, such as RackSpace, Amazon, Peer1, and others. For example, RackSpace offers an HPC Cluster in a Cloud Environment, which incorporates a technology called Open MPI (Message Passing Interface) that supports the threading of HPC applications across a cluster. RackSpace allows their customers to self-provision HPC clusters for remote access using multiple Virtualized Rackspace Cloud Servers.

Amazon and Peer1 offer similar ideologies, where the virtualization layer becomes basically a transport layer to connect physical servers to virtual machines for HPC processing.

However, there are some other vendors that take a different approach, aiming to ease the burden on customers by handling the provisioning and maintenance of Virtualized HPC offers. Cases in Point include companies such as NIMBIX and IBM's SoftLayer, which offer private cloud types of virtualized HPC clusters. Those vendors offer solutions that are somewhat preconfigured and fully managed, allowing customers to focus on compute jobs and not ancillary issues.

2 Maximize Computing ROI

For many businesses, virtualization is about maximizing the value of what they already have — in other words, increasing the return on investment on systems already purchased.

One way to do this is by extending the reach of internal HPC resources out to remote workers and satellite offices. By combining web access with virtual machines, those businesses can deliver a full HPC environment to a distant engineer, without having to invest in additional hardware. That scenario also extends to mobile workers as well, where a user can access an HPC virtual machine on a tablet, notebook computer or even a smartphone — eliminating the need to bring expensive (and cumbersome) hardware out into the field.

Those scenarios are typically powered by leading technology vendors such as VMware, Citrix, Microsoft and Parallels, who offer virtualization platforms that abstract the hardware from the virtual machine. However, most adopters are finding that those basic platforms are not enough and have to assemble ecosystems that support VDI (Virtual Desktop Infrastructures). Vendors in that space include LiquidWareLabs, a company that provides pre-assessment, deployment and management tools for VDI implementations. Other vendors include LUCIDLOGiX, Syncron, Quest, Ericom and Moka5. However, remote VDI capabilities doesn't end with just software vendors, there are others offering a hybrid solution, which pairs a client device with VDI software. PanoLogic offers its "zero client," a small Ethernet attached device that presents a virtual machine to users — no local CPU needed. The device simply attaches the desktop peripherals to the remote virtual machine via an Ethernet connection.

Dell's recent acquisition of Wyse Technologies brings another solution to play, a terminal device that works much in the same way as Pano's offering. nComputing is yet another vendor offering a combination of virtualization and remote desktop access — the company offers a multiuser card that is installed into a PC and then uses Ethernet to deliver the experience to a small client device that powers a terminal setup.

Other technologies also are available that do a good job of enabling remote access to virtual systems. Take for example Teradici, a company that offers a card that plugs into a host system and then delivers the host's capabilities to a remote, dumb terminal — while not exactly a virtualization product, it does abstract the user's desktop from a high performance system, allowing those HPC systems to be accessed remotely.

3 Boost Performance

The third virtualization scenario often found in the engineering space focuses on performance and not so much remote access or cloud enablement. Here, engineering firms are using virtualization (both hardware and software) solutions to maximize performance and minimize wasted CPU cycles.

One major player is NVIDIA, with its Grid Series of add-on boards that are designed to allow virtualized systems to offload graphics processing to a dedicated GPU, improving performance, responsiveness and usability of virtualized systems working with intensive graphics. Ideally, a GRID board can use a single high performance workstation as a host for virtual machines, allowing several users to share the processing power of that system, while not experiencing drops in graphics performance.

The key driver of virtualization seems to be the need to centralize HPC, making it easier to manage, scale and provision based upon project needs and not assumptions. That has led to the adoption of high-end virtualization systems, which operate by accumulating and assigning multiple cores to a single machine. The single virtual system aggregated from multiple physical machines proves to be a powerful management tool that helps the IT department increase its efficiency, as well as the efficiency of engineering computing. **DE**

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→ **NVIDIA:** nvidia.com

→ **Parallels:** parallels.com

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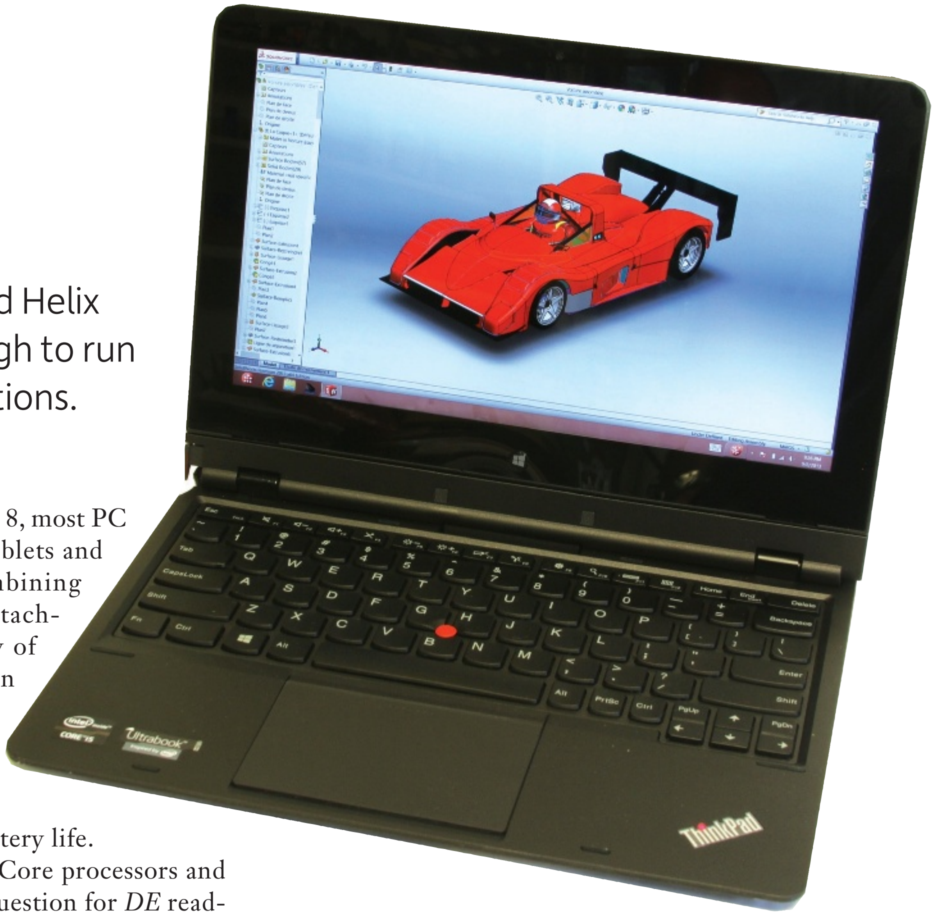
Yes It CAN

The new Lenovo ThinkPad Helix ultrabook is nimble enough to run mainstream CAD applications.

BY DAVID COHN



With the advent of Windows 8, most PC manufacturers released tablets and convertible systems combining touchscreens with small, often detachable keyboards. One new category of systems is the ultrabook. Based on a specification developed by Intel, ultrabooks represent a new class of high-end subnotebooks designed to feature reduced bulk without compromising performance and battery life.

Ultrabooks use low-power Intel Core processors and solid-state drives (SSDs). The big question for *DE* readers, however, is whether these new ultrabooks are capable of running mainstream CAD software. We finally got a chance to find out firsthand when we received the new Lenovo ThinkPad Helix.

The machine consists of two distinct components: an 11.6-in. tablet and a keyboard dock featuring an 83-key full-sized, spill-resistant keyboard. On its own, the 11.7x7.3x0.5-in. (WxDxH) tablet weighs just 1.8 lbs., and features a bright (400 nits) full HD 1920x1080 display with a screen protected by Corning Gorilla glass. When inserted into the keyboard dock, the Helix resembles a small, 3.7-lb. laptop measuring just 11.66x8.9x0.77 in. You can also insert the tablet into the keyboard dock with the screen facing away from the keyboard for use as a stand — or even fold the entire system flat.

Lenovo offers a choice of either the 1.8GHz Intel Core i5-3337U CPU, which came in our evaluation unit, or the nearly identical Core i5-3427U processor, which has a slightly faster maximum turbo frequency, faster built-in graphics and adds Intel Clear Video, vPro and Trusted Execution technologies. The i5-3427U processor adds $80 to the overall system price. Both processors are designed specifically for ultrabooks and feature two

INFO ➔ Lenovo: Lenovo.com/thinkstation

Lenovo ThinkPad Helix

- **Price:** $1,609 as tested ($1,477 base price)
- **Size:** 11.66x8.90x0.77-in. (DxWxH) notebook
- **Weight:** 3.7 lbs. as tested, plus 0.25 lb. for power supply and cords
- **CPU:** 1.8GHz Intel Core i5-3337U dual-core w/3MB cache
- **Memory:** 4GB DDR3 at 1,333MHz
- **Graphics:** integrated Intel HD Graphics 4000
- **Display:** 11.6 in. full HD (1,920x1,080) IPS (400 nits)
- **Hard disk:** 180GB SSD (128GB and 256GB also available)
- **Audio:** Dolby Home Theater 4.0 with 3.5mm combo audio jack
- **Network:** integrated Intel Centrino Advanced-N 6235 Wi-Fi, Gigabit Ethernet via supplied USB dongle, Ericsson C5621 TFF (with GPS), Bluetooth, NFC and optional 3G broadband
- **Other:** one USB 2.0, mini DisplayPort, and SIM card in tablet; two USB 3.0 and mini DisplayPort in keyboard dock
- **Keyboard:** integrated 83-key keyboard
- **Pointing device:** 10-point multitouch, ThinkPad digitizer pen, five-button Clickpad
- **Warranty:** one year

CPU cores for a total of four threads, a 3MB cache, and support for up to 32GB of memory, although Lenovo only offers the Helix with 4GB of RAM.

Lots of Flexibility

On its own, the Helix tablet is considerably bigger and a half-pound heavier than an Apple iPad. But its dimensions result in an industry-standard 16:9 display, compared to the iPad's 4:3 ratio. The Helix powers on via a button on the upper-right edge. A digitizer pen fits into a storage slot in the upper-left edge, and a fan louver extends along a portion of the upper edge. In spite of the fan, which is sometimes audible, the tablet does get a bit warm — around 86°F. The digitizer pen has both a tip sensor and a side-mounted button; it enables you to input text in a natural manner as well as take notes, annotate PDF files, and draw when used in conjunction with compatible software.

A combo audio jack, volume controls and a screen rotation lock button are located on the left edge. Along the bottom edge are a power connector, emergency reset hole, keyboard dock connector, subscriber identity module (SIM) card tray, mini DisplayPort connector, and a single USB 2.0 port. A 2 megapixel 1080p front-facing camera

Mobile Workstations Compared		Lenovo ThinkPad Helix ultrabook (1.8GHz Intel Core i5-3337U dual-core CPU, Intel HD Graphics 4000, 4GB RAM)	Eurocom Panther 4.0 mobile workstation (3.1GHz Intel Xeon E5-2867W 8-core CPU, NVIDIA Quadro K5000M, 16GB RAM)	Lenovo ThinkPad W530 mobile workstation (2.90GHz Intel Core i7-3920XM quad-core CPU, NVIDIA Quadro K2000M, 16GB RAM)	HP EliteBook 8560w mobile workstation (2.30GHz Intel Core i7-2820QM quad-core CPU, NVIDIA Quadro 2000M, 16GB RAM)
Price as tested		$1,609	$6,800	$2,592	$4,063
Date tested		9/10/13	4/20/13	12/29/12	5/1/12
Operating System		Windows 8	Windows 7	Windows 7	Windows 7
SPECview 11	higher				
catia-03		n/a	65.87	34.82	27.49
ensight-04		1.33	61.01	18.40	18.46
lightwave-01		8.68	65.85	62.75	48.21
maya-03		8.78	102.18	62.04	58.12
proe-5		1.00	13.82	15.58	9.77
sw-02		4.90	55.06	39.48	35.85
tcvis-02		1.37	59.28	30.63	23.12
snx-01		0.82	64.62	25.14	19.85
SPECapc SolidWorks 2013	Higher				
Graphics Composite		n/a	2.26	2.06	n/a
RealView Graphics Composite		n/a	2.42	2.18	n/a
Shadows Composite		n/a	2.42	2.18	n/a
Ambient Occlusion Composite		n/a	5.14	3.76	n/a
Shaded Mode Composite		n/a	2.41	2.13	n/a
Shaded With Edges Mode Composite		n/a	2.12	2.00	n/a
RealView Disabled Composite		n/a	1.72	1.65	n/a
CPU Composite		n/a	3.72	3.59	n/a
Autodesk Render Test	Lower				
Time	Seconds	244.16	57.33	62.00	89.83
Battery Test	Higher				
Time	Hours:min	6:18	1:14	6:09	2:37

Numbers in blue indicate best recorded results. Numbers in red indicate worst recorded results. Results are shown separately for the ultrabook and mobile workstation classes.

and Windows button are centered above and below the screen, respectively. There are also stereo speakers located at either corner below the screen, as well as a built-in microphone and an ambient light sensor.

On the rear of the tablet, an illuminated dot in the ThinkPad logo glows red to indicate when the tablet is powered on and in use, and blinks to indicate other modes. There is also a 5 megapixel 1080p HD webcam with auto focus and a built-in flash. It's capable of shooting video at 30 frames per second, as well as Motion JPEG.

The standard tablet houses a 128GB SSD, but Lenovo included a 180GB drive in our evaluation unit, which added $100 to the price. A 256GB drive (a $200 option) is also available.

In addition to adding an excellent keyboard, the keyboard dock acts like a port replicator and holds the tablet upright to provide a typing experience similar to that of a notebook computer. A gesture-sensitive 4x2.5-in. touchpad is centered below the keyboard, while a TrackPoint pointing stick is nestled above the B key. Again, a red LED within the ThinkPad logo in the lower-right corner of the palm rest functions as a system status indicator, with a blinking or constant light indicating the current system status. On the rear of the keyboard dock are a pair of USB 3.0 connectors, a mini DisplayPort connector, a power connector and an emergency reset hole.

One of the most interesting features of the Lenovo ThinkPad Helix is that both the tablet and keyboard dock include batteries. The tablet itself comes with a three-cell battery that Lenovo claims to provide up to six hours of battery life, while the keyboard dock has its own four-cell battery. According to Lenovo, the combination provides up to 10 hours of use. On our own battery run-down test, however, the system ran for just six hours before warning that our charge was down to 5%. The system shut down completely 18 minutes later.

Performance Better Than Benchmarks

So now the big question: Can you run mainstream CAD applications on this ultrabook? We are happy to report that the answer is yes! We installed AutoCAD, SolidWorks and a host of other applications — as well as all of our standard benchmarks — and put the Lenovo ThinkPad Helix through the exact same paces as any other workstation. While the Helix certainly didn't set any records, and we do not recommend it for daily production, you can definitely load it up and take it with you for extended trips away from the office.

In fact, our benchmark results do not really reflect our actual experiences using CAD applications on this diminutive device. Because the Helix relies entirely on the Intel HD Graphics 4000 integrated into the Core i5 CPU, its graphics performance on the SPECviewperf benchmark pales in comparison to systems equipped with discrete graphics. Indeed, the Helix was incapable of even completing the Computer Aided Three-dimensional Interactive Application (CATIA) portion of the SPECviewperf test.

Similarly, we were unable to run the SPECapc SolidWorks benchmark because the Intel HD Graphics 4000 does not support the SolidWorks RealView feature, which is an integral part of the test. But the Lenovo ThinkPad Helix ran SolidWorks 2013 just fine — and we had no problem working with parts and assemblies.

We also ran our standard AutoCAD rendering test. Again, because this test is multi-threaded and is meant to illustrate the benefits of multiple, fast CPU cores, the results were the slowest we've recorded in years — averaging slightly more than four minutes. But we doubt anyone would rely on a system like this for rendering unless they were out in the field and had no other choice. The Lenovo ThinkPad Helix performed fine when doing actual work in AutoCAD.

Prices for the Lenovo ThinkPad Helix start at $1,477. Although the base configuration comes with Windows 8 64-bit, our evaluation unit came with Windows 8 Pro 64, which added an additional $50 to the price. Other than that and the bigger hard drive, our review unit was pretty basic. You can have Lenovo preload Microsoft Office and various other software, and add a mini DisplayPort/VGA monitor cable to connect to an external monitor. We hooked the Helix up to an external monitor using a mini DisplayPort cable we already had on hand.

Lenovo backs the Helix with a one-year depot/express warranty. The company also gives you a number of custom tools, including Lenovo Quick Launch, which adds a Start button that can be used in lieu of the standard Windows 8 interface, as well as Evernote, Skype and a number of other preloaded applications. With built-in Wi-Fi, Bluetooth, near field computing, and optional 3G mobile broadband, the Lenovo ThinkPad Helix is a great system for engineering executives on the go. It's certainly not a replacement for a high-end mobile workstation, but at just 3.7 lbs. and with a price of $1,609 as tested, the Lenovo ThinkPad Helix may be just right when you need to travel light and still get some work done. DE

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Additive Manufacturing's New Design Paradigm

3D printing allows companies to rethink previously impossible to manufacture designs, optimize their products, and support new business models.

BY JAMIE J. GOOCH

In September, a small part that will make a big splash in the world of manufacturing was successfully tested. It's a new fuel nozzle being developed by GE Aviation for the next-generation LEAP jet engines, which are scheduled to be in production by 2015. GE says the fuel nozzle is 25% lighter and as much as five times more durable than the current nozzle. It is being 3D printed in one piece, as opposed to the 20 parts that comprise the current model. Those numbers are impressive, and illustrate the weight and process optimization benefits of additive manufacturing (AM), but they are not the most remarkable part of GE's announcement.

The number that has everyone taking notice is 85,500. That's how many of the new 3D printed fuel nozzles GE Aviation will produce in order to install 19 of the parts in the 4,500 LEAP jet engines that have already been ordered.

GE calls itself the largest user of additive technologies for metallic parts, and it has one of the largest fleets of 3D printers that it regularly uses for prototyping and tooling. While it's no longer unusual to use 3D printing to simplify the production of complicated parts, or to optimize specialized parts for weight and strength, the volume of fuel nozzles GE plans to make via its direct laser melting process is unprecedented. In fact, it's so far forward that it's not feasible yet.

GE's Business Development Leader for Additive Manufacturing, Greg Morris, recently told *Bloomberg.com* that existing additive manufacturing (AM) systems aren't efficient enough to economically meet the demand, so GE is banking on the development of new, more efficient 3D printers. Morris should know the existing technologies' limitations. GE Aviation acquired the 3D printing company he founded, Morris Technologies, and its sister company, Rapid Quality Manufacturing, in November 2012.

"Throughput is an issue," admits Prabhjot Singh, manager, Additive Manufacturing Lab, GE Global Research. The $27 million lab acts as a central research and development hub focused on developing new AM processes for all of GE. "We're not talking one-offs, we're talking hundreds of thousands of parts."

CFM INTERNATIONAL, a joint venture between Snecma (Safran) and GE, initiated testing of the first full LEAP engine in September. The engine includes 19 3D printed fuel nozzles.

Consistent Quality

However, Singh seems more concerned with quality. "Making sure every part is made consistently is a top concern moving forward," he says. "More and more parts are going to pass though additive manufacturing machines, and they all will need to be qualified. That's a big challenge."

The infrastructure needed to produce parts in high volume: materials for specific applications, a published materials database of characteristics, rapid part inspection systems, better post processing, better design tools, and a supply chain for all of the above, isn't yet mature.

"We have a very strong materials and manufacturing group," Singh says. "It is helping us bring in new technology and mature it to our needs. The engineering teams we

REDEYE ON DEMAND by Stratasys is a "factory of the future" that quietly creates parts using 150 AM systems.

work with keep us real, and they help us develop the right kinds of technology."

In a recent webcast titled "The Future of Manufacturing," GE Global Research's Technical Director, Manufacturing & Materials Technologies, Christine Furstoss, echoed Singh's concerns.

"We're just learning what gives the materials the types of properties it's achieving," she said. "What are the things we can do in the equipment to make sure we make a material strong enough and tough enough? How do we make sure we do that every time for every part?"

While GE has been able to develop that quality control process for its new fuel nozzles, it needs to grow exponentially to advance other end uses for AM technology.

Expanding the Reach of Additive Manufacturing

Thus far, professional 3D printing technology has largely focused on rapid prototyping and what Stratasys' CEO David Reis calls augmented manufacturing, which refers to using 3D printers to create tools, jigs and templates to support traditional manufacturing processing. The design cycle optimization opportunities for prototyping are obvious: a physical model can be used to advance a concept, sell executives on a design change, or cut down on costlier physical testing.

"People are less aware of the augmented part of additive manufacturing," Reis says. "It's a huge opportunity for Stratasys and a huge opportunity for our customers. All of them are using tools today in a traditional way, which is long, expensive, not efficient. Here (with 3D printing) we have tools that can go into production the next morning. There are hundreds of thousands of production facilities who can use this technology today."

While augmented manufacturing brings design engineers one step closer to the manufacturing process, creating end-use parts via 3D printers the way GE is doing — what Reis calls alternative manufacturing — further breaks down the walls between design and build. With business units in power and water, oil and gas, energy management, aviation, health care, transportation, and home appliances that dwarf many competitors in their own right, GE is in the rare position of being able to advance alternative manufacturing in many industries. The way it does so will no doubt serve as a template for other companies looking to use 3D printing to speed design and development.

During the GE webcast, Furstoss called AM part of the next industrial revolution that "represents a convergence of design and materials and manufacturing. It's a new way of thinking about manufacturing as being as important as any product. That process is the product. That materials and manufacturing and design can meet."

Such a meeting could shift the design engineer from the front of the design-to-manufacture process to its center. If the process is the product, then the engineer will be designing for manufacture in a way that makes an immediate impact on a com-

MakerBot Academy Launched

The US has been the leader in additive manufacturing (AM) ever since 3D Systems' founder Chuck Hull patented stereolithography and Scott Crump designed Stratasys' first 3D printer, but that may be changing. Both the UK and China have invested serious amounts of money into the technology, and the EU, with the European Space Agency as a partner, isn't far behind. The US does have its own investments in place, such as America Makes, the National Additive Manufacturing Innovation Institute, but the race is tight.

MakerBot is hoping to help keep the US at the forefront of AM with its MakerBot Academy program. It represents a partnership between donorschoose.org, Autodesk, America Makes, and, of course, MakerBot (now a owned by Stratasys).

Businesses and individuals who would like to assist with the MakerBot Academy program can visit donorschoose.org and offer financial support for the program. Teachers can then register on the site to receive a MakerBot Academy bundle. Each MakerBot Academy bundle includes a MakerBot Replicator 2, three spools of PLA filament, and a full year of the MakerBot MakerCare Service and Protection Plan. MakerBot will also assist teachers in the development of ongoing 3D printing curriculum for classroom activities, and draw upon Autodesk's software and educator curriculum as well.

— John Newman

pany's output. In some instances, the time to market would be measured in hours, not days, weeks or months.

An example of this was presented at Stratasys' Manufacturing the Future Summit in October by Bryan Dods, an executive in Manufacturing Engineering & Technology at GE Power & Water. Dods' customers include large power plants that could stand to lose $1 million each day that they're offline due to a faulty part. If a 3D printed part could be designed and manufactured to get them up and running quickly, it would change the traditional design to manufacture cycle for that service industry.

Challenges are Opportunities

GE's investment in AM bodes well for advancing the technology, but there's still a long way to go. Despite the challenges of new materials and quality controls, there seem to be nearly endless possibilities on the horizon.

"There are areas of opportunities — where we need to develop multi-material functionality, where we need to develop conductivity, we need to be able to embed intelligence functionality and sensing — where a great deal of development is required," said Avi Reichental, president and chief executive officer, 3D Systems during GE's webcast. "We see a clear opportunity for mashups between additive and subtractive in a single manufacturing box as a way to expand the degrees of freedom and flexibility in manufacturing."

GE Power & Water's Dods is equally optimistic.

"3D printing is giving us functionality we can't get otherwise," he said. "It changes the business model by allowing the company to make what it can design." **DE**

Jamie Gooch *is managing editor of Desktop Engineering. Send e-mail about this article to de-editors@deskeng.com.*

INFO ➜ 3D Systems: 3dsystems.com

➜ **America Makes/NAMII:** americamakes.us

➜ **GE:** ge.com/stories/additive-manufacturing

➜ **Makerbot Industries:** makerbot.com

➜ **Stratasys:** stratasys.com

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

Optimization Improves Style Without Adding Costs

Evenflo redesigns a car seat release handle using solidThinking Inspire.

If you have kids, you've probably heard of Evenflo Company, Inc. You may have even trusted your most precious cargo to one of the Ohio-based company's infant car seats, or stopped junior from falling down the stairs with one of the company's baby gates. The 93-year-old company's product offerings span a range of infant and juvenile categories. Its products have to be structurally sound, but also aesthetically appealing to compete for consumer attention. The company is always looking for ways to improve both without increasing costs.

"Safety is the key consideration in the design process. Ease of use is also important, but costs must be controlled," said Andy Davis, senior design engineer, Evenflo CAE.

With solidThinking Inspire shape and topology optimization software, Davis found he could investigate structurally efficient concepts that his industrial design colleagues could use to make aesthetically pleasing designs. Even better, it allowed Evenflo to reduce material costs.

In 2008, Altair acquired solidThinking, allowing it to expand Inspire's capabilities. Inspire is included in Altair's HyperWorks suite, which Evenflo was already using.

"Inspire software is included in our licensing, and Altair pointed out it might be something we would be interested in," Davis said. "Since it was already included in the licensing and had the potential to reduce material usage, we started trying it out."

Davis was intrigued by the organic shapes that Inspire suggests when using optimizing design topology.

"For us, making consumer products, interesting shapes resonate with our customers," he said. "We don't make boxy square shapes. If we could optimize the material and make it an interesting shape for the customer, it would be a win-win."

Davis showed the software to Brian Pleiman, senior project engineer in the Child Restraint team at Evenflo, who saw it as a potential solution for the perennial struggle of structure vs. design vs. cost.

The pair decided to use Inspire to redesign a car seat handle for an existing product. The handle secures the car seat shell to a seat base or a stroller. The intent of the redesign was to improve the styling and maintain ease without increasing costs relative to the current part.

Getting a Handle on Optimization

To use Inspire, the team needed two things: a package space and a set of static loads for the release handle. As this was a replacement part, the package space was easy to create with a simplified version of the current part in PTC's Pro/ENGINEER.

"Brian and I talked about the block of material to optimize," Davis says. "It was very easy to modify the model slightly to get it into inspire and still keep all of the CAD geometry that could not change."

The crash and abuse loads that the handle may see during its life are dynamic. This means equivalent static loads needed to be developed for Inspire. Generating approximate loads involved using previous data, making some assumptions and using a few rules of thumb.

"From some of the finite element analysis we have done — we are dealing with a lot of dynamic loads from drop testing and crash testing, for example — so we have grown accustomed to approximating static loads for dynamic situations," Davis said. "Between myself and Brian, we had a good understanding of the load scenarios that this part would see."

The design would still be developed in CAD and validated using the standard corporate procedures so that a high degree of accuracy wasn't essential for idea generation. Inspire also made it easy to evaluate different loading conditions and view their effect through the concept designs generated.

Positive Results

The initial Inspire results showed potential for a 30% mass and material reduction. The result also enabled less measurable benefits. The engineering design team was able to see load paths for the design in Inspire before exporting to Pro/E. The results also provided a place to start a conversation with the industrial design team to ensure the delivery of style and function.

"The industrial designers were pretty excited about Inspire as well," Pleiman said. "The team we have here likes it when form meets function, and this plays into that."

Once the design direction was finalized, the part was matured in Pro/E and a 3D printed rapid prototype was built for stroller and sled testing.

"This was a successful project for us. After styling the part, we were still able to achieve a 25% improvement," said Pleiman. "The quick results we were able to get from Inspire assisted the co-development of the new part between ID (industrial design) and engineering."

"solidThinking Inspire shows the material that cannot be removed from a design. This helps you understand your design earlier and it can be used as a common language between departments," added Davis.

Evenflo has since asked Altair for Inspire training session with a larger group of engineers. Now that Evenflo understands the capabilities of Inspire, Davis said they are looking for any place where it might provide material reduction and better aesthetics without reducing quality.

***Source:** Interviews with end users and information provided by Altair's solidThinking.*

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Driving for Design Success — and Cleaner Air

Scania redesigns truck engine components, helping reach Euro 6 emissions goals, using SIMULIA Tosca Structure.

Image courtesy of Scania.

As the European Union adapts to Euro 6 — legislation that sets the highest-ever pollution regulations on trucks and buses — global commercial vehicle maker Scania is finding new ways to meet the challenge.

Over the 20 years since Euro 1 was instituted, the Swedish-based company has had an ongoing program to develop vehicles and engines with a host of innovative technical solutions that have radically cut emissions. For additional design refinement of powertrain and drivetrain components, however, it has added the optimization software Tosca Structure to its CAE toolkit.

The software creates design concepts early in the product development process to show the potential to reduce material weight while maintaining, or even improving, rigidity and durability. Such optimized structures have helped Scania build lighter-weight vehicles that consume less fuel and produce fewer emissions, helping the company meet the Euro 6 standards that have applied to all new trucks registered in Europe since Jan. 1, 2013.

Seamless Integration

Scania's engineers work in a mixed CAE environment, using a variety of design tools. For optimization, they use Tosca Structure from FE-DESIGN — since May 2013, part of the Dassault Systèmes 3DEXPERIENCE technology portfolio under the SIMULIA brand.

SIMULIA Tosca Structure is a flexible, modular software system for non-parametric structural optimization of topology, shape and bead design using finite element analysis (FEA). With its open interfaces to FEA industry-standard solvers, Tosca Structure allows for easy integration into any existing CAE environment. This lets engineers work in their accustomed IT environment with their existing FEA models.

Scania's primary FEA solver is Abaqus, also from SIMULIA. Using Tosca Structure along with their own FEA models and knowledge base enables the engineers to exploit the full potential of optimization ...

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Pushing the Pedal to Its Mettle

Mechatronic simulation enables PSA Peugeot Citroën to enhance fuel efficiency and reliability of powertrain components.

Car manufacturers face multiple challenges when designing powertrain architectures. They must reconcile numerous (and sometimes contradictory) requirements to reach the desired level of product quality, pollutant emissions, passenger comfort, fun-to-drive performance, reliability and safety. And they must do all of this while striving to be profitable, shorten the product development cycle and reduce time-to-market.

Powertrain systems are becoming increasingly complex, and include a growing number of actuators, sensors, hybrid traction systems, and electric and electronic components — requiring controls and protection strategies to limit component damage. Developing powertrain thermal management strategies is a major issue for original equipment manufacturers (OEMs), and these strategies are taking more systems into account than ever before, including the internal combustion engine, gearbox, car interior, electric powertrain battery and electronic controls units.

Powertrain thermal management optimization enables car manufacturers to reduce fuel consumption (for example, via warm-up phase acceleration) and carbon dioxide (CO2) emissions. Therefore, it allows the OEMs to meet stringent international standards. It also facilitates appropriate powertrain cooling and passenger thermal comfort by controlling cooling fluid temperature and flow rate in the air heater.

In addition, effective powertrain thermal management maintains an optimal operating temperature for the engine and gearbox, promoting component reliability and fuel efficiency. The thermal management system can adapt to vehicle usage under a variety of conditions, and set temperature thresholds to further help protect powertrain components.

Broad Appeal

PSA Peugeot Citroën addresses powertrain thermal management by using simulation throughout the powertrain component and system design process.

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Becoming Empowered by PLM

With Omnify Empower PLM, security provider Genetec integrates PLM software with ERP and engineering tools for better integration and data quality.

Based in Montreal, Genetec is a pioneer in the physical security and public safety industry, and a global provider of IP video surveillance, access control and license plate recognition (LPR) solutions to markets such as transportation, education, retail, gaming, government and more.

Genetec had previously implemented an open-source product lifecycle management (PLM) system to replace the use of spreadsheets for managing product information. Although the team did realize some improvements in their processes, they needed to find a new PLM solution to meet their requirements in an electronic manufacturing environment. They found with the open-source solution that minimum functionalities such as reference designators, redlining, bill of material (BOM) compare, and importing capabilities had to be implemented via customization of the software. The time spent by software designers to customize the tool to meet their needs was extensive and counterproductive.

It was becoming important for Genetec to have the ability to catch product documentation problems early on, prior to manufacturing, and to have a complete history of the changes for accountability. Genetec needed a PLM system that delivered robust, out-of-the-box functionality including electronic management of part data, engineering changes, BOMs, and product documentation that did not require customization to implement. It also needed a system that offered easy integration with its existing engineering design tools (Altium Designer and SolidWorks) and the ability to interface with its enterprise resource planning (ERP) system (MS Dynamics) — all at a price that made sense for the organization.

After researching the market, the team decided on Omnify Software.

"Ultimately, we were impressed by how easy the software seemed to configure, and by how many functionalities this software offered out-of-the-box," says Danny Roy, hardware development manager for Genetec.

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From Mud Stream to Value Stream

Viatran's redesign for manufacture and assembly implementation benchmarks competition, reduces part count, and re-imagines a pressure transmitter design with total cost of ownership in mind.

Sensitive, yet tough. That's the job description of the hammer-union pressure transmitter used in oil and gas well servicing applications like cementing, fracturing and acidizing. This fine-tuned sensor must accurately (and repeatedly) measure the hydraulic and pressure characteristics of drilling fluid in the harsh environments found in the secondary oil and gas recovery industry.

Withstanding mud, corrosion, vibration, humidity, temperature extremes — and the routine shock of hammer blows during installation — the unit plays a pivotal role in communicating with down-hole measurement-while-drilling (MWD) tools to help ensure safety and efficiency in the production environment. The unit's reliable performance is critical to the integrity of hammer-wing union fittings, used in thousands of energy installations around the globe.

The Viatran business unit of Dynisco, a Roper Industries company, has offered model 510 Hammer Union pressure transmitter as an industry staple for years. With a number of competitors vying for position in the supplier arena, Dynisco decided to take a renewed look at its core product to ensure that its lead would hold. The company launched a redesign project with the goal of providing functional improvements to which customers would respond, along with increased assembly efficiency and cost-effectiveness.

Begin with Benchmarking

A company-wide philosophy of continuous improvement has led Dynisco to emphasize the role of early design evaluation in its product development process. Knowing the value of applying Design for Manufacture and Assembly (DFMA) from Boothroyd Dewhurst — with benchmarking, Lean, and Total Cost of Ownership (TCO) methodologies — Viatran engineers teamed with Dynisco's Value/Analysis/Value Engineering (VAVE) group to launch the redesign project.

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The Mojo 3D Printer knocks out complex parts with ease.
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