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Engineering the Mars Rover

How NASA engineers designed and tested the Mars Science Laboratory before blasting it off to the red planet. P. 28

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by Steve Robbins

From FIRST Robotics to the Moon

Years ago, I was involved in the sensors technology segment of design engineering when I worked for *Sensors Magazine* and Sensors Expos. *Sensors'* editor-in-chief, Barbara Goode, introduced me to Dean Kamen and FIRST Robotics, whose mission is to inspire young people's interest in science and technology. We invited FIRST Robotics to hold demonstration competitions at our Sensors events. It was great seeing the interest in the kids, as they guided their robots in the competition area. It also engaged the minds of all the design engineers at the show. Design engineers would cheer their favorite team on as the robots competed. It was a great success.

Now, fast forward to last December, where I was attending another event, Autodesk University in Las Vegas. The event started early with Jeffrey McGrew, co-founder of design-build studio Because We Can, kicking off the keynote speech. As he introduced Edwin "E.J." Sabathia of Moon Express Robotic Lab for Innovation (MERLIN), the music picked up and a mockup of a lunar lander started descending from the roof of the stage. E.J. is one of eight student robotics engineers and a former member of a FIRST Robotics team. He and his team were mentored by the NASA Ames Robotic Academy, and it paid off. E.J. and seven of his Moon Express team have designed a robot that will land on the moon. They are hoping to win the Google Lunar X Prize for a cool $30,000,000.

To inspire young people to embrace science and engineering is not an easy job.

To the Moon, On a Budget

We have all heard of recent efforts to commercialize space. Space X, Orbital Science and others are leading the way. But E.J. works for a relatively small, privately held company, working on a tiny budget (in aerospace terms). Landing a robot on the lunar surface and sending back high-definition imagery is a complex challenge for a large aerospace company. Until now, it cost about as much as the gross national product of a small country to accomplish this feat. But times are changing fast.

E.J. and his team have designed twin micro-rovers that will be landed on the surface of the moon. They are named "ARTHUR" and "ROBERT" after Arthur C. Clarke and Robert Heinlein, two well-know science fiction writers. These robots are capable of capturing stereo HD images and video. They will also be able to transport a payload.

Moon Express has announced its own competition: "The Moon is ME Lunar Mining Design Challenge" (themoonisme.com) to design mining tools that the rovers can use to collect samples of lunar soil. The contest is open to anyone using Autodesk Software. Moon Express is planning on equipping one of the lunar rovers with the winner's mining technology.

Technology Inspires

Dean Kamen was a visionary in the founding of FIRST Robotics. To inspire young people to embrace science and engineering is not an easy job. If you ask, most kids will tell you they want to be a football or basketball player. FIRST Robotics makes subjects like mathematics and science interesting. It gives students a practical application to capture their attention. It makes engineering cool. I remember the excitement in the students' eyes at Sensors Expo when their efforts at creating a competitive robot were recognized by the design engineers on the show floor.

E.J. Sabathia is now mentoring his own FIRST Robotics team. Imagine how inspiring it must be for high school students to work with a guy that's putting, not one, but two robotic lunar rovers on the moon!

Moon Express has completed a successful lander flight test. It is working with NASA to develop technology that will commercialize low-cost space exploration. Barney Pell, co-founder and CTO for Moon Express, has been quoted as saying: "The Moon has never been explored before from and entrepreneurial perspective. I believe the Moon may be the greatest wealth creation opportunity in history. It's not a question of if; just who and when." And they are doing it with an engineering team inspired and mentored by FIRST Robotics. How cool is that? **DE**

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


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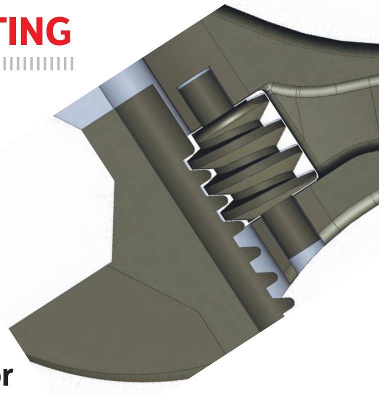

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On a Mission to Mars

ON THE COVER: An artist's rendering of the Mars rover Curiosity being deployed on Mars via a sky crane. *Image courtesy of NASA JPL-Caltech.*

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by Kenneth Wong

Solid Edge Plugs into LCA

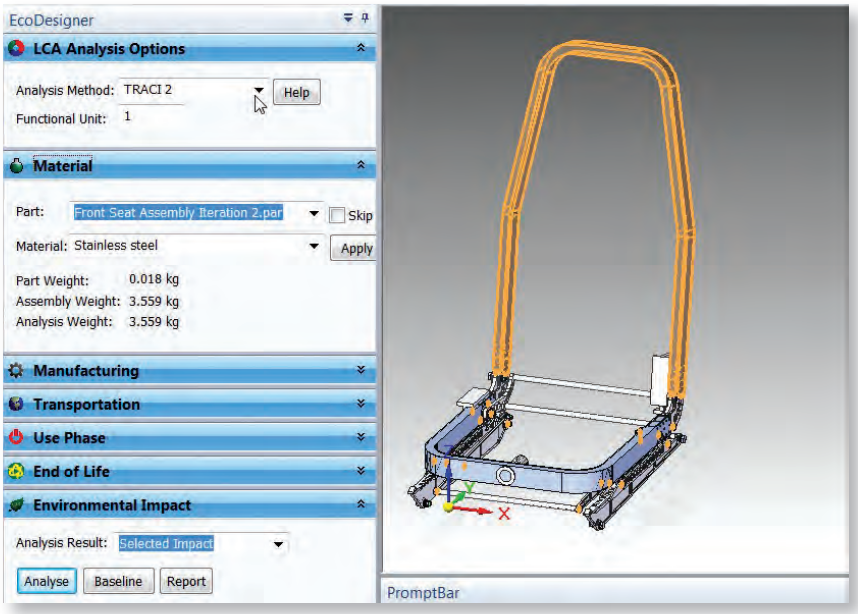
With the EcoDesigner plug-in from Trayak, Solid Edge joins the growing number of CAD packages that give you the option to perform lifecycle assessment (LCA) of your design. Like Sustainability Xpress for SolidWorks and Eco Materials Adviser for Autodesk Inventor, EcoDesigner for Solid Edge adds a slim column to the CAD program's window, allowing you to tally up the environmental impact of your design as you work. But there are significant differences between EcoDesigner and its rivals, according to Prashant Jagtap, Trayak's president and CEO.

"You don't have to be a tree-hugger to want to do sustainability," notes Jagtap. "It just makes economic sense."

Jagtap says that he sees sustainability as much more than complying with local and regional regulations—an area on which product lifecycle management (PLM) software vendors have been focusing. He wants people to use EcoDesigner to "proactively start designing [sustainable products]."

Through a dropdown menu, the EcoDesigner plug-in gives you the option to select the type of analysis you'd like to conduct: TRACI 2, ReCipe Endpoint, IPCC 2007 GWP 100a, CML 2 Baseline 2000 or Eco-Indicator 99. Each analysis standard is associated with a set of measurements. If you select to run TRACI 2, for example, your assessment criteria will be Acidification, Eutrophication and Global Warming. But if you pick another analysis standard, your criteria will change accordingly. No matter what standard you choose to run, Energy Use will be part of the output you get.

Other input fields include Manufacturing Method, Transportation, Use Phase and End of Life. For Transportation, EcoDesigner's interface lets you specify the distance covered, the weight



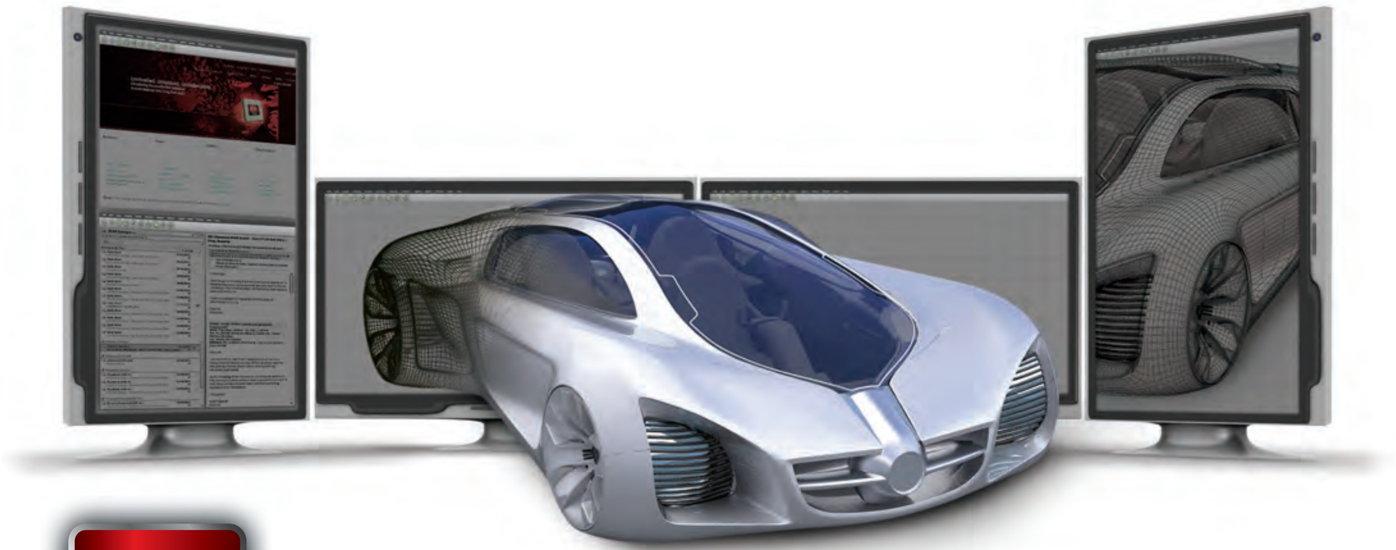
Trayak's EcoDesigner plug-in lets users evaluate the environmental impact of their designs in Solid Edge.

transported and the means of travel (air, train, truck, bus). The module is aimed at assembly-level LCA, but if you choose to be granular, you can specify input for each part, then get a rollup for the entire assembly. (Currently, the transportation field can only be used for assembly, not parts.) Product use phase is currently limited to calculating energy consumption only, but Jagtap says he may add other types of calculations in the future.

Like other LCA solutions, EcoDesigner lets you select one design configuration as the baseline, then try to improve your LCA score. The plug-in facilitates LCA by adding sustainability information (based on publicly available databases) to the Solid Edge material library.

Jagtap, who previously held the director of strategic marketing post at Siemens PLM Software, saw value in merging LCA to PLM. Accordingly, his company offers an enterprise version of EcoDesigner, which works like a client app that communicates with PLM databases. The enterprise version can also be integrated with more sophisticated LCA systems, like SimaPro. Price for EcoDesigner for Solid Edge starts at $3,000; Trayak doesn't publish the enterprise version's price.

Some LCA programs like Sustainable Minds work independently as web-hosted software, without incorporating CAD models. CAD-integrated LCA solutions like EcoDesigner offer an easy way to reuse the volume, mass and material information available in a CAD model. Without tight integration with a CAD package, LCA exercises may be limited to swapping out materials (picking materials that do less harm), manufacturing methods, and juggling transportation options. The integration with a flexible CAD modeler like Solid Edge with Synchronous Technology allows you to also experiment with the geometry of your design (for instance, reducing the wall thickness of a product's housing unit, thereby reducing its carbon output) and witness the immediate effect on your LCA score.



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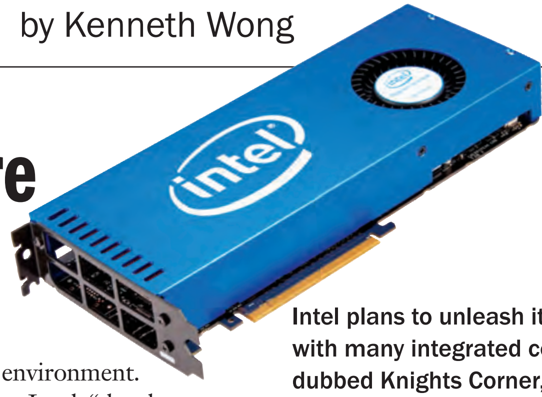
by Kenneth Wong

Intel Knights Prepare for Parallel Battle



Intel plans to unleash its coprocessor with many integrated cores (MIC), dubbed Knights Corner, in the high-performance computing market.

CPU maker Intel is steadily assembling an army of Knights to go jousting in the parallel arena. The chipmaker's new architecture, dubbed Knights Corner, represents the move from multicore (two, four, six, eight …) to many integrated cores (MIC, more than 50 Intel processing cores on a single chip).

Intel describes MIC as a coprocessor, a power-booster to the central processor. The new product is expected to be a contender in the high-performance computing (HPC) market, where graphics coprocessors (GPUs) have been grabbing market shares because of their parallel computing capabilities. What distinguishes Intel's MIC from graphics coprocessors may be its programming environment.

According to Intel, "developers can program these cores using standard C, C++ and Fortran source code. The same program source code written for Intel MIC products can be compiled and run on a standard Intel Xeon processor. Familiar programming models remove developer-training barriers, allowing the developer to focus on the problems rather than software engineering."

Taking advantage of GPU-powered parallel computing depends on GPU-specific language (for example, NVIDIA's compute unified device architecture, or CUDA). Intel's calculation is that the ease of use with which its Knights Corner processors can be programmed will make them easier to deploy for highly parallel code. For engineers and designers, Intel's MIC may lead to better performance in CPU-based ray-traced rendering and finite element analysis/computational fluid dynamics simulations.

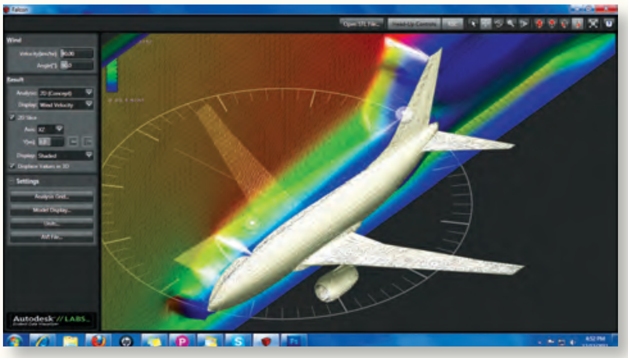
Intel announces, "The first presentation of the first silicon of Knights Corner coprocessor showed that Intel architecture is capable of delivering more than 1 teraflop of double precision floating point performance (as measured by the Double-precision, General Matrix-Matrix multiplication benchmark)."

Conduct a Wind Tunnel Test on a Desktop

Project Falcon, Autodesk's latest technology preview downloadable at Autodesk Labs, is flying straight into wind tunnels. The application is as an independent software program, but it's designed to complement surfacing programs like Autodesk Alias.

Once installed, Project Falcon allows you to import a design as an STL file, then simulate a wind tunnel test on it. The interface is fairly straightforward, with just enough controls to let you run basic tests. You set the wind velocity and direction, set the analysis plane's orientation, specify the type of results you want to see (pressure, airflow or displacement volume), then watch the screen come to life.

The results—wind flow patterns and pressure fields—are displayed in real time (or near real-time speed, if your computer has slower processors). Specialists who wish to do more detailed analyses may need more sophisticated packages, but for design engineers exploring different geometric shapes and curvatures, Project Falcon's tool set is just the right amount.



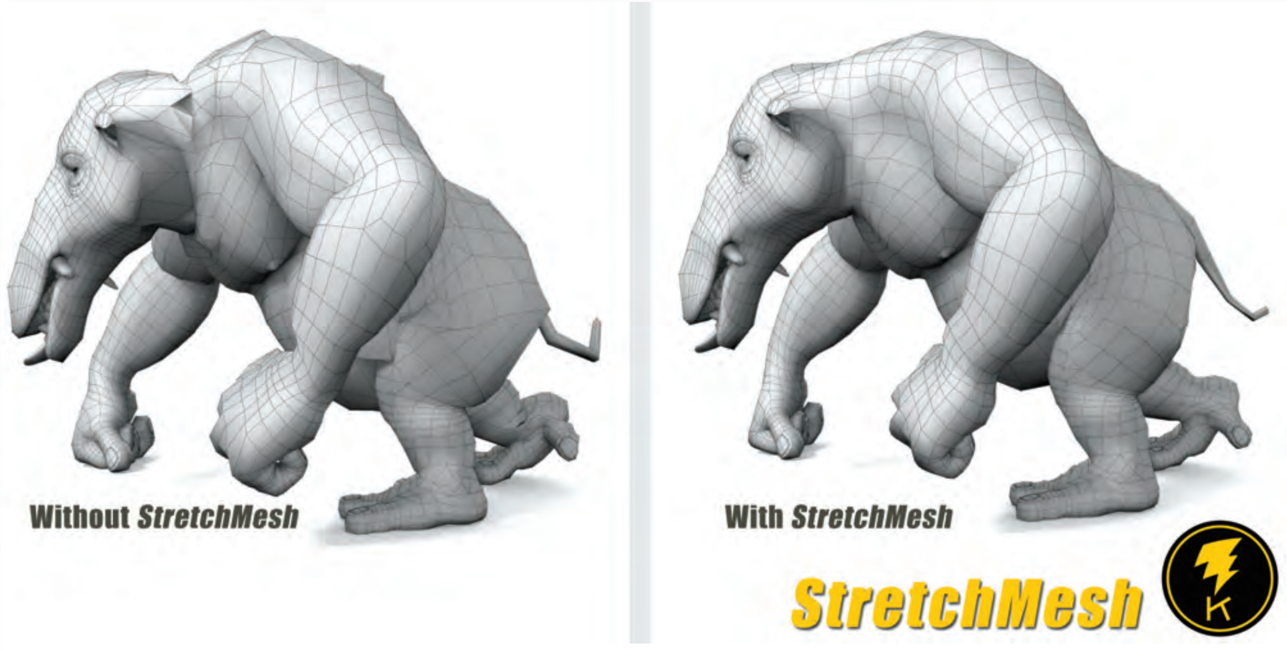
Autodesk's Project Falcon, a technology preview now available at Autodesk Labs, lets you perform virtual wind-tunnel tests on STL models.

Digital wind tunnel simulation may not be a replacement for physical wind tunnel tests, but an easy-to-use software like Project Falcon can help steer you in the right direction in early conceptual phases.

To watch a video demonstration of the software, including wind-tunnel test results from Kenneth Wong's attempt to verify the aerodynamic nature of his own head, visit deskeng.com/virtual_desktop/?p=4825.

by Kenneth Wong

Kickstand Kickstarts
Open Source Surfacing Software



Kickstand uses Indie Gogo to raise funds to make its Maya plug-in StretchMesh open source.

In software development, even giving away software seems to come with an expense. Last December, Kickstand, responsible for the popular StretchMesh plug-in for Autodesk Maya software, decided to launch "a campaign to evolve StretchMesh Surface Deformaton software into Open Source technology."

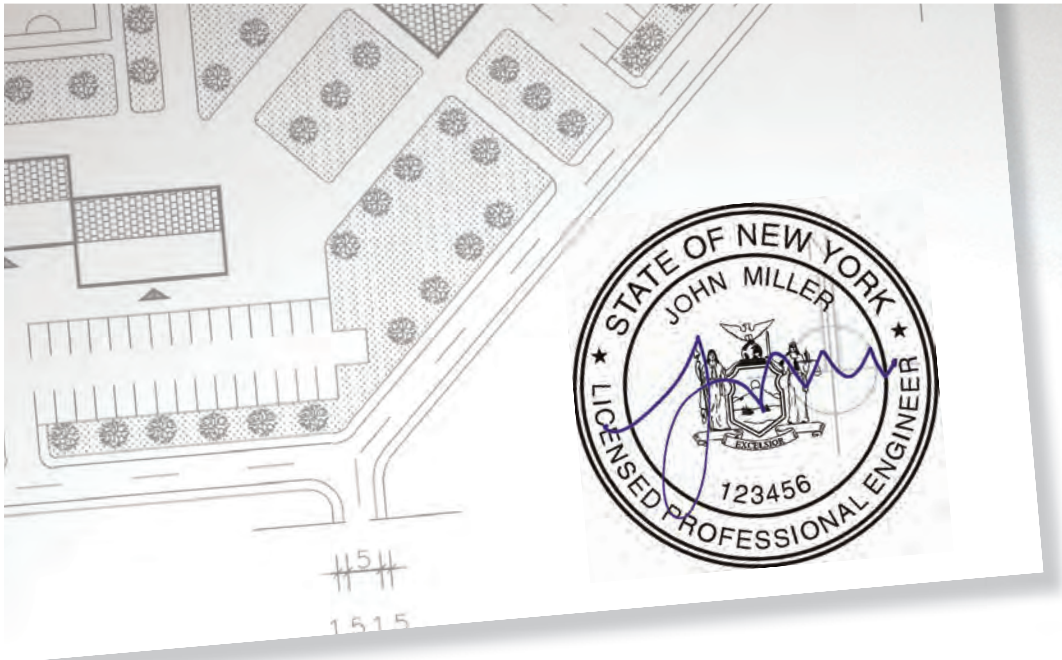
But apparently, it needs about $15,000 to fund the open-source transformation. So the company decided to use Indie Gogo, a social media-driven fundraising portal, to raise money at IndieGoGo.com/StretchMesh-for-Autodesk-Maya. (At press time, fundraising was still ongoing, so the editors could not determine whether the project is a go or no-go.)

According to Kickstand, "by making the source code available to the 3D community, Kickstand opens the door for artists working in Maya to incorporate the surface deformation technology into their 3D workflow. The StretchMesh Open Source initiative also allows programmers and developers of software programs such as Autodesk 3D Studio Max and Softimage, NewTek LightWave, Luxology modo and Maxon Cinema 4D to incorporate advanced surface deformation functionality in future product releases."

Describing its StretchMesh software, the company writes, "StretchMesh is a plug-in for Autodesk Maya, which gives geometry an inherently stretchy characteristic. As geometry is deformed using native Maya deformers or other plug-ins, StretchMesh gives the geometry a built-in stretchy quality by preserving the relationship between vertices. Collision objects can be added to simulate the underlying anatomy over which the skin slides. A 'stiffness' map can be painted to accommodate areas where stretchiness is not desired."

The Achilles heel in parametric modeling—a method employed by most mechanical CAD packages—is its lack of easy surfacing tools. (You can create complex surfaces, but it takes you so many steps that you'll be tempted to give up.) The challenge has prompted many automotive and consumer goods designers to employ a special surfacing program like Autodesk Alias, Maya or Rhino, then import the geometry into a mechanical CAD program to add other components. DE

Kenneth Wong *is senior editor of* Desktop Engineering. *Contact him via de-editors@deskeng.com, at deskeng.com/virtual_desktop or via Twitter @KennethwongSF.*



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Efficient Transistors via Quantum Physics

Quantum physics could help reduce computers' energy consumption by a factor of 100 by 2017, thanks to innovations in transistors. Researchers in Europe (and elsewhere) are pinning their hopes on tunnel field-effect transistors (FETs), which use quantum tunneling to create ultra-low power transistors. In addition to boosting mobile computing, thanks to decreased battery power consumption, this could also lead to more supercomputers with lower power costs.

According to Switzerland's Ecole Polytechnique Federale de Lausanne (EPFL) researcher Adrian Ionescu (who wrote an article on the topic for a special issue of *Nature* in November), "by replacing the principle of the conventional field effect transistor by the tunnel effect, one can reduce the voltage of transistors from 1 volt to 0.2 volts. In practical terms, this decrease in electrical tension will reduce power consumption by up to a factor of 100."

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The Electric Car as Home Generator

Nissan's Leaf is a fully electric car that was launched in 2010. It has an estimated 100-mile range per charge, and a top speed of 90 mph. At the 2011 Tokyo Motor Show, Nissan discussed its future plans for the Leaf, which include some advanced engineering to tightly integrate the electric vehicle into a smart home design.

The company plans to release a product line devoted to the Leaf. The first offering is a wireless electromagnetic induction recharging pad. Nissan also plans to use the Leaf as an emergency generator. The car can provide up to 6kW of power.

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ElectronVault Develops Batteries with Inventor

Electron Vault, via Autodesk's Clean Tech Partner Program, is working on solutions for some of the issues that typically affect electric vehicles.

The company is designing large-scale battery packs that use batteries similar to those found in digital cameras and laptops. Its approach to creating batteries suitable for both electric vehicles and power grids alike is to simply increase the number of battery packs used, rather than creating different batteries for each.

According to the company, potential cost issues are addressed by "mixing commodity cell prices with ElectronVault's proprietary management technologies." It says battery pack costs are halved when compared to other offerings. And, instead of replacing an entire battery when power runs low, the proposed design would allow individual cells to be replaced to refresh the pack.

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Brits Invite Engineering Innovation Competition

The UK's Royal Academy of Engineering has launched the Queen Elizabeth Prize for Engineering, which will award £1 million to an individual or team of up to three people of any nationality "directly responsible for advancing the positive application of engineering knowledge."

Awarded biennially, the first prize will be presented in 2013. Nominations are due by July 31, 2012.

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5 Predictions for 5 Years into the Future

IBM's sixth annual "IBM 5 in 5" list showcases five areas of innovative technology they believe will have an impact on people's lives within five years. This year's list includes:

1. Renewable energy sources. The sorts of renewable energy that IBM believes will have an impact in the near future includes the usual suspects, such as improved lithium batteries. But it also looks to new ideas, like parasitic power collection. The example IBM includes is the possibility of incorporating a small energy-capture device into shoes that can collect enough power to recharge your cell phone.
2. Biometrics. No more memorizing passwords when your workstation can recognize your face, voice or retina.
3. The field of bioinformatics. Bioinformatics refers to using "advanced sensors to read electrical brain activity that can recognize facial expressions, excitement and concentration levels, and thoughts of a person without them physically taking any actions."
4. The end of the Digital Divide. IBM theorizes that this divide can be bridged by cheaper mobile devices, and innovations in ways of accessing information.
5. Tailored advertising. Expect ads that reflect topics you're interested in to be displayed to you automatically.

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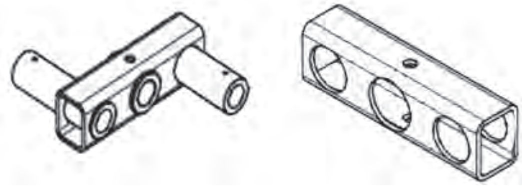
Cost-estimating Software Helps Manufacturer Boost Productivity, Profits



Tillage walking beam (left) with a detail of the walking beam tube.

In 2007, engineers at the Landoll Corp. in Marysville, KS, began researching options for replacing their existing cost-estimating software. They needed a flexible system that would produce accurate job quotes, and process plans for a wide variety of machining, fabricating and assembly jobs. They also wanted software that was easy to learn and that would provide the company's cost estimators with the ability to quickly calculate process cycle times and costs.

Landoll's Manufacturing Engineering Supervisor, Alan Koch, who participated in the search for a new system, says his department realized those benefits and more when they began using the Costimator cost estimating, quoting and process planning software by MTI Systems Inc. The system's database of materials, work centers and process cost models allowed for quick, easy implementation and a short learning curve, according to the company.

The software's benefits multiplied a year after the estimating system installation, Koch adds, when Landoll upgraded to the latest version of the Costimator software. This was when MTI Systems, located in West Springfield, MA, developed the system's new Cost Modeler feature. MTI says this cost model-building tool enables estimators to generate cost estimates up to 70% faster than traditional estimating methods.

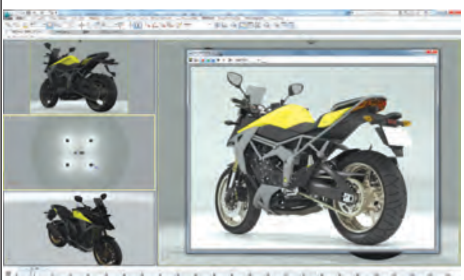
"Cost Modeler requires far fewer inputs by the estimator, and yet it generates cost estimates that are more accurate and consistent," says Koch. "We have found the software easy to use, even when the end user has minimal computer experience or limited manufacturing knowledge. Our cost estimators—who work in a time-sensitive and highly competitive manufacturing environment—now can produce consistently accurate estimates, regardless of their manufacturing experience."

MORE ➜ deskeng.com/articles/aabdta.htm

NVIDIA Maximus Makes 'Design Clinic' a Success for Cleat Inc.

Tokyo-based Cleat Inc. specializes in the delivery of 3D computer graphics (3D CG) services. To meet growing client demands, the company realized it needed to dramatically reduce rendering times while preserving the quality of its graphics.

Cleat was founded by Kensuke Yamashita in 1990, following his experience as a car designer at Honda R&D Co., Ltd. Over the last two decades, the company has landed a number clients, including Giant, a global sports bicycle manufacturer, Nike Japan, and Square Enix, a Japanese video game and publishing company.



The Autodesk 3ds Max 2012 Subscription Advantage Pack software includes the ActiveShade real-time rendering application featuring NVIDIA iray rendering software.

During the recent economic downturn, competitors went on the offensive in all areas, armed with large-scale operations and low prices—creating competitive challenges for Cleat. It was in that environment that Yamashita conceived Design Clinic, a company initiative using 3D CG.

The initiative is offered as a supplement to a manufacturer's product development process—something that has historically been hard for major production companies and publishers to break into. However, as a former industrial designer, Yamashita had a lot of expertise and personal contacts in this area that helped ease Cleat's entry into engaging in it with clients.

"We provide customers with consultants who develop a methodology for better product design, which can be a competitive advantage," he explains. "This approach is easily understood by clients who are trying to rise above the competition. However, they couldn't sacrifice the speed of delivery, even for an improved design methodology. As soon as our Design Clinic was presented, manufacturers then demanded more precision and speed."

The recent emergence of HP Z800 workstations with NVIDIA Maximus technology gave Cleat an opportunity to accelerate its Design Clinic approach.

Accelerating Turnaround

In October 2011, Cleat installed an NVIDIA Maximus-powered HP Z800 workstation. The configuration at Cleat consists of an NVIDIA Quadro 6000 ultra high-end professional graphics card and an NVIDIA Tesla C2075 companion processor. They use Autodesk 3ds Max 2012 Subscription Advantage Pack software that includes the ActiveShade real-time rendering application featuring NVIDIA iray rendering software.

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Coping with the Analysis Data Deluge

The growth of simulation spurs a new quest for data management.

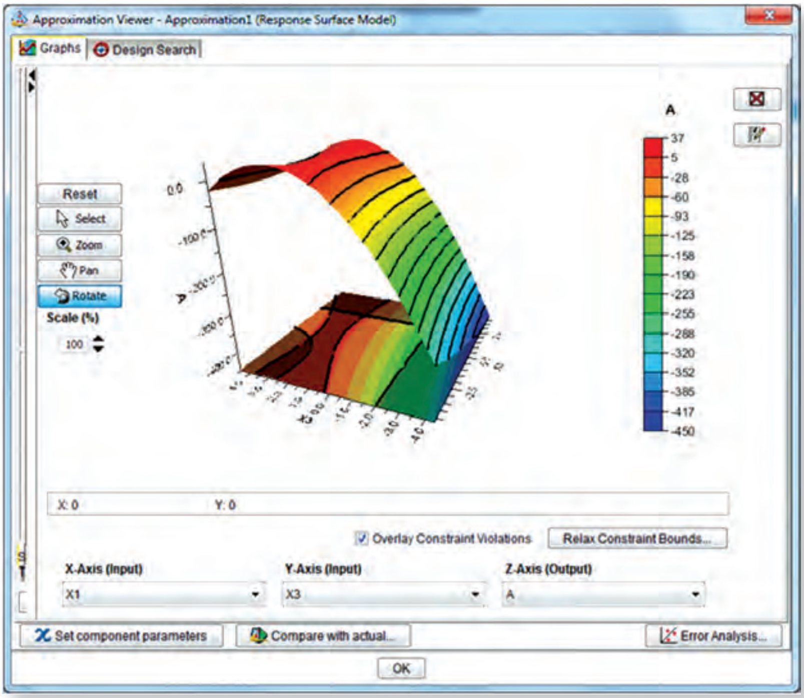
BY KENNETH WONG

Last November, Scott Imlay, Ph.D., chief technology officer of Tecplot Inc., made a short trip across the bridge from his company's headquarters in Bellevue, WA, to Seattle, where the Supercomputing 2011 conference was taking place. While swapping war stories with fellow simulation experts, he overheard one of his customers speaking of performing "tens of thousands of simulation runs." The number might seem extraordinary to untrained ears, but it didn't faze Imlay at all.

"Some [customers] are even talking about running hundreds of thousands of cases," he notes.

In the not-so-distant past, when manufacturers had no choice but to build and destroy concept mockups made from foam core, clay and plastic to test their designs, they kept their simulation exercises to a small number. After all, it's not economically feasible to construct and break 10,000 sample units of a product, be it an iPod docking station or a new sports utility vehicle. But the switch from physical to digital prototypes changed the practice. With a modest investment in hardware and software, design firms can now virtually explode, stretch, crash and scorch a digital mockup made of pixels—over and over, with very little overhead. In fact, they don't even need real laboratories to run these tests. They can run them in virtual space, right from their desktop workstations. So, as if to make up for all the years they've been holding back, engineers have begun performing tens, hundreds and thousands of simulation runs, sometimes on many different variations of their designs simultaneously.

Studying the scattered remnants of five to 10 drop tests and making intelligent deductions from them is easy. But sorting, storing, processing and reviewing the digital output from hundreds or thousands of finite element analysis (FEA) tests? That's beyond the scope of human capacity.



Insight 5.6 from Dassault Systèmes gives users a way to automate the execution of hundreds or thousands of simulations.

"The topic of simulation data management comes up every time I'm at an event," reports Bob Williams, a member of Autodesk's SIM Squad. "It's one of the hottest topics out there right now."

Should you treat simulation as part of your product lifecycle management (PLM) strategy, and should you store simulation information in your product data management (PDM) system? Can you manage simulation as you would a business process? What is the best approach? At the present, few experts can point to a series of workflows you can follow as best-practice templates. But the worst you can do, as Williams observes, "is to do nothing."

Content and Context

In technology, there are two ways to spot a pressing issue:

1. The industry begins using acronyms to refer to the problem. (If you're going to be talking about it a lot, you'd better abbreviate it to save your breath.) So far, the data deluge in simulation has already produced two competing acronyms: SDM (simulation data management) and SLM (simulation lifecycle management).

2. An analyst firm writes a report to highlight the issue. CIMdata, a firm that closely monitors the PLM industry, decided it was time to bring SLM-related headaches to the forefront with a report—sort of like the FBI adding a new mug shot to its Most-Wanted list. The outcome was "Simulation Lifecycle Management," a report released in July 2011. It was underwritten in part by Dassault Systèmes, which develops and markets the multiphysics simulation software suite SIMULIA Abaqus.

Keith Meintjes, Ph.D., CIMdata's practice manager for simulation and analysis, points out what might be the crux of the problem: "Individual engineers running their own simulation projects know what they're working on today. But ask them about the details of a project they did six months ago, they're not quite sure. Ask a different engineer to look at another's project, and they won't really know what it is. The context and rationale are missing."

Most simulation software packages were originally developed to answer urgent design questions—one at a time: What would happen to the display screen of a phone when the battery heats up over three hours of continuous usage? (That calls for a thermal-electrical analysis job, in anticipation of a teenager chattering on a smartphone.) How will saline fluid behave inside the redesigned chamber of a catheter? (That's a multiphysics computational fluid dynamic, or CFD, job.) Most analysis software packages are quite capable of addressing these questions as they come up, but storing, managing and comparing the outcome from hundreds and thousands of analysis jobs is not their specialty. If they include tools for that, they're mostly an afterthought, not part of their primary mission.

To reuse designs, engineers must be able to know the context of a previous design. When the context is missing, and figuring it out seems like a daunting task, an engineer is invariably tempted to make a new design rather than to reuse an old one. Meintjes recalls a costly incident involving the reuse of an automobile horn in a new vehicle—"except the orientation of the installed horn was not recorded with the original design. With a different installation in the new vehicle, there was a 100% failure due to water intrusion and corrosion."

For simulation, a lack of context may force engineers to reproduce a new mesh model, rewrite the specifications (materials, load, pressure, fixture types, etc.), and run a test that someone else might have already ran six months ago. In a business where digital simulation is routinely performed, duplicate simulation runs can tie up precious computing resources and server time—not to mention the delays in decision-making. For example, no one knows about the CFD test an engineer has run to verify that the valves are wide enough. So the same test is rerun, prompting the design team to put everything on hold for the next 24 to 48 hours.

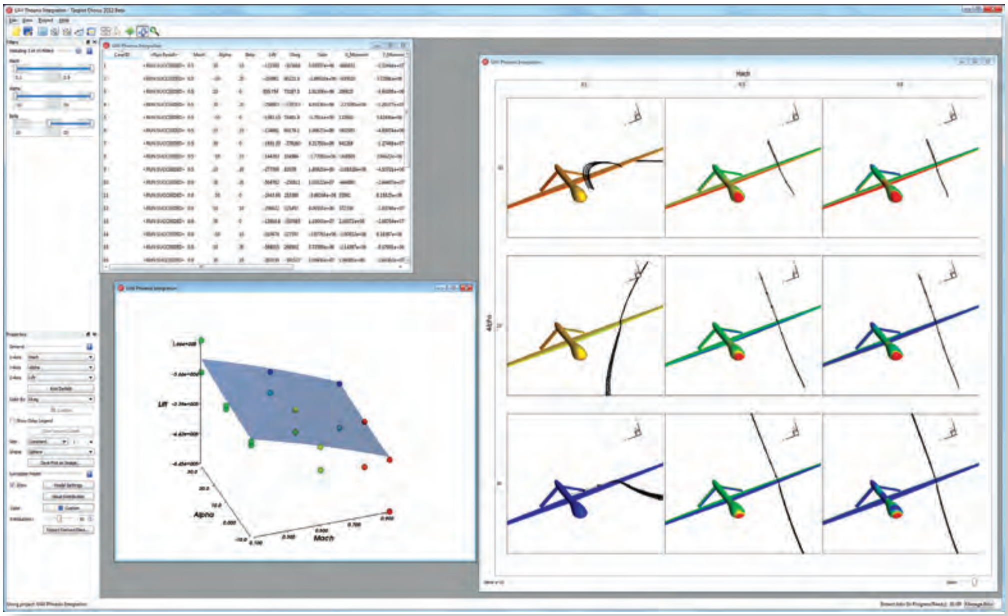
"You need to manage the process, and also the results," says Meintjes. "You need to know the provenance of the data [for example, the specific CAD model used to create the mesh model], to make sure you're using the correct geometry, material properties, and so on … You also need to understand the context of the data: What design question or performance evaluation does the simulation address?"

Selective Storage

As part of Autodesk SIM Squad, Williams and his colleagues take the time to respond to simulation software users' questions. He describes that the methods some frustrated project managers have tried to tame the monstrous growth of simulation data "run the whole gamut, from a network location [a shared folder on a server] to store result files, to burning DVDs to archive and setting up terabyte [removable] drives."

Instead, Williams suggests a delicate balancing act of storing enough data to be able to recreate the simulation conditions if you need to, but "don't store so much that it overwhelms you." If you ran a transient analysis, for example, do you need to retain the digital data generated for every time step of the event simulated? Can you settle for storing the data representing a critical stage in the event (say, the stage at which the product fails)?

Williams points out that one drawback with just storing the metadata—material properties, load and base geometry—is the possibility that, if you rerun the same simulation exercise using the same metadata but on a different hardware platform or a newer version of the analysis software, there's no guarantee that you'll get the same result. (Presumably subsequent analysis runs produce better results, generated by better hardware and improved solver code.)



Tecplot Chorus gives users a way to visually compare, contrast and inspect a series of simulation sessions from a single window.

A more formal approach is to use a PDM, like Autodesk Vault, to index and archive the data generated from simulation sessions.

"You can check in or check out files related to the simulation job," Williams explains. "You can also add notes and comments to the files. Managing simulation files and procedures inside PDM also helps you communicate better with designers."

Another approach is to use a dedicated simulation lifecycle management application, such as SIMULIA SLM from Dassault Systèmes. The product extends Dassault's ENOVIA PLM with functionality that is specific to managing simulation.

"This makes simulation a managed, repeatable process, which is important to many of our customers, ensuring consistent quality in the same way a well-managed assembly line ensures the quality of a manufactured product," said Steve Levine, SIMULIA's senior director of strategic planning. "The globalization of product engineering has made it increasingly challenging to ensure that best-in-class simulation methods can be shared and used across sites and national boundaries, while protecting important intellectual property. In practice, simulation contains critical information regarding the steps and conditions of the analysis—or in other words, the simulation scenario. We've learned that defining and managing this context is essential to leveraging the value of the data being stored, an aspect that is often overlooked."

Who, What, When, Where, Why

To better manage simulation data, engineers need to record not just a set of results—the temperature at which a design fails, along with an animation file showing the deformation process—but the five Ws investigative journalists always demand: *Who* performed the simulation? *What* type of simulation was performed? *When*, or at which stage of the design cycle, did the simulation occur? From *where* did the geometry, material properties and load conditions originate? And, perhaps most importantly, *why* was the simulation done?

"Traceability is important," notes S. Ravi Shankar, director of simulation product marketing at Siemens PLM Software. "There are more people inside a company [beside engineers and simulation experts] who need access to the knowledge that CAE [computer-aided engineering, or simulation] programs are generating. How do you make it more accessible without forcing them to become simulation experts themselves?"

The logical answer, Shankar proposes, is to manage simulation data inside a PLM system.

"What we've done with Teamcenter [Siemens' data management software] is to enhance the data model so it recognizes CAE data," he explains. "The data model enables Teamcenter to not only capture all CAE data, such as finite element meshes or loads, but also to establish the proper relationships between the various types of CAE and design data. We set it up so that you can launch the simulation application—be it a solver or a pre-processing program—from the Teamcenter environment itself. And the results and reports are stored back in Teamcenter with the right links to existing data. This enables others to figure out, at a future date, what work was done, on what version of the design, what the results were and, if the design was changed because of it, who was notified."

Because PLM systems track nearly every facet of the design cycle and revisions, if the design has been altered since a simulation is performed, it will be much easier for engineers to identify CAE results as out-of-date, Shankar points out.

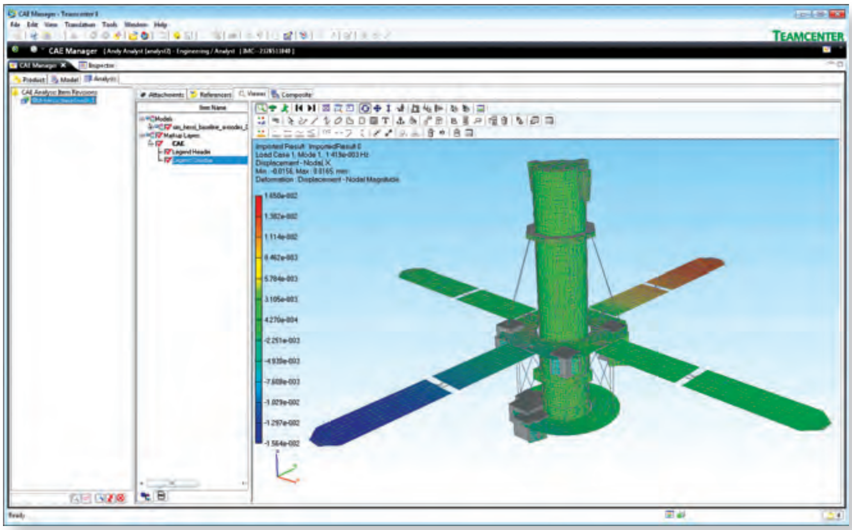
Teamcenter can also automate the process of building the correct CAE model for a given type of simulation, explains Shankar. If the user is performing, say, noise and vibration type analysis, he or she can specify "the different components he or she needs to take into consideration, the type of mesh model to use, and the process is automated to build the CAE assembly. So when the user opens the model in NX CAE [Siemens' simulation software] or a preferred pre/post environment, all the parts are in the right place. Some of our automotive customers have used this type of automation to significantly speed up the model build process."

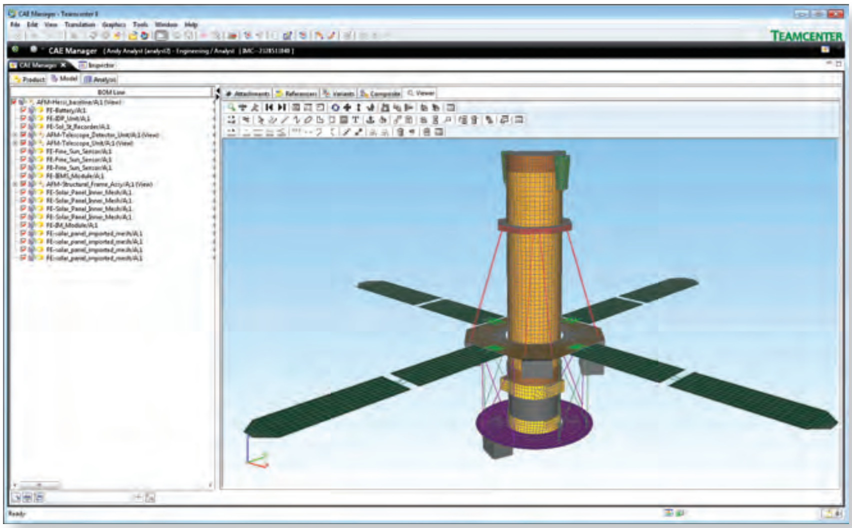
Strength in Numbers

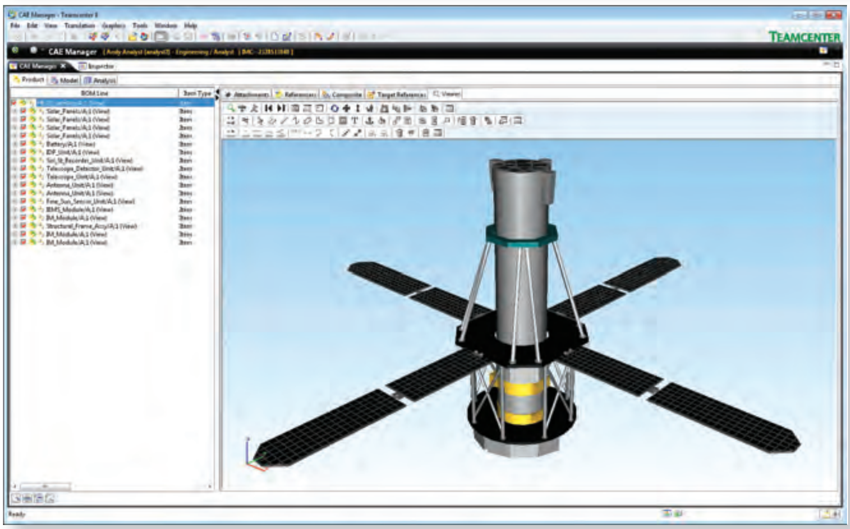
Another sign of digital simulation's growth: Users are shifting from processing one scenario at a time to considering many scenarios simultaneously. It's reflected in Isight 5.6, the latest release of Isight from Dassault Systèmes, which is said to provide "designers, engineers and researchers with an open system for integrating design and simulation models—created with various CAD, CAE and other software applications—to automate the execution of hundreds or thousands of simulations. Isight allows users to save time and improve their products by optimizing them against performance or cost metrics through statistical methods such as Design of Experiments (DOE) and Design for Six Sigma."

One of the new features is a method for users to compute and sample around the most probable point of failure in a design, according to a Dassault Systèmes announcement. The software also includes updates to the Abaqus component (part of the SIMULIA software suite) to run multiple Abaqus cases. It does so with the option to parse all detected input files and create output parameters for multiple analyses. An improved data-matching component then lets you define and match multiple result data sets within multiple ranges.

"SIMULIA SLM suite, including Isight 5.6, is conceived to address the needs of heavy, multi-discipline simulation users such as the automotive OEMs, to ensure that simulation can become an integral part of their business processes," states Levine. "In our view, tremendous efficiencies in new product development will come when design options are first evaluated by realistic, multiphysics simulations that are shared, managed and even automated, uniting the best simulation technologies available with proven in-house design practices. The advent of public and private clouds will produce breakthroughs in access







Siemens PLM Software's Teamcenter data management allows you to manage simulation data, such as mesh models, material properties and result files.

to high-performance computing, and become a key driver for this transformation."

Spotting Anomalies

Technology enables you to automate hundreds of thousands of simulation jobs, but when it comes to scanning and studying the outcomes, Tecplot's Imlay says he believes "there are few things better than the human eye for detecting anomalies in patterns."

Tecplot, which develops and markets the Tecplot 360 software, specializes in simulation data visualization. Its latest product, Tecplot Chorus, allows you to display a series of results simultaneously in the same window, making it possible for you to identify anomalies that you might otherwise miss.

"In terms of simulation management, process management and decision support, we're fulfilling a unique niche," Imlay says.

If each analysis session is the equivalent of a doctor's visit to address an individual ailment troubling your design, you might think of Tecplot Chorus' function as the annual checkup, where the primary physician studies your design's medical history over the past year to look for any warning signs.

Imlay admits he is not sure "every analysis project rises to this level that needs to be managed in a PLM or PDM system." A better approach, he proposes, is to keep the original data where it is, but extract the metadata, independent variables and graphics representing the outcomes from analysis sessions for comparison and diagnostics. In the future, Tecplot plans to add more automation features to identify anomalies in mounds of FEA and CFD results. But for now, Tecplot's aim is to keep users "in the loop, but help to optimize their time."

Analysis of Analysis Results

CIMdata's Meintjes has more than an abstract understanding of the subject. In a "previous life," as he puts it, he directed simulation engineers for vehicle and powertrain programs, and managed simulation strategy at GM.

"We had more than 150 simulation applications to look at different aspects of [vehicle] physics. We were doing structures for stiffness and crash, thermal analysis and fluid flow, kinematics and dynamics of mechanisms, electromagnetics, human factors, and all the rest," he recalls, noting that although 150 was an improvement from the more than 600 disparate applications the company used to juggle, the complexity continued to grow.

"Managed simulation data can be a competitive advantage; unmanaged data can become a huge liability," he states. "A few years ago, except for a few heroic individuals' efforts, there was very little cross-discipline analysis. Simulation engineers were pursuing competing objectives—for example, body stiffness for vehicle ride, handling and noise, vs. energy absorption for crash. Now, we have learned how to balance these requirements simultaneously, using multi-discipline optimization."

Looking Ahead

As simulation becomes an essential part of design validation and design optimization, the discipline also becomes a point of contention—and a source of headache. Ideally, an SLM system will allow you to not only chronicle, archive and retrieve the simulations you've run, but provide you with a way to make sense of the cumulative outcomes, to extract wisdom that you could not get from individual simulation runs.

"History matters," Meintjes concludes. "That's why you need simulation data management." DE

Kenneth Wong *is* Desktop Engineering's *resident blogger and senior editor. As part of his research for this article, he ran a wind-tunnel simulation on his own head, exported as a mesh model in a STL file. Check it out here: deskeng.com/virtual_desktop/?p=4825 and contact him via de-editors@deskeng.com or on Twitter @KennethwongSF.*

INFO ➜ Autodesk: Autodesk.com

➜ **CIMdata:** CIMdata.com

➜ **Dassault Systèmes:** 3DS.com

➜ **Siemens PLM Software:** Siemens.com/PLM

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Seeing Past the Clouds: PLM and What's Next

Companies are cautiously turning to PLM on the cloud.

By Eric Marks

There has been a lot of talk about cloud computing, and its exponentially growing presence among enterprise technology—particularly product lifecycle management (PLM). While PLM "in the cloud" is available today, its adoption can be slow. Customers are having a difficult time deciphering when, how and even whether to use PLM in a cloud. With the type of sensitive information that is managed in PLM, there has been some apprehension about moving to the cloud. Still, adoption is slowly gaining momentum as more customers see the available options and advantages.

PLM software is branching out from its traditional stronghold in engineering-intensive discrete manufacturing and moving aggressively into such process-oriented industries as energy, food-and-beverage and consumer goods, according to a new study released in November from the ARC Advisory Group. Because of this move, cloud-based PLM is receiving more support and higher adoption as these industries, new to PLM, start to deploy newer technology and more-evolved IT computing environments. However, there is still quite a bit of education needed of cloud-based PLM in the market overall.

Perhaps PricewaterhouseCoopers' Principal Technology Leader Tom DeGarmo puts it best: "Cloud computing accelerates innovation, improves time-to-market successes and offers added flexibility within PLM applications. Overall, it can improve connections across a company's network of suppliers, time zones and cultures. It enables an extendable enterprise."

Cloud-based PLM Strategies

The easiest explanation of cloud computing is to view it as a grouping of remote computers whose resources you can harness on an as-needed basis, regardless of where the computers reside, who owns them or can access them, etc.

"Product lifecycle management is a set of diverse business strategies, processes and applications. To identify the right projects, processes and problems that can be solved by introducing cloud-based PLM solutions can be a tall order when you factor in the importance of addressing ownership, location and privacy/security issues," notes Chuck Cimalore, Omnify Software president and CEO. Analysts agree, and are working with PLM customers today who are grappling with the concept of cloud computing—and how best to address these issues.

Analyst firm Frost & Sullivan reports that most people refer to public clouds when they talk about cloud computing. There are four types of cloud strategies being deployed in PLM applications:

1. Public clouds are typically systems that are shared by multiple people who use the system and have no control over who their fellow users can be.
2. Private clouds infer systems available for the sole benefit of a single company or entity, where cloud data is secure and protected.
3. Community clouds are where only specially selected companies with common or related goals participate in the system, such as partners, channels or a supply/design chain.
4. Hybrid clouds are where a private cloud can extend onto a public cloud for specific activities, and on an as-needed basis. The benefit of a hybrid approach that incorporates a public cloud is that it provides extra performance scalability for the private cloud that would be in use.

Identifying Cloud Services

In addition to the four types of clouds described above, there are three segments of cloud-based technology:

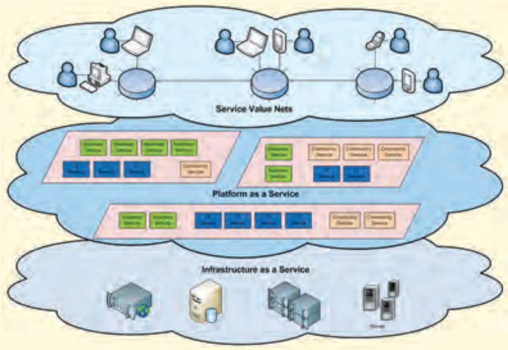
1. Software as a service (SaaS). Sometimes referred to as "software on demand," it deploys over the Internet and is made available to users when requested. It is usually served as a payment per-usage or on a subscription basis. According to Forrester Research, SaaS is the oldest and most mature segment of cloud computing, citing examples like that of salesforce.com, Netsuite and Google Gmail, among others.
2. Platform as a service (PaaS). This combination of development platform and solution stack is delivered as a service on demand. Forrester Research describes it as an infrastructure that can be used to develop a new software

CASE IN POINT: THE ULTIMATE HYBRID CLOUD MODEL

What does cloud computing mean for business strategy? How will cloud computing affect any enterprise more broadly? Let's take a closer look at one sophisticated PLM approach where a company adopted all three segments of cloud (SaaS, PaaS and IaaS) within one computing architecture.

Mevion Medical Systems Inc., a radiation therapy company dedicated to advancing the treatment of cancer, has a workforce that is distributed across the globe and requires its business solutions to be available 24/7 on all company-supported platforms (PC, Mac, Linux, Android and IOS).

"Mevion is leveraging a 'hybrid cloud' in order to be able to scale quickly and efficiently to distributed cloud data centers at far less cost than purchasing expensive equipment or renting/building out corporate data centers," explains Mevion IT Manager Edward Quinn. "The IT department can leverage the advanced international infrastructure already in place by leading cloud-computing companies and activate and pay only for the services that its business needs."



Cloud computing can facilitate the proper management of IT resources.

Analysts view this hybrid PLM cloud approach as one that can bring real and immediate value to organizations by removing the traditional barriers to agility and innovation, including capital expenditure, protracted IT project timelines, reliability and end-user familiarization.

Overall, PLM in a cloud environment will enable companies to capture and manage product information, as well as processes to continuously improve the products they manufacture. Customers of all sizes will be able to tap into the full promise of PLM via a cloud.

Mevion, like most companies, will seek to leverage technology and solutions that provide a distinct advantage. In this case, it is using cloud computing with Omnify PLM so that the company will be able to expand quickly while decreasing overall technology costs—and still achieving a reliable, agile IT infrastructure.

This "hybrid cloud" computing architecture uses both internal and external cloud solutions that will provide SaaS, PaaS and IaaS solutions. The architecture can support a distributed workforce by using key security measures; integrate with the corporate data center to ensure data integrity; and scale across multiple external solutions to ensure reliability and uptime.

"Our entire company will be on the Mevion 'hybrid cloud' architecture, depending on the employee's job function," Quinn says. "All employees in the company can access the PLM solution from the cloud on a daily basis from their computers, smartphones and tablets, both within the company network and through remote secured VPN connections."

app or extend existing ones without the initial cost of buying and implementing additional hardware and software. According to Forrester, PaaS often can extend the capabilities of existing SaaS solutions, such as Force.com (from salesforce.com), Google App Engine and Microsoft Azure.

3 Infrastructure as a service (IaaS). This provides an environment for running user-built virtualized systems, sometimes termed as a platform virtualization environment. It encompasses service, software, data-center and network equipment delivered as a single bundle. Forrester Research cites examples of IaaS environments as Amazon EC2 (Elastic Compute Cloud), GoGrid and Flexiscale.

Most industry analysts (Forrester, Gartner, Frost & Sullivan, ARC and The Yankee Group) covering IT agree that the power and potential of cloud computing, properly leveraged and deployed, can have a significant impact on the PLM industry. PLM customers are giving serious consideration and evaluating their PLM business processes in regard to how to run them seamlessly and securely connect them to cloud-based data sets.

All that said, today, few systems are fully deployed. The systems are still in the infancy stages of use, despite the technology having matured. It would seem that it is still curing. DE

Eric Marks *is an industry practice leader for PricewaterhouseCoopers. Prior to PwC, Marks worked with Cambridge Technology Partners, CycleBridge and Novell.*

INFO → Mevion Medical Systems Inc.: Mevion.com

→ Omnify Software: OmnifySoft.com

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On a Mission to Mars

How engineers designed and tested the latest Mars rover.

BY MARK CLARKSON

Artist rendering of the sky crane maneuver. *Image courtesy NASA/JPL-Caltech.*

As the recent failure of Russia's Phobos-Grunt probe highlights, it's tough to get to Mars. Even NASA has only a 65% success rate with Mars missions.

It's not just the mechanics of the vehicles, themselves. Sure, a Mars rover is a fantastically complex machine with tons of onboard computers, instruments and sensors, but so is a Cadillac CTS-V or a Boeing 777. A Mars rover does, however, present some unique challenges.

Most manufacturers have the advantage of being able to replace a part if something goes bad. They can issue a recall, or just recommend replacing your car's oil filter during normal servicing.

"We don't have those kind of luxuries," notes Bill Allen, mechanical design engineer at NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA. "We don't get a chance to retry or rebuild or service or redesign. We have one shot—and it's usually doing something we've never done before. We're trying to use existing tools and processes to get us through a unique design."

A World Apart

Those unique designs must face uniquely challenging environments. Sure, there's a temperature difference between Oslo in the winter and Phoenix in the summer, but that's just peanuts to space.

"When you're dealing with Earth-based development, you just don't have the range of dynamic and thermal loads that something that's expected to leave our planet and land on another planet is going to experience," says JPL's Art Avila. "We have to balance risk, cost, volume [and mass] in a different trade space than one would with a car or a plane."

Case in point: The Mars Science Laboratory (MSL), NASA's latest Mars rover, due to arrive at Mars this August.

Avila, a 27-year veteran of JPL, was the manager of the MSL's Thermal and Cryogenic Engineering Section. They created the thermal control system for the rover, which maintains all the vehicle's components within their specified temperature ranges, during all parts of the mission.

"You have to accommodate ground operations here at the Cape," says Avila, "and the ascent portion, which has a whole host of environmental conditions—free molecular heating, depressurization, things that cause the temperature to change either rapidly or slowly on the vehicle. Then, of course, the cruise to Mars, out in deep space."

And the really tricky part is yet to come.

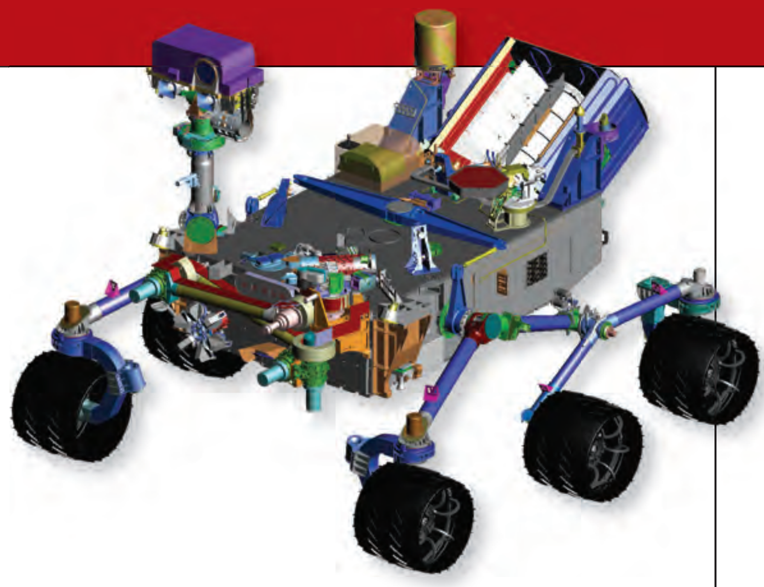
Entry, Descent, Landing

MSL will have spent eight-and-a-half months in a hard vacuum, drifting through the utter cold of deep space. Then the challenge becomes to keep it warm. Now it hits the Martian atmosphere. The ablative heat shield reaches temperatures in excess of 2,700° F. The G loads and vibration are even worse than those during launch.

Once the vehicle slows down to around Mach 2, a parachute deploys and the heat shield is jettisoned, exposing the rover and the descent stage to the frigid carbon dioxide (CO_2) winds of Mars' upper atmosphere. After a plunge through a fiery inferno, the craft is now convectively cooled as it descends beneath its parachute.

Next, the backshell and parachute are jettisoned and the descent stage fires its rockets. Too massive for the airbag-style landing employed by the Mars Exploration Rovers, the MSL rover itself is lowered from the descent stage on an improbable arrangement of cables. When the rover touches down, the cables separate and the descent stage flies away to crash, leaving the rover on the Martian surface, ready to deploy.

Consider: Less than 20 minutes have passed since the rover was in free fall, in a vacuum, in outer space. Leaving aside for the moment the staggering mechanical complexities of carrying out this phase, the sheer range of environments the rover has been through in the short intervening time—vacuum, re-pressurization, wind, vibration, noise, gee loads, scorching heat, freezing cold—is mind-boggling.



A 3D CAD rendering of the MSL rover in fully-deployed 'traverse' mode. Different systems are color coded.

"It's an interesting combination of contrasting environments," says Avila. "It makes this not only challenging to design, but also very challenging to verify and validate the performance."

A family portrait of JPL's Mars rovers. Mars Exploration Rover (left) launched June-July 2003; Mars Pathfinder (center) launched December 1996; and Mars Science Lab (right) launched November 2011.

Validating the Model

To validate those designs, the rover is dropped from cranes, shaken on shaker tables, exposed to a vacuum and baked under artificial suns to thoroughly test its components.

Testing for the deep space cruise phase occurs in a vacuum chamber chilled to -292° F. The Martian surface can't be simulated nearly as well—Mars' 38% of Earth's normal gravity is a real showstopper—but JPL does the best it can. The rover goes into a large chamber with an 8 torr CO_2 atmosphere, a cold floor and walls to simulate the Martian surface and sky, and a solar simulator beaming down.

"We put it through some very controlled thermal stress tests," says Avila. "We get temperatures, pressure and the measure of irradiance when we're using our solar simulator. The rover has its own flight sensors, and we augment those with several hundred test temperature sensors to give us all the additional detail that we need to understand how the system behaves within that test chamber."

The results are carefully monitored and fed back into the all-important computer models of the rover, developed in Siemens PLM Software's NX tool.

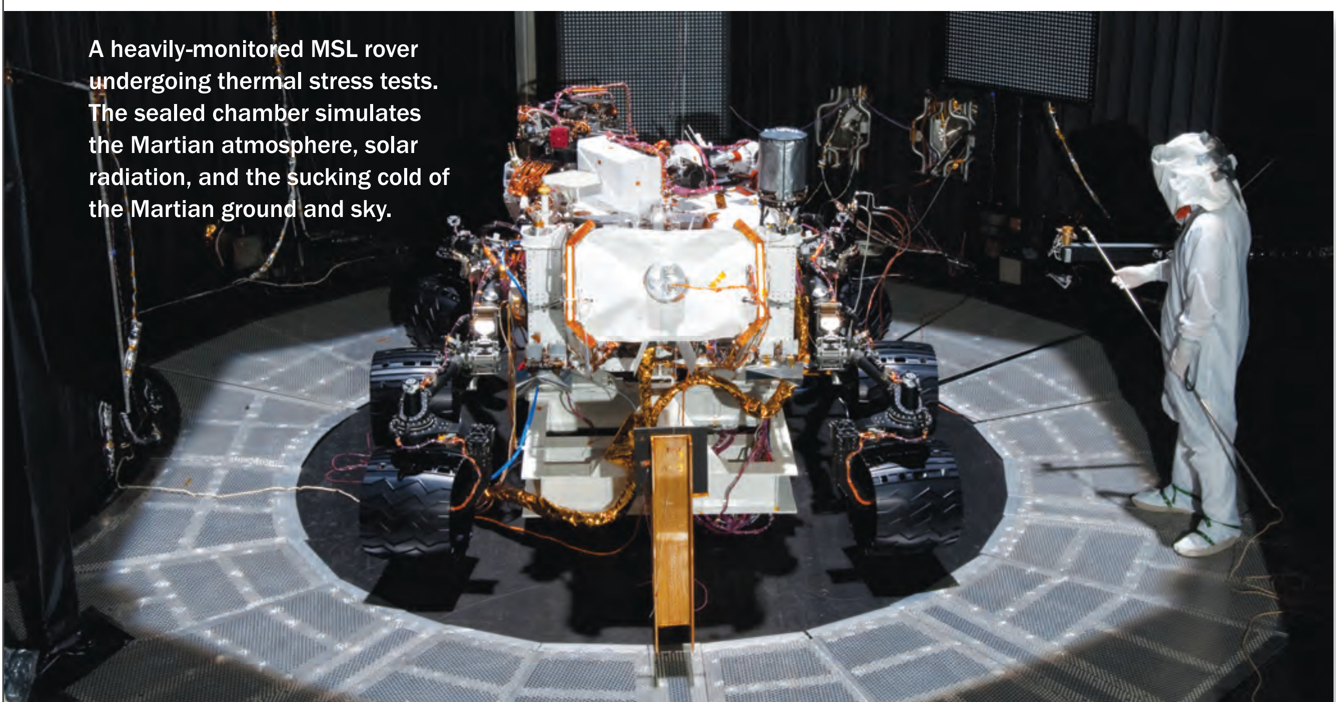
"Once we get good agreement with our mathematical models," says Avila, "we feel very positive that we can simulate those things that we can't test on the ground. We do the appropriate thermal magic to it, and that becomes our analysis thermal model."

"We are very excited to contribute to JPL by implementing NX suite of CAD/CAM/CAE and Teamcenter software on the Mars Rover project," said Jon Heidorn, vice president of marketing, Siemens PLM Software Americas. "NX successfully helps JPL create the geometry and generate the thermal model, while Teamcenter efficiently captures and maintains the design data. That allows much quicker integration of new design features into their CAE environment to update their models and perform analyses quickly."

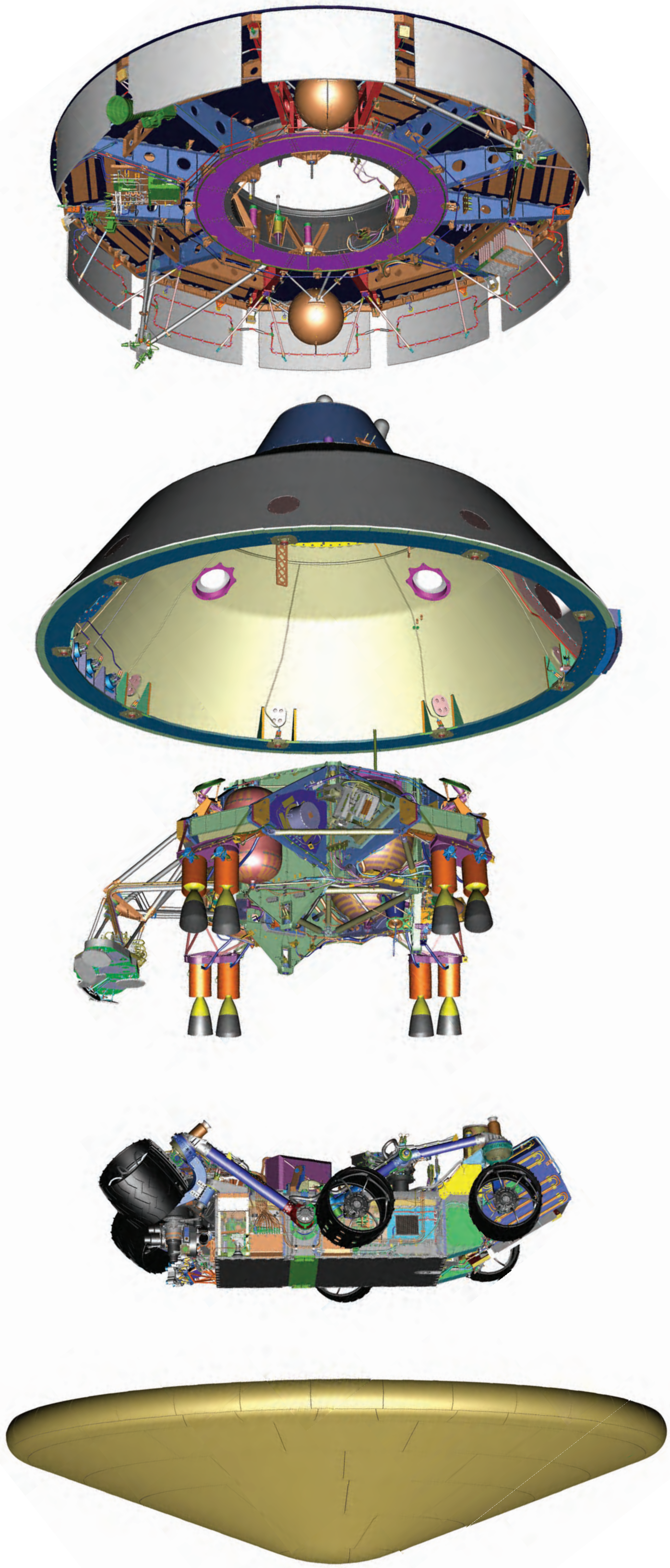
This model undergoes continuous revision, as the project moves from design studies to validation and testing and, eventually, the mission itself. It's being used right now for flight operations. It will also provide valuable, hard-won knowledge for future missions.

Now, Where Did I Put That Thruster?

"During the whole development of the Mars program," says Avila, "from the time of Mars Pathfinder in the mid '90s,



A heavily-monitored MSL rover undergoing thermal stress tests. The sealed chamber simulates the Martian atmosphere, solar radiation, and the sucking cold of the Martian ground and sky.



Left: A CAD rendering of the MSL showing (from top to bottom) cruise stage, backshell, descent stage, rover, and heat shield.

we were demonstrating certain technologies and design approaches, exercising them, and then infusing them into the next mission.

"The problem was that, during much of that time, we had a very diverse set of modeling and data management tools — mainly [people's] file cabinets," he continues. "We needed to get away from that and get into some kind of future-proof environment."

Because some of the team's projects are highly dependent on upstream and downstream data consumption, Avila says, it "became clear that we had to be very careful about how data is transferred, translated and configuration managed. Mistakes occur when people are pushing pencils in that environment. With a seamless architecture, more software-to-software interfaces, you have better control of the delivery and receipt of data—and hopefully we minimize the 'gotchas.'"

With JPL's current approach to modeling, he explains, "We were able to capture the entire MSL mission. For future missions, we're able to pull out a lot of designs or design features: a thruster or particular heat rejection system. We have all of that now in a managed database, and that's what's really going to help us in terms of efficiency, configure management and knowledge retention."

Smoothly Centralized?

So, is JPL's software all seamlessly integrated now?

"I'd like to tell you, 'Yes,'" Allen says with a laugh. "Centralizing is a goal, but it's always a challenge. We're fairly well centralized, especially within the mechanical environment."

On Siemens tools, for enterprise activity, JPL is moving from Teamcenter Enterprise to Teamcenter Unified Architecture, which is used for JPL's mechanical engineering data management.

"But you have different fiefdoms within your organization that use different tools for different reasons," Allen explains. "It might be a specialty task where they need a special tool. And it's a moving target: What was best yesterday may not be best today."

JPL, fortunately, is good at dealing with changing environments. **DE**

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The **New** Multicore

Today's multicore processors open doors to an entirely new level of high performance.

BY PETER VARHOL

Although almost unheard of just a decade ago, multicore processors are ubiquitous today—as just about every high-performance computing (HPC) server and workstation uses cores to deliver the power needed for better and faster engineering.

The beginning of 2012 introduces a new generation of multicore processors, which will continue to have an impact on engineering design, analysis and prototyping for the next decade. In the race to deliver the fastest processor, chip makers are extending the multicore theme in some new and inventive ways.

A core incorporates an entire processing unit within a die, so multiple cores in effect mean several processors that typically work very closely in concert, often sharing caches. Sometimes, as with the Intel hyper-threading processors, they offer the ability to run multiple threads within each individual core. This is valuable for computations that can be broken into smaller and independent parts, so that they can be executed in parallel.

ABOVE: The Intel Sandy Bridge E processor will be making its way into servers and high-end workstations later this year.

LEFT: For those requiring energy-efficient servers, the EnergyCore ARM processor may be able to pick up some of the engineering workload.

As it became increasingly more complex to design processors with smaller components and higher clock speeds, processor manufacturers like Intel and AMD began putting multiple cores on the same die to achieve greater absolute performance. In addition, Intel came out with Xeon multicore processors, and also offered multiple core processors for workstations. Now, Intel has its own new multicore solution, with the next generation of its Sandy Bridge processor.

Flurry of New Processors

Many of these new processor announcements came out of last November's Supercomputing conference, which is increasingly becoming the preferred venue for high-performance statements. With Intel, NVIDIA, AMD and ARM licensee Calxeda all making a statement at or near Supercomputing 2011, expect more processor announcements to happen at the end of 2012 as well.

Perhaps the best place to start with this new explosion of new multicore designs is with Intel, whose Sandy Bridge E processor is the next generation of its workstation/server flagship Sandy Bridge processor line. The most obvious addition to the older Sandy Bridge is two extra physical cores, bringing the total up to six. Because each physical core also sports a secondary logical core thanks to hyperthreading, a Sandy Bridge E processor can execute up to 12 threads simultaneously.

Sandy Bridge E was never intended to be entirely a workstation processor. Rather, it's likely going to emerge sometime in the first part of this year as a Xeon-branded processor for single- and dual-socket servers and high-end workstations. While today's Sandy Bridge E processors run at 3.3 GHz, like the older Nehalem processor, they dynamically overclock up to 3.9 GHz in response to the need for greater computational performance. This ranks them as among the fastest processors commercially available.

By itself, Sandy Bridge E is more of an evolutionary than revolutionary processor, offering relatively modest improvements over the older Sandy Bridge model. But it demonstrates that multicore processors are nowhere near running out of computational steam.

In fact, the AMD Opteron 6200, announced the same week as Sandy Bridge E, has more cores—with a 16-core processor architecture specifically targeting server applications, including HPC servers. But it might be a misnomer to call it a true 16-core processor, as its architecture has eight two-core modules rather than 16 independent ones. The distinction means that its cores aren't as tightly coupled as you might find in a true 16-way processor.

AMD Server Product Marketing Manager Michael Detwiler says that customers could see up to a 35% performance increase over AMD's Opteron 6100 series, the company's previous top-performance server processor. He also reports that the Opteron 6200 tested with better performance in two-socket configurations than Intel's Xeon 5600 series on applications such as floating-point processing computing.

Graphics and Power Management Drive Multiple Cores

NVIDIA'a Maximus represents the 3D graphics capability of NVIDIA Quadro professional graphics processing units (GPUs) with the parallel-computing power of the NVIDIA Tesla C2075 companion processor. Jeff Brown, general manager of the Professional Solutions Group at NVIDIA, refers to the vision behind Maximus as "unifying graphics and parallel computing."

With NVIDIA Maximus-enabled applications, GPU compute work is assigned to run on the NVIDIA Tesla companion processor, which frees up the NVIDIA Quadro GPU to handle graphics functions. Further, the processor is able to differentiate which code will best run on which processor, without any underlying software changes. While this only works for GPU-compiled code, it represents a significant advance over current processors, which can't make decisions on where to run code.

Despite the drive to improve absolute performance, there is also a significant interest in power management, driven by both the cost of electricity and a concern about conservation. In industry, data centers have become one

Rajeeb Hazra, general manager of Intel's Technical Computing Group, holds "Knights Corner," an Intel Many Core Architecture co-processor capable of delivering more than 1 TFLOPS of double precision performance.

of the largest users of power. In this environment, ARM processors have been designed for low-power applications. While ARM has been used in phones and other low-power devices, it is unusual for them to be used in either HPC or general-purpose computers. That seems like it's about to change.

Calxeda has been talking about producing ARM servers for some time, and made it official earlier in November when it announced a new ARM processor designed for servers, called EnergyCore. In addition, it announced that Hewlett Packard has plans to build a low-energy server around the chip. The processor is essentially a complete server on a chip, minus the mass storage and memory. A quad-core server uses just 5 watts of power per server and 1.25 watts per core, which is almost five times better than high-performance Intel servers.

With low power consumption and the use of multiple cores, ARM processors are an intriguing prospect for HPC. Of course, you still need an operating system and application software that have been ported to the ARM architecture, but if there is truly value in energy-efficient computing, that could happen.

Not a Panacea

The explosion in computing power driven by multicore processors benefits many, but not all, engineering applications. Those applications whose computations can be broken down into small parts, each executing independently, can receive a significant boost in performance. That includes most types of analysis, such as finite element analysis (FEA), computational fluid dynamics (CFD) and generic simulations, but doesn't do a lot for bread-and-butter applications like design and rendering. In cases like these, though, extra GPU horsepower will likely pay off.

In fact, rendering and other graphical operations are getting a twist from next-generation GPUs. Innovations like NVIDIA's Maximus enable workstations to automatically parse out work to the best processor available for the job. However, in this case that means one of two GPU architectures, not a general-purpose processor and a graphics processor.

As always, the availability of software will determine the ultimate value of these multicore innovations. Most engineering software vendors, including ANSYS, Autodesk, Dassault Systèmes and MathWorks have developed versions of their applications that take advantage of multiple cores if they are available. Some, such as MathWorks, enable engineers to specify how many cores they want to use.

Configurability is also available through virtualization technologies. Parallels Workstation Extreme lets engineers create a virtual machine and assign it a set number of cores and amount of memory. Jobs that can execute independently can have a virtual machine configured for optimal performance, while also retaining enough resources for interactive tasks.

But given enough time, the underlying system itself may take care of application software. NVIDIA's Maximus starts to take the technology in that direction, as long as the code is compiled for that processor. In the future, there may be ways of just-in-time compiling code for a specific processor and its cores, depending on the nature of the code.

It's clear that multicore processors have become a fixture in mainstream computing, and are essential in HPC. This new generation of multicore processors hints of systems in the future with multiple processors and cores, with system software that will automatically determine where best to execute any given task. In the next several years, as this vision is realized, engineers will see a significant boost in processing power that will have the potential to change engineering design more significantly than the changes of the last decade. **DE**

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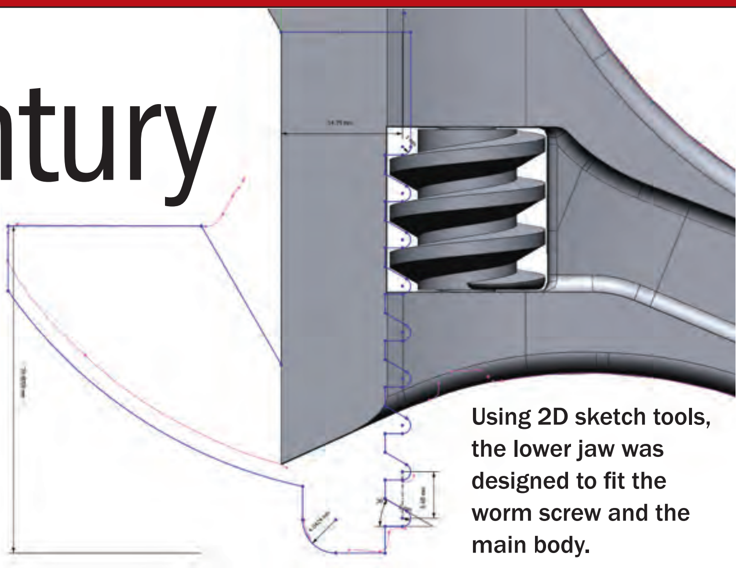
The 21st Century **Replicator**



Using 2D sketch tools, the lower jaw was designed to fit the worm screw and the main body.

Behind the scenes of National Geographic Channel's wrench video, which recently went viral.

BY MICHAEL MOCK AND JOE TITLOW

In the science-fiction TV series *Star Trek: The Next Generation*, a replicator creates food and water during space voyages in the 24th century. Occasionally, replicators even created spare parts, enabling the crew to repair damaged parts onboard the *USS Enterprise*. This futuristic technology was the concept behind National Geographic Channel's recent episode of *Known Universe*. The segment explored a technology, available today, that could allow astronauts to replicate tools damaged or lost in space.

The show's producers selected 3D scanning and 3D printing technology from Z Corp., which was aquired by 3D Systems last month. Demonstrating how a wrench (or any other tool) could be scanned and then reproduced by a 3D printer, a fully functional, full color "printed" wrench—complete with a moving worm screw—became an Internet and social media phenomenon. The wrench video hit YouTube and went viral, reaching more than 8.7 million viewers.

Clearly, 3D printing captivates the public. To appeal to and explain complex concepts in a 4½-minute video, the producers of the *Known Universe* series simplified the technology. But there is much more to the story. While it is not possible to simply photocopy an object with moving or hidden parts, we can indeed replicate these objects, with the aid of advanced reverse engineering software.

With that in mind, what follow are explanations of the 3D scanning, 3D reverse engineering software and 3D printing technology behind the wrench video.

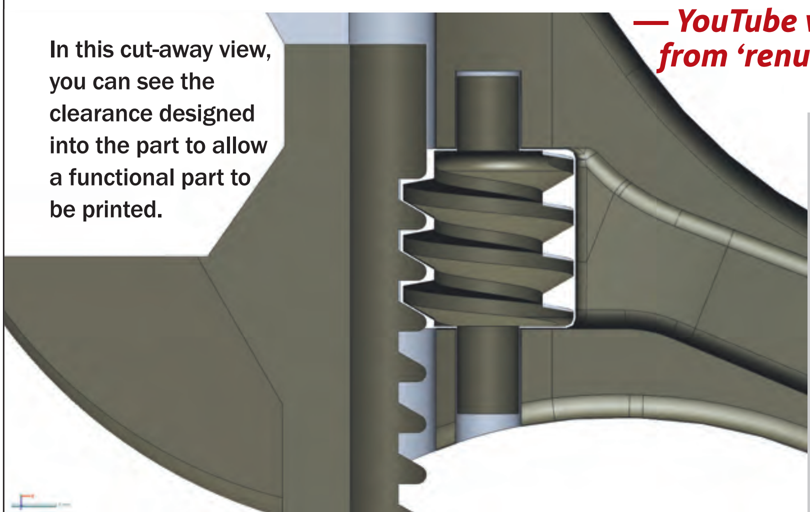
> **"As many people pointed out before, the scanning is a scam, because the scanned wrench and the final wrench are not same.**
> ***— YouTube video comment from 'renumeratedfrog'"***

Capture with 3D Scanning

The first step in the 3D replication process was to scan the wrench using a 3D scanner. A 3D scanner creates a cloud of x, y and z points in 3D space that represents the visible surfaces of the scanned object. Using a high-definition, portable ZScanner, we produced a full-color, 3D point-cloud model from the physical wrench by passing the scanner around all sides of the object.

Even though the video did not show a near-exact replica of an object's scanned surfaces, it is possible to produce one. For example, Z Corp.'s ZScanners have an XY accuracy ranging from up to 40 microns for the high-end scanner, to up to 80 microns for the entry-level scanner. Additionally, the resolution ranges from 0.05mm in XYZ for the high-end scanner to 0.1mm in Z for the entry-level scanner.

The ZScanner couldn't scan the internal details of the wrench, because it is a laser-based scanner that can only capture surface information within line of sight. We solved that problem with the next step: reverse engineering.



In this cut-away view, you can see the clearance designed into the part to allow a functional part to be printed.

Create with Reverse Engineering Software

One piece missing from the wrench video is the reverse engineering of the 3D scan data into a complete assembly model of the wrench. While the laser scanner effectively captures all surface information that can be seen, the wrench had some internal areas that were not visible to the scanner. We used reverse engineering software to digitally recreate the hidden details, such as the hidden areas of the worm screw. The editors of the *Known Universe* wrench segment edited this step because of the time limitations of the show segment.

Enter INUS Technology and its Rapidform XOR software. This software helps designers and engineers convert 3D scans into complete parametric CAD models. Using Rapidform, we created a functional CAD model that is ready to print on a 3D printer.

The first step in the wrench replication process was to pass a portable, handheld ZScanner 700 CX around all sides of the wrench, to produce a full-color, 3D point-cloud model.

Step 1: Create a 3D Sketch

The first step in almost any CAD model is to define the shape by making a 2D sketch. For this reverse design project, we used a section tool in Rapidform XOR to digitally slice the scan data and generate a 2D sketch outline of the part.

This functionality is much like using tracing paper, and is found in the software's 2D sketch mode. We wanted to recreate a similar shape using mathematical entities, such as lines and arcs. Using the software, we could easily snap onto the 3D scan data outline while drawing, extracting lines and arcs to map directly to the scan data.

Step 2: Create a Solid

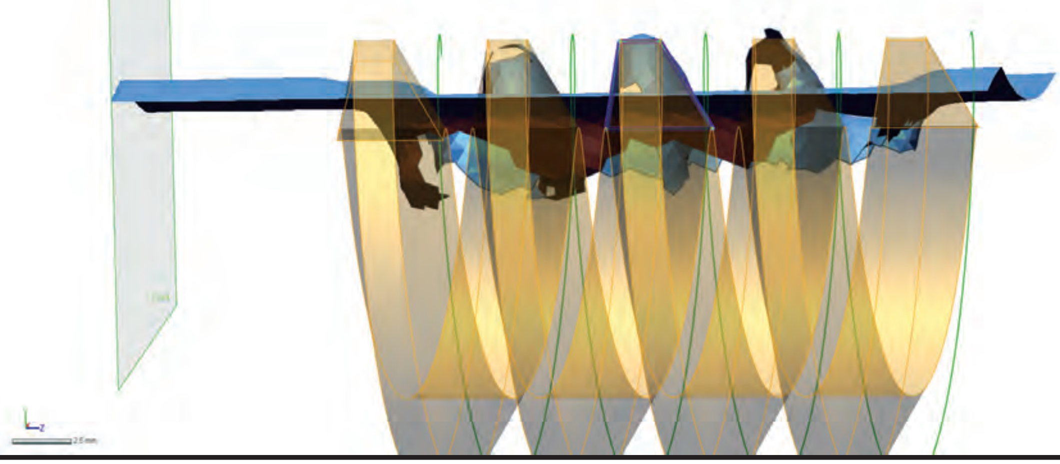
Once the sketch was complete, we followed our normal CAD process again—creating a solid operation from that sketch. We used extrude, revolve, loft and sweep to make solid features. All the while, we were building a history tree with our actions.

We repeated this process several times, adding and cutting away from the model, and literally carving out the correct shape. Our reverse-engineered model contained several advantages over the scanned model:

- It was "intelligent," meaning it included the design history and constraints.
- Surfaces were geometrically accurate and perfectly smooth.
- It was complete in areas that the scan wasn't, or couldn't be (such as the hidden areas we mentioned earlier).

Simply put, the 3D reverse engineering software allowed us to build a copy of the wrench, complete with added colors/features. In the original *Known Universe* segment, viewers accurately pointed out that the 3D printed wrench was different from the one scanned. The differences between the original wrench and the printed one were done intentionally to demonstrate that once scanned, geometry could be digitally modified before it is printed. Because time didn't allow this process to be shown in the TV segment, we produced a supplemental video illustrating how a wrench can be scanned and reverse engineered into a complete 3D

The Helix tool makes it possible to create the spiral thread of the worm screw.



The ZPrinter 450 creates physical 3D models by spreading a layer of high-performance composite build material, then printing an inkjet binder (with color) in the cross-section of the part, a process that repeats itself until the 3D printed model is complete.

model that is a printable, functional part. (View it online at http://bit.ly/3d-wrench.)

Step 3: Add Mechanical Components

When it came time to add the mechanical components (the worm screw), we again inserted the intelligence needed. To make the wrench work correctly, we needed certain clearances, as well as design intent. The gear teeth on both objects needed to match, or the parts would bind when turned. We added this intelligence and extracted other useful information, such as the pitch of the helix, etc.

When the reverse engineering of the wrench was complete, we had created a model ready for printing. Our model was also ready for simulation, testing and any other revisions we chose to include.

Print with a 3D Printer

After the reverse engineering process was complete, we imported the 3D CAD file of the wrench into Z Corp.'s ZPrint software. The software sliced the file into thin cross-sectional pieces, and fed that information to the 3D printer.

The printer created the model one layer at a time by spreading a layer of high-performance composite powder build material, and then printing an inkjet binder (with

> **"They're either leaving out a boatload of important information, or this is a hoax.**
> ***— YouTube video comment from 'stillspooky'"***

color) in the cross-section of the part. The wrench was built from nothing—one thin layer at a time, with each layer of the powder measuring approximately 0.004 in.

When the binder is printed into the powder, the printer binds the individual powder particles together to create a solid part. The binder not only solidifies each individual layer, it also binds it to the layer below. In less than an hour, the printer "printed" 200 layers, which created the ¾-in.-thick wrench featured in the video.

After the printing process was complete, we removed the wrench and cleaned it to remove any loose powder remaining in the voids around the worm screw. The 3D printer includes an air compressor, which we used to force the powder out of the nooks and crannies. Any loose powder was automatically recycled back into the machine and made ready for the next print.

The Finished Product

As the *Known Universe* video depicted, we did indeed print a fully functional wrench. This video demonstrates that, with the innovation available today, astronauts on future space missions can use 3D technology to scan, create and print any tool they may need.

Back here on Earth, using 3D scanning, 3D reverse engineering software and 3D printing, we can rapidly design and evaluate not only a wrench, but all types of products. Despite what some of the Known Universe video comments said, these technologies are real and used for a variety of applications, including mechanical design, architecture, entertainment, geospatial and healthcare.

Kudos to the National Geographic Channel for highlighting the incredible potential of 3D technologies. Millions of viewers now know more about innovative 3D tools that are dramatically changing how products are designed, made and tested. DE

Michael Mock *is product manager in the Americas for INUS Technology Inc. Joe Titlow is vice president of product management for Z Corp., which was recently acquired by 3D Systems. Contact them via de-editors@deskeng.com.*

INFO → INUS Technology Inc.: Rapidform.com

→ National Geographic Channel: Channel.NationalGeographic.com

→ 3D Systems.: 3Dsystems.com

→ Z Corp.: ZCorp.com

How to Avoid Design Bottlenecks

Keep your design project moving forward by de˜ ly preventing and resolving routine obstacles.

BY JOHN EDWARDS

Like an author who suddenly faces writer's block or an artist who can no longer bear to pick up a brush, an engineer encountering a design bottleneck knows that the situation can be agonizing, costly and difficult to shake.

Designers use a variety of terms to describe the incidents that can pop up to delay a project at any point during its life, including bottlenecks, challenges, roadblocks and hangups. The good news is that most design headaches can be avoided entirely, or at least quickly overcome, simply by following a few basic rules. Here's a look at how experienced designers and design managers keep their projects on schedule and moving forward.

The Biggest Bottlenecks

Project bottlenecks often develop when the designer is unsure of a project's requirements and goals, observes Scott Harmon, a vice president at Z Corp., a prototyping systems developer located in Burlington, MA, which was acquired by 3D Systems in January. "Critical bottlenecks occur as a result of uncertainty and a lack of decision-making," he says.

Harmon notes that while some decisions are relatively straightforward, such as whether a design can withstand a specific operating temperature, other decisions are much less clear-cut, "such as determining whether a particular design will appeal to its target market."

When facing a bottleneck created by poor or indecisive planning, the designer needs to work closely with project stakeholders to gather as much relevant data and insight as possible to overcome the bottleneck and complete the project. Unfortunately, designers are often left out of the decision-making process.

"They are stuck while someone less connected with the project fails to make a decision," Harmon says. "But when the project is late, it's rarely the decision maker's fault; it's usually blamed on the engineering team."

Rich Walters, director of design at Red Fusion Studios, a Downers Grove, IL-based product development firm, says he believes that cross-functional teams are essential for developing clear and specification-rich product designs, yet warns that there are limits to the amount of input any design can bear. "Attempting to gain consensus on all design issues can add significant time to a project, and have a negative impact on the integrity of the design," he notes.

Sudden and unexpected design changes are another major source of project hangups, says Justin Scott, a design engineer based in Washington, D.C. Schedules are based on a best-case scenario, and extra time and money is often not included for changes in specifications, he notes: "If a specification change is particularly fundamental to the design, an engineer may have to scrap weeks' worth of effort to˜accommodate˜it."

Occasionally, a design change results in a project-blocking challenge that appears almost unresolvable, says Scott. "Certain components of a design may become difficult or impossible to obtain, which requires the design be re-engineered," he adds. "These challenges are less frequent, but they do occur. I have found the best resource in this situation is the assistance of another engineer to help overcome hurdles from a new perspective."

Addressing Challenges

The best way to solve virtually any kind of bottleneck is for the design team to gather together—in person—and discuss the relevant issues in an open forum, Walters says. "Although business cultures are changing, we still see a lot of management by memo, where emails fly back and forth, creating a tone of conflict and distrust," he says. "By bringing the team together physically and using the project brief as a discussion

Rich Walters
Red Fusion Studios

Tim Jacobs
Optimation

Justin Scott
Design Engineer

guide, you can usually resolve issues in a matter of hours instead of days or weeks."

The first step when encountering a design process challenge should be to check the requirements document, says Tim Jacobs, process design group manager and senior technologist with Optimation, an industrial engineering services company in Rush, NY. "If one does not exist, develop one with the client," he advises.

Once the requirements have been defined, the next step is often a block diagram and then a flow diagram. At this point, space requirements can be developed in a preliminary way—often in the form of a layout or 3D model. "The flow diagram and preliminary model are the foundation for the project, and should be agreed upon before proceeding with the design," Jacobs says.

A physical prototype is critically important in resolving many kinds of bottlenecks, Harmon notes. "It's specific, there's no uncertainty—it's not a drawing or a rendering [and] nothing is hidden or half-done," he says. "It's an object that you can hold in your hand; you can see, feel, measure and assess a prototype.

Harmon says he believes that models tend to reveal big mistakes sooner. He notes that a prototype also allows non-CAD people to interact with a design in a comfortable and familiar way.

"Managers, manufacturers, customers, marketers, salespeople, market researchers and others are all involved with successful new product launches, but none of them uses CAD," he explains. Harmon says that prototypes effectively bridge the gap between designers and the non-tech world.

"I know most engineers would rather gouge their eyeballs out than invite the opinion of the sales department," he says. "Still, I'd rather have them criticize early and sell later, than criticize after the product is done and find something else to sell."

Setting Design Requirements

Most experts agree that having clear, specific, agreed-upon design specifications helps keep bottlenecks from developing.

"These specifications should not be set down until sufficient research has been done on similar products in the market, customer requirements and engineering methodologies to avoid costly design challenges," Scott says. He notes that once all of the specifications are in place, good project management takes over. "If specifications change, so should the project schedule and cost estimates. An experienced project manager˜shepherding a product through the design phase will ensure that bottlenecks are anticipated, accounted for and˜alleviated."

Design requirement specifications are essential for preventing project delays, as long as they are set thoughtfully and with a purpose, Walters says. "Designers need to know limitations, end goals and the reasons for the spec," he explains. "If a specification is expressed as a design solution, the reason should be made clear."

Specifications that are in conflict with each other must be eliminated, and the remaining parameters prioritized, according to Walters.

"On legacy projects, the tendency is to use the abundance of resident knowledge to create an extensive list of specs," he says, noting that while it's important to learn from history, care must be taken not to let past experience stifle the design process: "Be leery of a 10-page specification after one week into a project."

Good designers, he notes, understand that development is not always linear, and that new problems will arise—creating a need for changes.

"In new product development, specifications are often best left flexible until initial research is done and initial concepts are developed," Walters says. "But at some point, the team needs to put a stake in the ground to allow the project to move forward."

Staying flexible will help keep projects from derailing over a minor obstacle. "Single-minded adherence to a spec sheet in a changing environment is a path to ruin," Harmon warns. "This is why tools that aid decision making and allow for rapid changes during the design process are so critical."

Using the Right Tools

According to Walters, using the appropriate software for each task helps a designer avoid bottlenecks and efficiently produce accurate, usable results.

"Design software is a tool to communicate intent and/or to prove out a solution before the start of creating any physical manifestation of the product," he says, noting that if the design software isn't integrated into the system and doesn't provide useful data downstream, then efficiencies are lost, design intent can suffer, decisions can slow and—perhaps worst of all—wrong decisions can occur.

"That's why it's important for design, engineering and manufacturing to have a coordinated set of software tools and well-trained people using them," he says. Installing software updates is also important, because obsolete software could lead to wasted time, incorrect designs and other mistakes: "Just like in the shop, it is dangerous to use a dull tool."

Jacobs says that designers who handle a variety of different assignments need to be familiar with an array of software tools, using each one for a specific type of work.

"Is it going to be machine design with tight tolerance?" he questions. "Or plant layout requiring many disciplines to share space? Is it 2D or 3D? Database or just simple graphics? Analysis required for strength or stress?"

Harmon agrees with the need for task-specific software. "Design software is a tool—use the right tool for the right job," he says. "You wouldn't use a screwdriver to pound a nail."

On the other hand, however, Harmon stresses that software is no substitute for solid experience. "I'd take a great designer/engineer with an average software tool over an average designer/engineer with a great tool," he says.

Physical prototypes help non-designers understand a product and suggest changes before it goes into production. *Image courtesy of 3D Systems.*

Managing Change

"It often seems as if the designer's primary responsibility is managing change," says Walters, who opines that designers can most effectively gain control over change management by building trust and communicating openly with fellow team members. "When change occurs—and it will—communicate with all team members who will be affected as early and often as possible."

Walters says that it's also helpful to develop alternative solutions, which will give project stakeholders options and allow them to participate in problem-solving exercises. "That way, you won't adopt a change that looks good on paper, but can't be executed on the manufacturing floor," he says.

Scott says a good designer manages change by setting expectations properly. "Having a can-do attitude is paramount when working alongside management, sales, marketing, production and so on," he adds, "But an engineer must always be careful not to make off-the-cuff estimates of time or cost that may have to be revised later."

Scott advises that engineers should strive to make accurate estimates and finish projects in less time than their estimates project. "If design specifications change, an engineer should try not to become frustrated—design is our job, after all," he says. But a designer should always be ready to explain, quickly and clearly, exactly how any changes will affect schedules and cost estimates.

"Trying to make design changes without affecting these things will almost always fail, and hurt the engineer's reputation in the long run," Scott says.

Solving Problems

Walters notes that an important step in problem-solving is correctly framing the issue in a way that creates the widest possible range of potential solutions.

"We like to use the phrase 'In what way might we…?' to help us do this," he says. "So rather than saying, 'The product fails in testing,' the opportunity becomes, 'In what way might we change the design to extend product life?'"

Intelligent problem-solving also includes a willingness to think creatively, and to be willing to search for solutions wherever they may exist.

"By looking outside your industry, you might find a material, technique or process that will help you leapfrog your competition," Walters says. Meanwhile, if a problem is truly vexing, or if team members disagree on the course of action, an outside facilitator can be brought in to help optimize the options and identify any underlying issues that may be creating the bottleneck.

In the case of an unexpected behavior that crops up in the testing phase, scientific reasoning can be used to find the answer. Scott recommends a four-step process:

1. Observe the behavior.
2. Form a hypothesis that explains the behavior.
3. Devise an experiment to test the hypothesis in a repeatable manner.
4. Perform the experience and record the results in detail.

"Analyze the data recorded and repeat the process again until the behavior is explained," Scott says. "At this point, suitable solutions can be devised and tested."

He warns that skipping any of the steps "will result in frustration, lost time and wasted effort."

Walters, meanwhile, has one final word of advice and reassurance: "No problem is so big that it can't be solved, especially if the team members trust and respect each other's skills and are committed to open communications throughout the process." DE

John Edwards *is a freelance writer based in Gilbert, AZ. Contact him via de-editors@deskeng.com.*

INFO → Optimation: Optimation.us

→ **RedFusionStudios:** RedFusionStudios.com

→ **3D Systems:** 3DSystems.com

→ **Z Corporation/3D Systems:** Zcorp.com

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1


2


3


4


1 Honeywell Load Cell Offers a Low Profile

Honeywell International's (measurementsensors.honeywell.com) Model 3140 Load Cell offers a low-profile design for both tension and compression applications. The welded carbon steel construction and stabilizing diaphragms provide the same ruggedness of its Model 41 and 43 pancake type load cells. It is available in ranges of 300 to 100,000 lbs., and mounting dimensions are universally interchangeable within the test and measurement industry.

New Piezoresistive Shock Accelerometers

Meggitt Sensing Systems (meggittsensingsystems.com) has introduced the Endevco model 7274 series, a family of undamped, high-g triaxial piezoresistive shock accelerometers, designed for high-acceleration shock measurements across three mutually perpendicular axes. The Endevco model 7274 series is the triaxial version of the company's single-axis 7270A series, sharing the same footprint, bolt pattern and sensing system. It's available in four ranges: 2,000g, 6,000g, 20,000g, and 60,000g.

New MEMS Capacitive Accelerometer Modules

Silicon Designs (silicondesigns.com) has introduced a ±5 g MEMs Capacitive Accelerometer Module to its 2011 2210 series. Designed to support a variety of lower frequency aerospace, automotive, defense, energy, industrial, and general test and measurement requirements, the low-noise, single-axis model 2210-005 accelerometer module incorporates MEMS capacitive sensing elements. Sensing elements are packaged within a compact, lightweight anodized epoxy sealed aluminum housing, occupying a total footprint of 1 sq. in.

2 NI CompactDAQ for Strain Measurements

National Instruments' (ni.com) CompactDAQ provides a portable and modular solution for strain measurements and more. The NI CompactDAQ platform offers up to eight strain channels per module and 64 channels per chassis. The chassis can stream data through USB, Ethernet, or wireless. An NI CompactDAQ system consists of a chassis, NI C Series I/O modules, and a Windows host computer connected over USB, Ethernet, or 802.11 Wi-Fi. More than 50 measurement-specific modules are available for 1-, 4-, and 8-slot NI CompactDAQ chassis.

Measure Force

FUTEK's (futek.com) FBB300 Force Sensor is designed for measuring force, surface pressure, and displacement. The company says the sensors are a cost effective and reliable OEM solution for high-volume applications. The FBB300 Force Sensor incorporates balancing, compensating and conductive elements into its strain gauge, which is laminated onto the 300-stainless steel flexure. The capacity ranges from 1 lb. to 40 lbs.

3 Store 1 Billion Measurements

Saelig (saelig.com) is distributing the MSR145 mini datalogger, which is now available with a slot for a removable microSD card that can hold up to 4GB of data. This increases the storage of the logger to 1 billion measurements, according to the company. The MSR145's SD card can be changed during on-going experiments for undertaking extremely long-term measurements. This allows users to evaluate the saved data at any time, whenever it may be necessary.

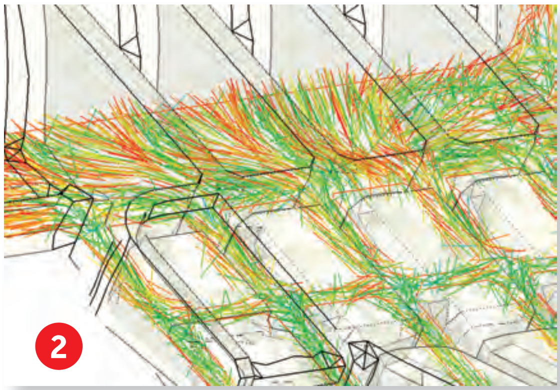
4 Test by Measuring Pushing and Pulling

Vernier Software & Technology's (vernier.com) Dual-Range Force Sensor is a general-purpose sensor for measuring pushing and pulling forces. Two ranges allow you to measure forces as small as 0.01 newtons and as large as 50 newtons. It can be used as a replacement for a hand-held spring scale, mounted horizontally on a dynamics cart to study collisions, mounted on a ring-stand to measure forces in a vertical direction or to collect data from two force sensors simultaneously.

Tools of the Month

New Products for Engineers

1



2

1 3D Systems Introduces Consumer 3D Printer

3D Systems (3Dsystems.com) has introduced its first consumer-targeted 3D printer, the Cube personal printer, that may also be of interest to some design engineers. The printer, priced at $1,299, is an "out of the box" printing system that the company displayed at the recent CES trade show in Las Vegas. It includes a tablet-like touch-screen interface, and weights less than 9lbs. The EZ Load cartridge can provide hours of 3D printing capabilities, according to the company, with a variety of colors and immediate access to 50 free printable creations. The Cube printer also comes with a membership to the company's Cubify.com site.

Kubotek USA Releases Comparison Suite

Kubotek USA (KubotekUSA.com) has released the Kubotek Comparison Suite, which includes the Kubotek Validation Server for automated validation of model translation; the Kubotek Validation Tool and a CAD validation quality tool to identify changes that have occurred in translations. It also includes ECO Manager, a CAD comparison system that automates the process of identifying, managing and communicating the impact of engineering changes throughout the extended enterprise; ECO Navigator to browse engineering changes and the ECO Inspector for automatically identifying and reviewing design changes.

2 CoreTech Releases Moldex3D R11

CoreTech (moldex3d.com) has announced the latest release of its Moldex3D R11.0 plastic design and analysis software for high-end injection molding simulations. The company has re-positioned Moldex3D R11.0 as four solution packages, including eDesign Basic, eDesign, Professional, and Advanced. The solution includes new tools that enable users to design various feeding and cooling systems depending on individual needs more easily. It also improves the quality of mesh generation, according to the company, which should help users better portray model features with complicated geometry and acquire more accurate simulation results.

Inspection Lifecycle Management Suite Released

PAS Technology (PASTechnology.com) has released the PAS Inspection Lifecycle Management Suite, which allows manufacturers to establish an automated

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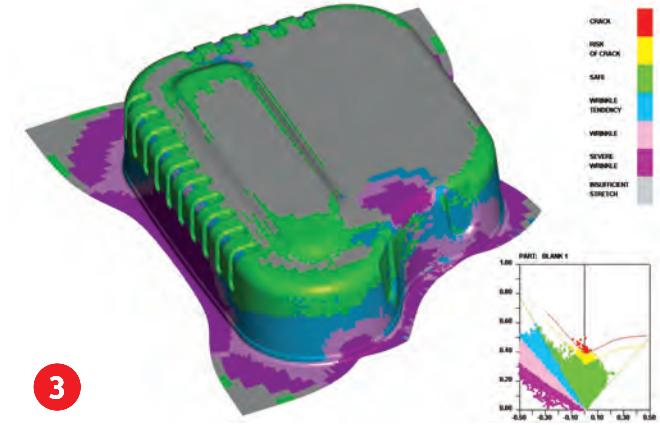
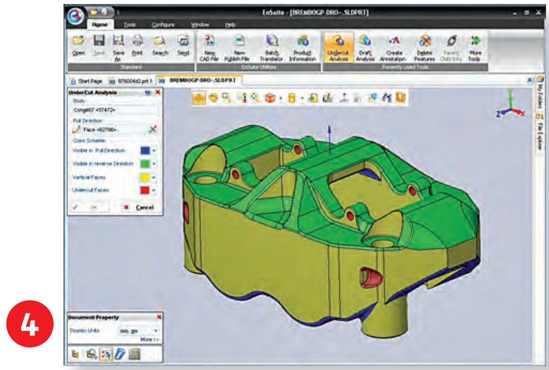




inspection process from a CAD model. According to the company, the PAS Technology Inspection Lifecycle Management (ILM) Suite automates the inspection process, and eliminates the need for data translation throughout the process. Users can generate inspection plans directly on-model and output inspection results to FAI-compliant or other forms.

ESI Group Updates VA One Simulation Tool

ESI Group (ESI-group.com) has announced the latest release of VA One, its solution for simulating noise and vibration across the full frequency range, which combines finite elements, boundary elements, and statistical energy analysis (SEA) in a single model. The new release includes performance and productivity improvements, along with new functionality for full spectrum modeling of acoustic ducts.

3 New Version of DYNAFORM

Engineering Technology Associates (eta.com) has announced Version 5.8.1 of its DYNAFORM die system simulation solution. The FEA software solution guides the engineer through a range of stages in the manufacturing process, from cost estimation and die face design to formability analysis and stamping process simulation. DYNAFORM's new Die Face Engineering (DFE) module offers the capacity to parametrically build die faces for a symmetrical part. After the user defines the symmetry line, the program can automatically build the die faces for the other half of the symmetrical part accordingly.

Design Your Own Custom Transducer Online

Omega (Omega.com) has introduced a new line of 316L SS Micro-Machined Silicon Pressure Transducers, the MM Series. The company has developed a custom delivery system that allows fast delivery of this transducer series, typically stock to 1-week. An online product configurator offers custom designs, which allow the user to select specific features for the MM Series including the accuracy range, pressure fitting, output, temperature range and thermal accuracy.

Altair Engineering Opens Data Center for HyperWorks

Altair Engineering Inc. (altair.com) has announced the opening of a high-powered data center in Troy, MI, to house and manage its growing HyperWorks On-Demand cloud-based computer-aided engineering (CAE) solution for customers who rely on high-performance computing. HyperWorks On-Demand (HWOD) is a high-performance computing (HPC) solution for design in the cloud.

4 CCE Updates Ensuite 2012

CCE (cadcam-e.com) has announced the release of EnSuite 2012 with support for the latest versions of NX, SolidWorks and Parasolid files. The new release enhances the Viewers and Translators in EnSuite to support NX8, SolidWorks 2012 and Parasolid 24 version files without requiring a license of the respective CAD systems. CATIA V5 R21 support was added in the previous release. EnSuite was designed to provide quick access to critical engineering information residing in CAD data.

EPLAN Releases Latest Version of CAE Software

EPLAN (eplanusa.com), a computer aided engineering solution, includes a central database that enables designers to provide additional automation. This database can hold a large archive of recurrent content, ready for insertion into a project. Engineers can convert project documentation into different languages or regional, national and international standards. Storing and reusing data opens the way to standardizing and modularizing product content, according to the company.

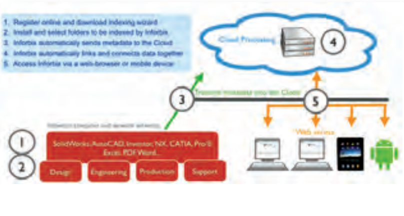
LMS Releases LMS Imagine. Lab AMESim Rev11

LMS International (lmsintl.com) has announced the Rev11 release of its LMS Imagine.Lab AMESim product for system simulation. For the automotive market, Rev 11 strengthens LMS Imagine. Lab AMESim transmission applications, with new Dual Mass Flywheel components and a larger suit of vehicle models, including cars, motorbikes, buses, trucks, tanks and trailers. Progress has also been made in the engine domain, with the new Model Test Bench for effective engine characterization, modeling and comparison/validation against test data, and combustion fitting tools for combustion model calibration. DE

Editor's Picks

by Anthony J. Lockwood

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



Cloud Product Data Solution Supports Manufacturing

Data applications help manufacturers find, re-use, and share product data.

There are three key reasons why Inforbix is a must-know. One, Inforbix is designed to help engineers, project managers, and your full product development team find, re-use, and share product data from disparate sources and file types quickly and easily. Not just a Google dump of finds, but connected and intelligently presented results. Two, it "understands" manufacturing data—CAD files, BOMs, assemblies, office docs, etc. Three, cloud-based means everyone can access it from everywhere and your IT burdens are less in terms of maintaining software and adding more storage and all that.

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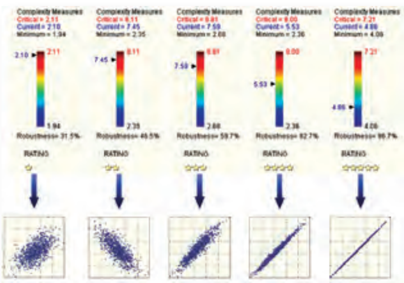

Ontonix Launches Design for Resilience Engineering Portal

Web-based service allows engineers to measure complexity of systems.

Ontonix—the outfit out of Italy that develops the OntoSpace system for measuring and managing complexity—has launched the Design for Resilience (D4R) engineering portal. It seems inexpensive. It looks and sounds impressive.

Now, the basic idea with D4R is simple: One, make complexity a design attribute similar to things like stress or frequency. Two, make complexity analysis and mitigation an early and often tool in your design cycle. It seems like what Ontonix is talking about here is complexity-based CAD extending simulation-based design to make products, processes, and systems more robust.

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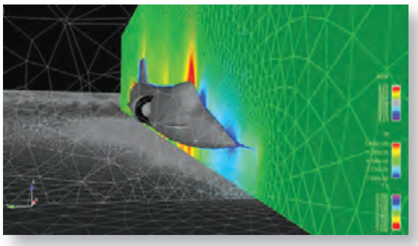

Geomagic Releases Geomagic Studio 2012

Software to transform scan and probe data for CAD use adds SpaceClaim integration.

Geomagic just released the 2012 version of its line of 3D reverse engineeering and inspection software. And it sounds like a great new version.

First though, we're going to focus on Geomagic Studio, the company's core 3D creation tool. But you'll find links to the 2012 versions of Geomagic Wrap for transforming point cloud data into 3D polygonal meshes, Geomagic Qualify for 3D inspection, and Geomagic Qualify Probe 3D inspection software for quality assurance engineers at the end of today's Pick of the Week write-up. You need to know about them too.

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AMD FirePro V4900 Handles CAD and DCC

New graphics card said to provide improved CAD performance and speed.

AMD's new FirePro V4900 graphics card is an entry-level card in the AMD pantheon of graphic accelerators for engineering professionals. Still—get this—AMD says that it provides more than double the performance of competitive offerings in many CAD and DCC application tests like SPECviewperf that *DE's* David Cohn beats on when reviewing workstations. In other words, it has the oomph to handle your medium to large models.

The FirePro V4900 uses AMD's advanced graphics technologies like AutoDetect for optimizing performance for multi-application workflows. And it also has AMD Eyefinity technology for panning across multiple displays.

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The Future Will Be Simulated

The effect of expanding computer power is that we will do more simulations. If you are not using simulation in your work today, perhaps you should add simulations to your solution mix.

Increased simulations enable us to continue to advance our abilities to integrate real data into models, to run more sophisticated models on that data and finally, to do deeper analysis of the validity of those models. Simulations will change the world more than most human endeavors; computer simulation has replaced physical laboratories as the most significant source of new discovery.

High-performance computing (HPC) offers a changing range of compute power, because yesterday's supercomputer is today's workstation or desktop supercomputer, which will be tomorrow's game console or cell phone.

In one recounting of the history of computing, we can summarize that "Problem A inspires the building of Computer A. Computer A can do much more and inspires the attempt to solve Problem B. Problem B strains Computer A and inspires the building of Computer B. However, Computer B can do much more …" In this explanation of computing history, it is evident that the way we solve problems evolves continually. In this world, the question "For what do we need all this computer power?" will always get an answer.

Parallelism is taking hold in every niche of computing.

Another way to think of it might be "computers are like electricity." Electricity was a discovery that saw rapid development and deployment with only a small set of uses. Electricity became available widely to solve known problems. Then more problems were invented, which required more electricity. It is hard to imagine what early electric pioneers would think of hydroelectric dams, arc furnaces, iPhones or remote control of exploration vehicles setting on the surface of other planets. I think it is safe to say they were not building their early electric generators with those problems in mind.

Personally, I'm drawn to considering the explosion of computing that is upon us now, and the profound effect it will have on many areas, especially simulation.

Parallelism's Role

For decades, the general trend in computing is that machines increase in performance about 40% per year. It is more common, and equivalent, to simply say that performance doubles about every two years. There is a notable exception to this: the HPC field has a strong history of increasing at 80% per year.

This faster pace is fueled by use of parallelism: parallel hardware and parallel programming to utilize it. With the emergence of multicore processors over the past six years, parallelism is taking hold in every niche of computing. It is highly significant, because it continues our version of computing history where computers just keep getting more powerful—and inspiring computing problems to reciprocate.

Desktop workstation computers, with more than 100 general-purpose x86 cores, will be very common and affordable within the next year. And honestly, I doubt any of us can understand quite what changes this will make.

Key Growth Area: Simulations

Simulations wrestle with at least three challenges:

1. Integrating real data into simulations. Weather prediction is one such area where the timely integration of real-world data is paramount to forecasting the weather instead of verifying it retroactively.

2. Running complex-enough models to do justice to solving the problem. Finer grained models, running competing models, or having more sophisticated equations are all considerations in how to refine and improve models. Models may be fully empirical, or rely on Monte Carlo method, or a hybrid. Simulations may even run both, or more than two methods and select the best. The more simulations we can run, the more we will run.

3. Verifying the validity of the models and their results. In many ways, this is the least-advanced area of simulation. There are enormous opportunities to do deeper analysis of simulation results, but the biggest opportunities lie in being able to compare multiple simulations (after all, we will be running more of them), and to look at more feedback from analysis into the models to refine and guide them.

The effect of advances in computer power on simulations is clearly more simulations—lots more. And more simulations will help us advance our abilities to integrate real data into models, run more sophisticated models, and dig deeper in our analysis of results from models.

I predict that the decade ahead will add a great deal of fuel that is driving simulations, and should prove to be the greatest decade of simulation results in our history. **DE**

James Reinders *is a senior engineer and director at Intel, based in Hillsboro, OR. Contact him via de-editors@deskeng.com.*

Cool Tools

Panasonic Toughpad A1 Tablet

Rugged Design

1 Both the 10-in. A1 and the forthcoming 7-in. B1 Toughpads are Android-based tablet computers designed for harsh environments. The devices have MIL-STD-810G ratings, including 4-ft. drop testing and IP65 protection against water and dust. The Toughpad A1 is also rated for operational use in temperatures from 14° to 122°F. The display is made of a heat-treated hardened glass designed for high impacts, and the edges of the tablet are protected by an elastomer to shield both the touch screen and the LCD inside the device.

Hardware Options

2 The Toughpad A1 has a 10.1-in. XGA capacitive, multi-touch, daylight-viewable screen, as well as a stylus and active digitizer. The magnetic tip in the stylus activates the WACOM digitizer when it touches the screen and deactivates the multi-touch for digital signature capture and handwriting. Other features include integrated cameras, a serviceable battery, multiple options for peripheral connectivity and battery life that Panasonic says will accommodate a full day of work. The company promises to offer a full set of accessories to support the Toughpad line, including cases, mounts, printers, keyboards, magnetic stripe readers, smart card readers and multi-unit storage and charging solutions.

Security Features

3 The Toughpad A1 incorporates security embedded at the hardware level and offer technologies like hardware and software encryption, enhanced VPN, dual factor authentication, trusted boot and device management. This enhanced level of device security means the Toughpad A1 will be compliant with FIPS 140-2 for Federal government use and HIPAA ready for healthcare environments, according to the company.

The Toughpad family can be managed with a custom set of low level controls that provide IT managers to distribute applications in a one-to-many environment and secure devices from unauthorized use

Customized for Business

4 In addition to having access to the existing selection of Android Market applications, the Toughpad is supported by the Business AppPortal, an enterprise-focused app store.

➜ DO YOU HAVE A COOL TOOL? *Desktop Engineering* editors are always on the hunt for great tools to share with our readers. Send us your ideas at de-editors@deskeng.com.

TECH SPECS

- Operating System: Android 3.2 (Honeycomb)
- Processor: Marvell 1.2GHz dual-core
- Storage: 16GB and an optional MicroSD up to 32GB
- RAM: 1GB LP-DDR2
- Display: 500 nit, daylight readable, 10.1-in. XGA (4:3), capacitive multi-touch with anti-reflective and anti-glare treatment and built in ambient light sensor
- Battery Life: 10 hours (serviceable battery)
- Weight 2.13 lbs. (without pen)
- Inputs: Micro-USB, microSDHC, micro HDMI
- Camera: 5MP rear, 2MP front
- Connectivity: 4G (LTE or WiMAX), 802.11 a/b/g/n, Wi-Fi Hotspot, Bluetooth v2.1 + EDR, Satellite GPS
- Dimensions: 10.5 x 8.3 x 0.67 in.

The Toughpad A1 will be available in the spring of 2012 starting at $1,299. The Toughpad B1 will be released later in 2012.

For more information, visit Panasonic-Toughpad.com


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