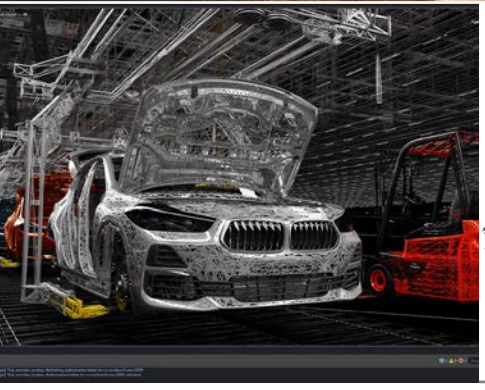
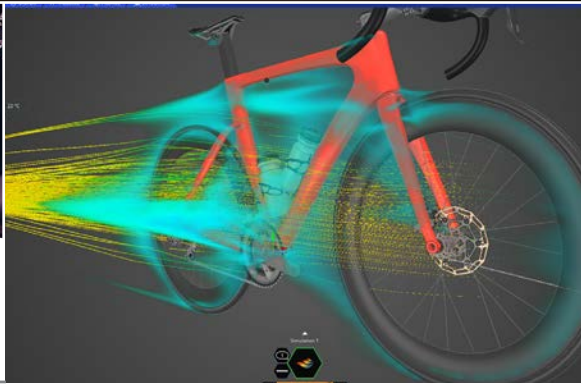
SPECIAL DIGITAL ISSUE

ACCELERATED DESIGN INNOVATION







Advanced PRODUCT DEVELOPMENT Resource Center

DE247 Digital Engineering

NVIDIA

DELL Technologies

Contents

Welcome

Advanced Design

The Advanced Product Development Resource Center (APDRC) is an ever-growing repository of information to help design engineering teams capitalize on the use of today's most advanced computing, design, simulation and visualization technologies. Produced in partnership with Dell and NVIDIA, the APDRC highlights how these technologies can be applied across the design cycle.

The APDRC is built around the five stages of the product development cycle: Conceptual Design, Detailed Design, Simulation & Analysis, Visualization, Computer-Aided Manufacturing (CAM).

The articles in this digital edition were selected to help guide you through the process of optimizing your workflow for specific design engineering tasks. By configuring your computing hardware to match the engineering design software you use, you can boost productivity and focus on innovation.

Visit the resource center at APDRC.com for the latest developments on technological advances, videos, white papers and more from DE, Dell and NVIDIA. We hope you enjoy the digital issue.

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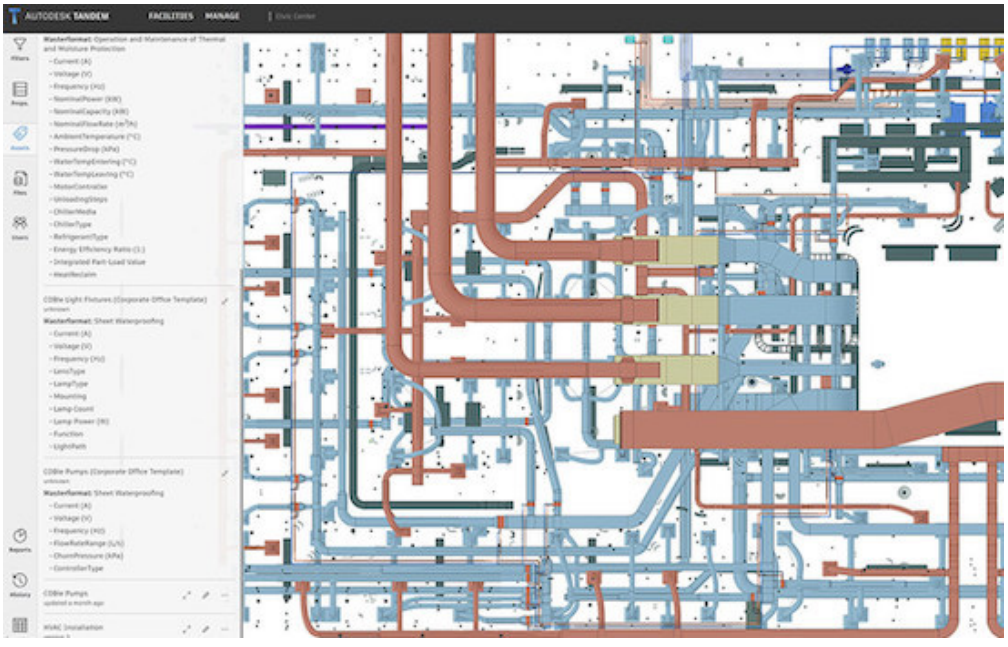
Digital Twins Evolve **in Manufacturing**

Simulation, modeling, visualization and sensor-based data converge to close the design-to-manufacture loop.

In the most recent *Digital Engineering* Technology While digital twin technology is still in the nascent stages of adoption, more and more manufacturing companies are launching programs to create and/or access virtual representations of the products, machines, and environments they design, manufacture or operate.

The convergence of advanced modeling and simulation, along with the explosion of network-connected devices and sensors in the real world, is accelerating this process. Deploying digital twins at scale remains a challenge, and organizations will need to be able to create and work with digital twins developed using a wide variety of tools, and do so in a way that enables virtual collaboration.

For organizations that want to incorporate digital twin technologies into their design, engineering, and manufacturing workflows, a number of organizational and cultural changes will be necessary to manage the collection and usage of digital twin data. The transition will also require new, interoperable software and hardware technologies that can accommodate those solutions.



Autodesk Tandem is a cloud-based digital twin platform.
Image courtesy of Autodesk

The NVIDIA Omniverse platform has emerged as a way to provide the digital fabric necessary to build and collaborate using digital twins in both the manufacturing and architectural space. BMW Group, for example, is leveraging Omniverse for its factory of the future project.

"At NVIDIA we believe that a digital twin creates a fully simulated and shared world in a virtual space," says Mike Geyer, Product Manager at NVIDIA. "It requires closed loop collaboration, and NVIDIA is really focused on being the company that closes that loop."

Jerry Chen, Director of Global Business Development, Manufacturing & Industrials at NVIDIA, adds that a digital twin rests on three elements: original design intent (e.g. CAD), the ability to simulate the behavior of a system (e.g. CAE), and finally grounding these physics-based models with data-driven models created from sensor data captured from physical systems in the real world.

"A true twin takes all of those things into account," Chen says. "The world needs to be able to condition the physics-based models we have typically relied on with the reality being captured by sensors in the field. Omniverse is a vehicle to fuse the data-driven and physics-based models together."

Todd Edmunds, global CTO and strategic innovation/technology leader at Dell Technologies, says that Dell has both an internal and external digital twin initiative in place across its business units. The company is focusing on six areas, including creating a true foundational reference architecture for digital twins; securing digital twins across the network; creating global alliances with ISVs/GSIs and partners like NVIDIA to create an open infrastructure approach; developing new hardware and infrastructure products to support digital twin implementations; managing patents and intellectual property in a digital twin environment; and helping customers understand how they can benefit from the use of digital twins.

Edmunds says that there is a broad misunderstanding of what a digital twin is. "This is not just a digital image or a simulation of something," Edmunds says. "It is not just a digital model, but one that represents that item in real time in the real world. You have to have real-time updating and synchronization as well as interoperability. If you have digital twins for different entities, how do they interface? You also need to be able to do simulations with those 3D models in real time, and visualize and consume the models in other applications."

To that end, Dell has partnered with NVIDIA to leverage the Omniverse platform for connecting and exploring a variety of digital twins.

The NVIDIA Omniverse Platform provides a new type of digital fabric. *Image courtesy of NVIDIA*

On the hardware front, Dell is creating new edge compute platforms, workstations, connectivity capabilities, high-performance computing (HPC) offerings, and hyperconverged infrastructure solutions that can support every aspect of digital twin implementation across the globe. For example, individual engineers will require high-performance workstations that include GPU-based acceleration in order to model and visualize those twins in real-time.

"As we add in some of the extra analytics and modeling, we will also need other types of acceleration," he adds. "Not just GPUs but advanced accelerators made specifically for AI."

Software solutions are emerging in the architecture, engineering and construction (AEC) space, as well as in manufacturing. In the manufacturing market, design and simulation software providers like Ansys, Siemens Digital Industries Software, PTC, and others have emerged in the engineering space. All of these companies have heavily leveraged NVIDIA GPU acceleration in their simulation, design and visualization tools.

In July 2021, Autodesk officially announced its cloud-based digital twin platform, Autodesk Tandem, for engineering and construction applications. Autodesk Tandem can gather all the information about a building, systems and equipment in both tabular and 3D representations. Building operators and facilities managers can then find the information they're looking for when responding to operational issues to keep proper maintenance. According to the company, Digital twins created in Autodesk Tandem are designed to improve operational efficiency and enable predictive maintenance to prevent disruptions and reduce operating costs.

In 2020, Autodesk also announced it was partnering with NVIDIA to leverage its Omniverse platform for collaborative design visualization. This was one of a number of partnerships that NVIDIA has formed to allow solutions vendors to integrate with Omniverse. Bentley Systems, for example, is using Omniverse to create a suite of applications on its digital iTwin platform. This would provide a graphics and compute pipeline for real-time visualization and simulation of infrastructure digital twins. Omniverse provides an open platform for working with models and data generated by a wide array of tools.

"Part of the challenge of digital twins is that someone creates a physical item, and they may use one application, and then that model has to be incorporated into different models from different vendors," Edmunds says. "Having a platform that can simplify that and handle multiple different vendors with different CAD systems, and different models, and having a standardized way of representing those pieces, that is going to be really important. The company who makes the physical item is not going to be the same company operating it or even the same one who is providing real time information back into updating that 3D model."

That is where the NVIDIA Omniverse comes in -- by providing a physically-accurate, virtual space where models and data can be accessed regardless of origin. NVIDIA GPU acceleration helps drive these interactions through real-time visualization, simulation, machine learning and analysis.

Edge computing will also play a role in expanding digital twin applications, as connected devices will need more computing horsepower to manage and communicate data in real-time. Edmunds says that these edge platforms are evolving to include GPUs, AI chips, and other processing platforms. "As the definition of what is required in manufacturing changes, you will need more high-performance compute on the machine, and that may even include a bank of GPUs. Applications will need to leverage those GPUs as part of an elastic pool of compute on the factory floor."

For example, an employee wearing AR or VR glasses could tap into those resources to troubleshoot machinery in real time.

According to Geyer at NVIDIA, a core philosophy of Omniverse is to help provide a neutral platform in which these use cases can emerge, because data can come from any source. We want to be complementary to existing tools. If we can facilitate a conversation between those tools and AIs using a common language like USD, that will solve a lot of problems for the industry. DE

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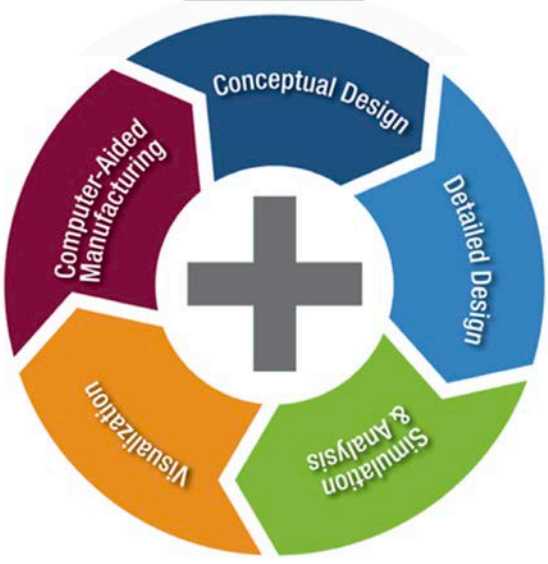

Produced in partnership with Dell and NVIDIA, the Advanced Product Development Resource Center is an ever-growing repository of information to help design engineering teams capitalize on digital distribution through the use of today's most advanced computing, design, simulation and visualization technologies.

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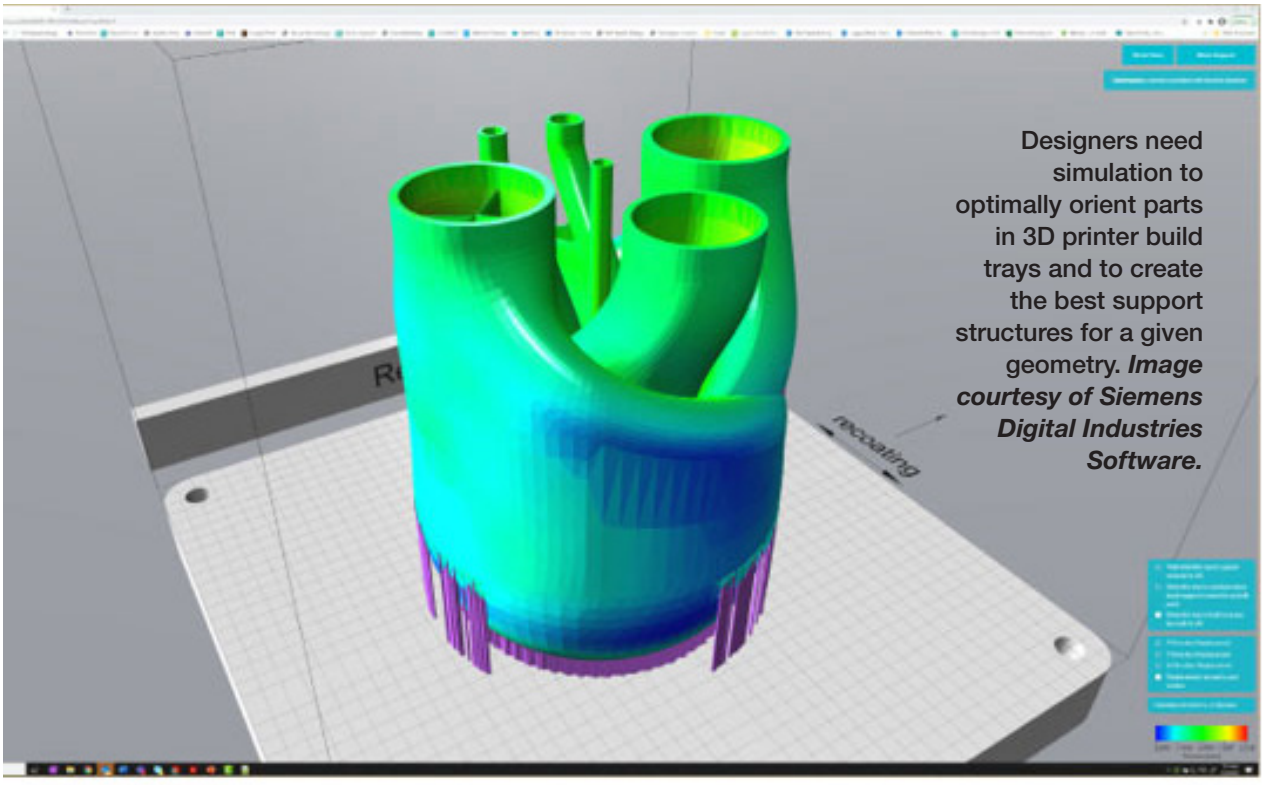

Designers need simulation to optimally orient parts in 3D printer build trays and to create the best support structures for a given geometry. ***Image courtesy of Siemens Digital Industries Software.***

Simulation Improves **3D Print Quality**

New simulation and optimization tools (leveraging GPU acceleration) are improving 3D printing performance and predictability.

With companies moving beyond prototyping into production-scale 3D printing use cases, there is growing emphasis on the need to print the part correctly the first time without wholesale reliance on institutional knowledge and free from the costly trial-and-error.

The need to get a part right the first time it's printed has sparked interest in a new class of simulation software designed for additive manufacturing (AM). These solutions range from tools that optimize build plate layout and support placement to more sophisticated capabilities such as design identification and recalibration in the virtual world to address part deformation before the print runs. To do this, a primary focus must be on robust simulation capabilities.

Simulation can improve performance and save money. "Build failures are extremely common—there could be upwards of 10 failures on production-scale parts, which run into costs of tens of thousands of dollars," says Erik Denlinger, principal researcher on AM simulation at Autodesk. "The ability to provide insight into if and how a part might fail is extremely valuable."

Designing for AM requires engineers to take into consideration such factors as residual stress from heating

and cooling of each print layer; the placement of support structures and their effect on warping and post-processing; topology optimization; and the effect of print orientation on build time, strength and surface finish.

With 3D print simulation, companies can avoid warping, deformation and other issues that can result in costly waste and failed 3D prints. Leveraging the power of professional engineering workstations, such as the Dell Precision family of desktop and mobile computers, and high-performance NVIDIA RTX GPUs, these tools make it possible to incorporate generative design and topology optimization, as well as simulation of the entire additive workflow.

3D print quality can vary significantly, even when creating the same geometry on the same printer, just by using different support structures or a different part orientation. 3D printer companies are working to address these issues via their own tools and through partnerships with existing simulation software vendors.

Stratasys has a long-standing partnership with MSC Software, part of the Hexagon Group, to collaborate on AM material and process modeling. The company is working with MSC's e-Xstream Engineering group to create tighter integration between its platforms and Digimat, a multi-scale material and structure modeling platform that can predict behavior for a large mix of composite materials. Simufact Additive, also from Hexagon, focuses on predicting distortion and automated distortion compensation for metal binder jetting sintering technology.

3D Systems, meanwhile, has been developing AM-specific simulation capabilities as part of its 3DXpert AM software. In addition to the ability to position and modify part orientation, optimize structures with lattice, and infill features and analyze design supports, 3Dxpert has simulation capabilities for predicting issues that might result in build failure or printer damage.

The company recently expanded its simulation capabilities with the acquisition of Additive Works. The German company focuses on simulation-based optimization and automation of the AM print preparation and workflow. Additive Works' software allows a manufacturing engineer to rapidly determine optimum print setup, such as part orientation and support structures, as well as directly adapt the process setup for effective thermal management and distortion compensation, 3D Systems says.

GPU Acceleration

Because AM simulation is often computationally intensive, many software providers are leveraging GPUs to provide faster and more accurate results.

For example, the Digimat FFT solver discussed above takes advantage of NVIDIA CUDA libraries for GPU-accelerated computations. The third major update of nTopology, for example, introduced GPU acceleration for seamless interactivity. This gives nTop users a performance boost when visualizing workflows that use complex field-driven geometry. Users can preview design changes in real time and regenerate parts with complex geometry in seconds. The company recommends the NVIDIA Quadro™ P2200 GPU or the NVIDIA Quadro RTX™ 5000 GPU for high-performance scenarios.

Dyndrite offers the Dyndrite Additive Toolkit for improving 3D printing workflows. The toolkit directly imports CAD design files and uses the data to drive additive manufacturing processes. The fully native GPU Kernel handles additive-specific computations and is naturally scalable with access to additional GPU nodes, both locally and in the cloud. The company developed the kernel using the NVIDIA Quadro RTX™ 6000. (You can learn more via this recent NVIDIA GTC session.)

The Live Sinter software from Desktop Metal also leverages the GPU to simulate the deformation of parts during sintering. Sintering can cause parts to shrink by as much as 20%, and improperly supported parts risk deformation, cracking and distortion. Live Sinter helps reduce the need for supports and improves adherence to dimensional tolerances. The product runs on an NVIDIA GPU-based multiphysics engine. (The Desktop Metal Live Parts generative design platform also leverages GPU acceleration.)

e-Xstream engineering (as noted above, part of Hexagon's Manufacturing Intelligence division) also leverages the GPU for additive manufacturing simulation. The latest Digimat software enables businesses to simulate the 3D printing process and calculate the total cost of producing each part including the material use, employee time, energy and required post-processing steps.

Manufacturers can CT scan a part and import the 3D RAW image to build a finite element model of its two-phase microstructure (e.g., carbon fiber-reinforced polymer) in Digimat and model its behavior. By embedding this validated material model in its CAE tools, a design engineer can perform analyses that account for variations within a manufactured part to reduce material use or avoid points of failure.

When refining new manufacturing processes, users can capture information about the part, material, 3D printer or process used and their physical tests as they work using material lifecycle management. The company's Material-Center software captures a traceable, validated database of trusted material properties so that they can be used in the

design phase of a product.

Leveraging the GPU, these solutions allow engineers to perform these tasks interactively and generate results in minutes. Benchmarks show the time required to analyze the stiffness of a material is reduced by 98%. This rapid solve time, combined with the introduction of a command line interface, also enables the use of Digimat finite element models within automated cloud-based optimization workflows on high-performance computing platforms.

A Plethora of Simulation Tools

Other emerging simulation tools take a variety of different approaches. Autodesk, for example, offers multi-scale modeling methodologies as part of its Netfabb AM suite and simulation extensions for the Fusion 360 software. The technique breaks the process into two pieces: the small-scale simulation (1x1 mm, for instance) at high resolution at the part and material level, followed by applying those results to the rest of the build volume as a way to circumvent the computational expense,

The Materialise Process Tuner is an online platform the company says will "help manufacturing companies, service bureaus and machine builders speed up the process tuning required for mass-manufacturing 3D printed parts. This allows them to reduce the cost and waste associated with printing hundreds of test samples before finding the optimal process parameters."

Process Tuner uses automation and simulation to predict sub-optimal prints.

Teton Simulation Software has launched its Smart Slice for Ultimaker Essentials simulation tool for optimizing 3D printer performance. Initially, the product was launched in Ultimaker's Cura Essentials Marketplace.

Smart Slice uses FEA analysis within the slicing environment to automatically provide optimal strengthening settings for a given print, eliminating the need to iteratively test actual prints. The tool validates a print configuration in advance, adjusts the slicing parameters that can influence part strength, and then provides that data so the final print can be completed.

The underlying philosophy for Siemens Digital Industries Software is that simulation tools will play an upfront role in determining how to orient a part in a printer for the least amount of distortion and predict the microstructure and macrostructure behavior of parts to direct material deposit or identify gaps and overheating areas on the build plate. Simulation also can be tapped to predict material properties from the manufacturing process applied or to map out and plan AM factories.

Siemens offers NX Build Optimizer for orienting parts and NX Path Optimizer, technology for powder bed fusion parts that combines physics-based simulation and machine learning. The Simcenter3D simulation portfolio offers various capabilities, including process capabilities for predicting and addressing distortion of metal parts and multi-scale modeling capabilities for predicting failure in advanced materials. Siemens is also partnering with a range of AM printer providers, including EOS and Evolve, to optimize its simulation tools for specific platforms and AM technologies.

EOS and Ansys are collaborating to provide an enhanced, streamlined workflow for developing AM parts. The new workflow teams EOS' metal systems for additive manufacturing with Ansys simulation solutions. This integration will help improve part geometries by predicting and compensating for distortion and other issues to reduce build failure and upgrade manufacturing processes to increase productivity. It will also improve material property selection by forecasting how design changes will affect the microstructure of parts.

While these new simulation tools can improve 3D printing outcomes, the software must be integrated into engineering workflows. Users will need to be educated on the potential benefits, companies will need to make the software more accessible to a range of potential users, and there will need to be a greater integration between the design and manufacturing functions. In addition, the engineers responsible for these processes should be equipped with suitably configured workstations in order to take full advantage of these new software tools. Dell Precision workstations (including both tower and mobile workstations) and professional NVIDIA GPUs allow engineers to optimize the performance of these 3D print simulation tools.

"Design simulation experts lock down performance in CAD, but with AM, it's not locked down until you define the steps of manufacturing," says James Berlin, senior software product manager, manufacturing and alliances, at Stratasys. "There's work to be done reconciling redistributed responsibilities between someone designing parts and someone manufacturing parts. Simulation needs to bridge that gap and take into account the intent of both areas." DE

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SIGGRAPH: Omniverse Expansion

NVIDIA is building the capabilities of its Omniverse collaboration platform in ways that will benefit engineering.

Omniverse provides a connected environment for creators. *Image courtesy of NVIDIA.*

At SIGGRAPH this week, NVIDIA unveiled significant expansions for its Omniverse simulation and collaboration platform. Chief among them are expanded partnerships with both Blender and Adobe that will expand the platform's reach to new users, as well as new capabilities that will improve users ability to render complex surfaces and quickly add objects and models to scenes.

"Design is a complex team sport," said Richard Kerris, vice president of the Omniverse development r platform at NVIDIA. "There are large teams involved with a broad range of skills, and their software does not seamlessly work together. The world of 3D is growing, software challenges are getting harder to solve, and teams are more dispersed than ever before. We are addressing the idea that there are multiple software products at remote locations, the projects are getting bigger, and the data gravity is getting larger. How do you manage a single source of truth?"

Omniverse provides a connected environment where creators can collaborate without the hassle of importing and exporting disparate file types. At SIGGRAPH, NVIDIA announced a number of enhancements that will further expand those collaborative capabilities.

Blender, the popular open-source 3D animation tool, will now have Universal Scene Description (USD) support, enabling artists to access Omniverse production pipelines. Adobe is collaborating with NVIDIA on a Substance 3D plugin that will bring Substance Material support to Omniverse, which the company says will unlock new material editing capabilities for Omniverse and Substance 3D users.

Pixar's open-source USD serves as the foundation for Omniverse. Apple, Pixar and NVIDIA have collaborated to bring advanced physics capabilities to USD, and Blender and NVIDIA have collaborated to provide USD support to the upcoming release of Blender 3.0. NVIDIA is also contributing USD and materials support in Blender 3.0 alpha USD, which will be available soon for creators.

"NVIDIA's engineering efforts on integrating USD into Blender is exemplary for how the industry contributes to open source," said Ton Roosendaal, chairman of the Blender Foundation. "Thanks to USD, Blender artists can have high-quality access to studio pipelines and collaboration platforms such as Omniverse."

Thanks to the Adobe partnership, Omniverse users will be able to work directly with Substance Materials either sourced from the Substance 3D Asset platform or created in Substance 3D applications, creating a more seamless 3D workflow.

"Adobe is dedicated to an open and connected community of 3D designers," said Sebastien Deguy, vice president of 3D and Immersive at Adobe. "As an industry standard, Substance will strengthen the Omniverse ecosystem by empowering 3D creators with access to Substance 3D materials."

Kerris also described the new OmniSurface Material Shader, a physically-based Uber Material Shader for rendering complex surfaces that is supported by the Omniverse RTX Renderer. This feature can provide detailed imperfections (for example, blemishes, pores and hairs in a rendering of human skin) that provide a more realistic rendering of these types of surfaces.

NVIDIA also announced that the NVIDIA AI Image2Mesh GAN, GANverse3D, is now available as an extension of Omniverse Create. This allows users to instantly create a 3D mesh from a 2D image of cars. The feature is available in open beta for Omniverse users. GANverse3D-Image2Car Extensioncurrently has been trained to allow users to quickly turn 2D images of cars into 3D models that can be placed in virtual Omniverse constructs. In the future, the network will be trained to quickly convert any type of 2D image to 3D for placement. For example, engineers could use the tool to add parts or machines to a product or factory simulation.

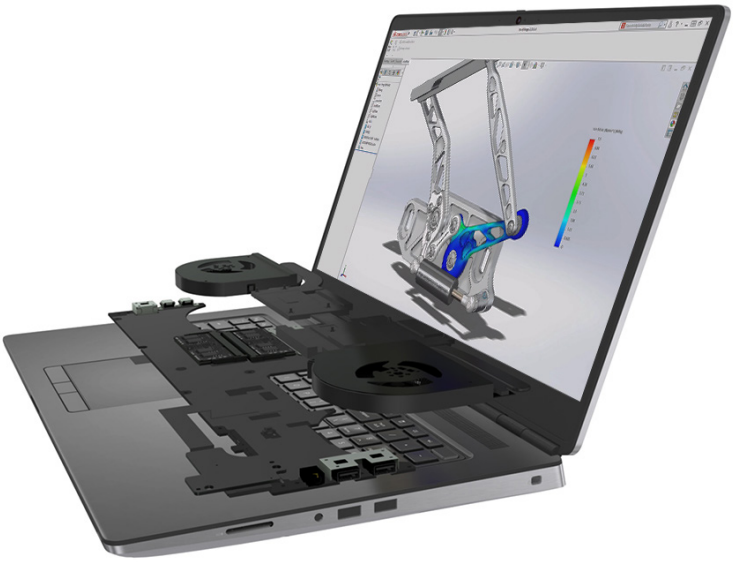
New NVIDIA RTX Graphics

During SIGGRAPH, NVIDIA also announced the NVIDIA RTX A2000, an mid-range , low-profile GPU for desktop workstations based on the NVIDIA Ampere architecture. "Workers everywhere need to connect, collaborate and communicate seamlessly," said NVIDIA VP Bob Pette in a pre-conference press briefing. "They are working together to simulate entire products, buildings and even cities to innovate, reduce risk and produce better products." The NVIDIA RTX A2000 "brings RTX down to the mainstream segment with a low-profile design, all for around $450."

Blender users can now access the NVIDIA Omniverse platform.
Image courtesy of NVIDIA.

This opens up the RTX platform for more designers that are increasingly being tasked with shifting from 2D design to 3D operations, and who need to work with simulation and and require real-time ray tracing. Compared to the previous model, the NVIDIA RTX A2000 provides 50% faster remodeling, 5X rendering times, and twice the simulation performance. One customer, Cuhaci & Peterson, reported that rendering times went from several hours down to minutes.

NVIDIA announced limited early access for Omniverse Enterprise earlier this year. You can learn more about Omniverse Enterprise here. DE



and GoEngineer
making it easier
o select the right
workstation
ge courtesy of Dell
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Workstation Selection: No More Guesswork

GoEngineer and Dell have partnered to streamline workstation selection for SOLIDWORKS users.

When it comes to getting optimal performance out of design and simulation software, workstation selection can increasingly make a big difference—advancements in CPU and GPU power can accelerate design tasks, complex simulations, and high-resolution renderings. But the hardware and software tools should be well matched, and most end users do not know what solutions can benefit from higher core counts in the CPU, GPU acceleration, more RAM, and other features.

Adam Hughes, Senior Application Engineer at GoEngineer (a SOLIDWORKS value-added reseller with locations across the U.S.) says that customers often have questions about what hardware to use. "It is not uncommon for customers to want guided assistance in selecting a computer," he says. However, GoEngineer is not in the hardware business, so the VAR wanted to find a way to help guide clients to the right workstation for their SOLIDWORKS deployments.

In partnership with Dell, GoEngineer has created a portal that allows customers to quickly evaluate Dell Precision workstations that are preconfigured for use with SOLIDWORKS. With the portal, GoEngineer can refer clients with hardware questions to a web resource that provides hardware built specifically for their use case, as well as access to a Dell account executive to help with any additional questions or customizations.

"Software resellers frequently field these questions about hardware selection, and they really need resources to help keep the VARs and their customers aware of new models, and trends in the market," says Luis Nunez, RTM manager, Strategic Alliances and Solutions, at Dell Technologies. "The idea is to provide the customer with a simplified process to acquire hardware directly from Dell Technologies. We display six to eight preconfigured and certified solutions supported by SOLIDWORKS. It has proven to be a very easy way for GoEngineer customers to identify themselves based on the profiles in the portal, and select the right mobile or desktop workstation."

You can explore the Dell and GoEngineer portal here.

"The portal gives our customers the confidence that if they select one of the preconfigured workstations, they are spending their money the right way and they don't have to second guess themselves,"

Hughes says. He adds that, in the past, many customers have made missteps when equating their experience in purchasing personal computers to buy new workstations, upgrading graphics cards or memory if they thought they were getting a bargain.

But in engineering applications, memory and GPU requirements can be highly specific to the software, and just spending more money on a workstation does not guarantee better performance.

And their needs are evolving. During the COVID-19 pandemic, with many engineers working from home, a lot of SOLIDWORKS users began exploring new and different features and modules. "In some cases, they may have more opportunities to look at things they wanted to do in the past, but they did not have time," Hughes says. "They may want to make better work instruction manuals, or integrate parts manuals online, or do more photo-realistic rendering for social media."

And the use of simulation has exploded. "It has gone through the roof," Hughes says. "People want to learn simulation. They want to test designs before production, but they do not want to rely on one specialist to do it. Because more people are using simulation, companies are willing to spend the money and buy them their own license or seat."

With the Dell portal, engineers can select from tower workstations and mobile workstations organized around a good-better-best configuration. Those working with smaller parts and assemblies, or conducting simple simulations, can use a basic system. The advanced configurations support more complex designs and simulations.

Because engineering time is expensive, organizations understand that spending money on a workstation to improve productivity maximizes the return on their most valuable asset—their designers. They just need to make sure they are spending in the right way to deliver those productivity gains.

"The biggest challenge is that they often buy the wrong hardware," Hughes says. "The most crucial components are ECC [error-correcting] memory, a solid SSD, and a workstation graphics card that can run SOLIDWORKS like a champ, like an NVIDIA RTX professional GPU. Those are really the pivotal decision points."

The Dell portal limits the CPU, GPU, memory and other options to those that are best suited for SOLIDWORKS and engineering workflows."With the portal, the customer can upgrade based on the configurations we provide, but if the changes they make to the chassis, or the power supply or the processor will not work with the software, they get a warning," Nunez says."That is built into the system, and they have the ability to reach out to the account executive as well."

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- 16GB, 2x8GB, DDR4 UDIMM non-ECC Memory
- 512GB PCIe NVMe™ Class 40 M.2 SSD

This 3650 configuration is perfect for standard SOLIDWORKS and provides upgrade options if your workload shifts into SOLIDWORKS Professional and Visualize.

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M.2 2230 512 GB, Gen 3 PCIe x4 NVMe, Solid State Drive

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ed a system that is perfect for LIDWORKS Standard but won't eak the bank? This is the go-to stem for 2d and 3d CAD.

w Special Offers

According to Hughes, the partnership helps customers find the best hardware for their workflow, as well as keeping them informed and up to date on Dell and NVIDIA strategies relative to SOLIDWORKS, and new products and solutions. Customers can also access new webinars and TechDirect courses via the portal, online service/support, and access to consulting and Dell financial services.

The portal is updated regularly as Dell releases new models and configurations. Dell and GoEngineer plan to further improve the content with additional industry and educational materials. Dell is also planning to launch similar portals with additional SOLIDWORKS VARs in other territories, as well as portals for other engineering software providers.

"We are being very selective in expanding the program so that we are working with VARs with a presence in different geographic territories," Nunez says. "We are also looking at expanding the program with other engineering software partners and in other parts of the world."

"We have been fielding hardware questions for a long time, and the portal really helps us provide the education our customers are looking for," Hughes adds.

Ken Coburn, President and Founder of GoEngineer, shares in Dell's enthusiasm for helping our customers level up the efficient use of their time and resources. "Dell's expertise in supporting the SOLIDWORKS community helps companies gain a competitive edge in a constantly changing global economy." said Coburn. DE

Beijing_national_stadium: The Beijing National Stadium by Jacques Herzog and Pierre de Meuron, inspired by bird nests, is considered an example of biomimicry. *Image by Peter23, Creative Commons, Attribution, Share Alike.*

Nature's Formulas Coded as Generative Design

GD software engineers turn to Nature to program micro-topological structures

The Biomimicry Institute, founded in 2006, describes biomimicry as "the practice of looking to nature for inspiration to solve design problems in a regenerative way." The history of product design shows biomimicry was already in practice long before the term itself was first coined.

Traveling at the speed of 150–200 mph, the Shinkansen bullet train from JR-West set new records in public transportation, but the engineers wanted to improve the passengers' experience by making it quieter. When it sped through the tunnel, the tunnel boom was particularly noticeable.

The engineers found the answer to their sonic problem in the elegant shape of the kingfisher's beak, which allows the bird to slice through air or water without making a splash to catch its prey ("High Speed Train Inspired by the Kingfisher," asknature.org).

A more obvious example is the Beijing National Stadium, designed by architects Jacques Herzog and Pierre de Meuron and built especially for the 2008 Olympic. Its general shape and the complex network of beams and trusses supporting it, are inspired by the shape and woven patterns found in bird nests. As a tourist attraction for China travellers, it's better known by its nickname, the Bird Nest, than by its official name.

A more prevalent example is the attachment mechanism in Velcro, which was inspired by the cockleburs that clung to the company founder's dog "A Mind-Blowing Biomimicry Example," www.velcro.com/blog).

But biomimicry is starting to transcend discipline, lately seeping into the basic architecture of the design software. Some commercially available generative design (GD) packages, as it turns out, include Nature-inspired algorithms.

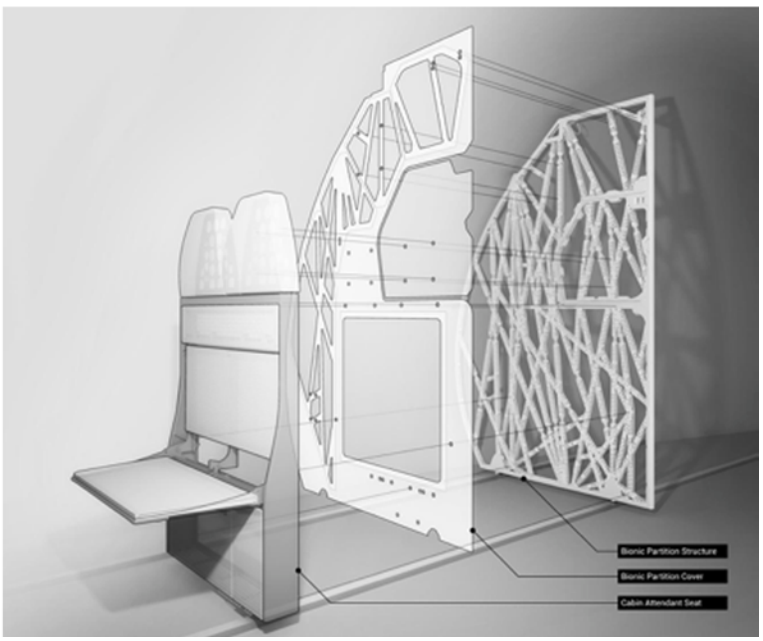
Autodesk's Project Dreamcatcher

Before GD became part of Autodesk Fusion 360, it was in incubation as a technology preview, under the name Project Dreamcatcher. Like all other GD software, Autodesk's technology relies on specific algorithms that instruct the software where to remove materials and where to add more to create the best topology to withstand the anticipated stresses in a given design.

Nanda Santhanam, Chief Architect, Generative Design Project at Autodesk, recalled studying, among other things, "the termite nests, and the way the termites use pheromones to signal one another." He explained, "We create stress or pheromone gradients. The core approach is quite simple, but the results are complex."

One of the early test projects for Autodesk's GD was the design of a cabin partition destined for the Airbus A320. Bastian Schaefer, Innovation Manager at Airbus, anticipates the plane of the future "will be designed to be much lighter, to use less fuel, and to leave a smaller carbon footprint," according to Autodesk's published case study. But he must also balance the lightweighting goals against the need for robust design. "Light is good, but we can't lose strength or safety," he said.

The final frame design, dubbed the Bionic Partition, includes a network of joints and membranes mimicking the growth patterns found in slime molds and the grid structures found in mammal bones. Made up of more than 100 separate high-strength metal alloy pieces, the partition was 3D-printed and assembled. The design was 45% lighter than the average Airbus partition, according to the case study.



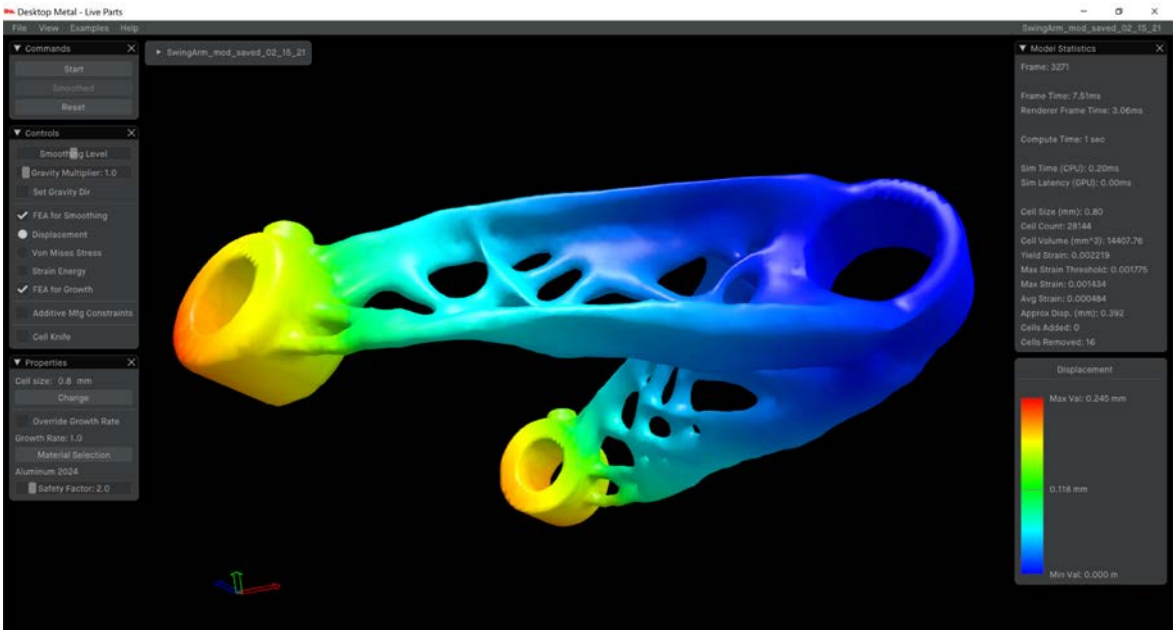
Airbus_Bionic-Partition-2: The Airbus Bionic Partition, designed in Autodesk Generative Design software.
Image courtesy of Autodesk.

Desktop Metal's Live Parts

Metal additive system maker Desktop Metal, whose investors include Google Ventures, Ford Motor Company, and BMW, is also known for its GD software, developed specifically to cater to additive manufacturing projects. Called Live Parts, the software is described as a tool for "rapid design exploration through real-time generative design."

To mimic the additive process, Desktop Metal's software engineers needed a way to automatically grow materials in response to stress regions. They found the formula in cell growth patterns.

"I looked at how plant cells respond to external stimuli, like chemicals from light. So I have cells in Live Parts reacting to stress and strains, then spawning additional cells, called child cells," said Andy Roberts, the development talent behind Live Parts and the Technical Fellow at Desktop Metal.



Desktop Metal Live Parts: Desktop Metal's Live Parts software uses algorithms that mimic cell growth in plants. *Image courtesy of Desktop Metal*.

With Live Parts, "users can adjust loading conditions, materials, resolution, and even design objectives while the design grows and evolves. Live Parts responds in real-time, optimizing the design to reflect modifications while showing stress concentrations and other properties in real-time," the company writes.

For more on this topic, read "Studying Ants and Plants to Build Better Parts," DE, June 2021)

Cloud and GPU

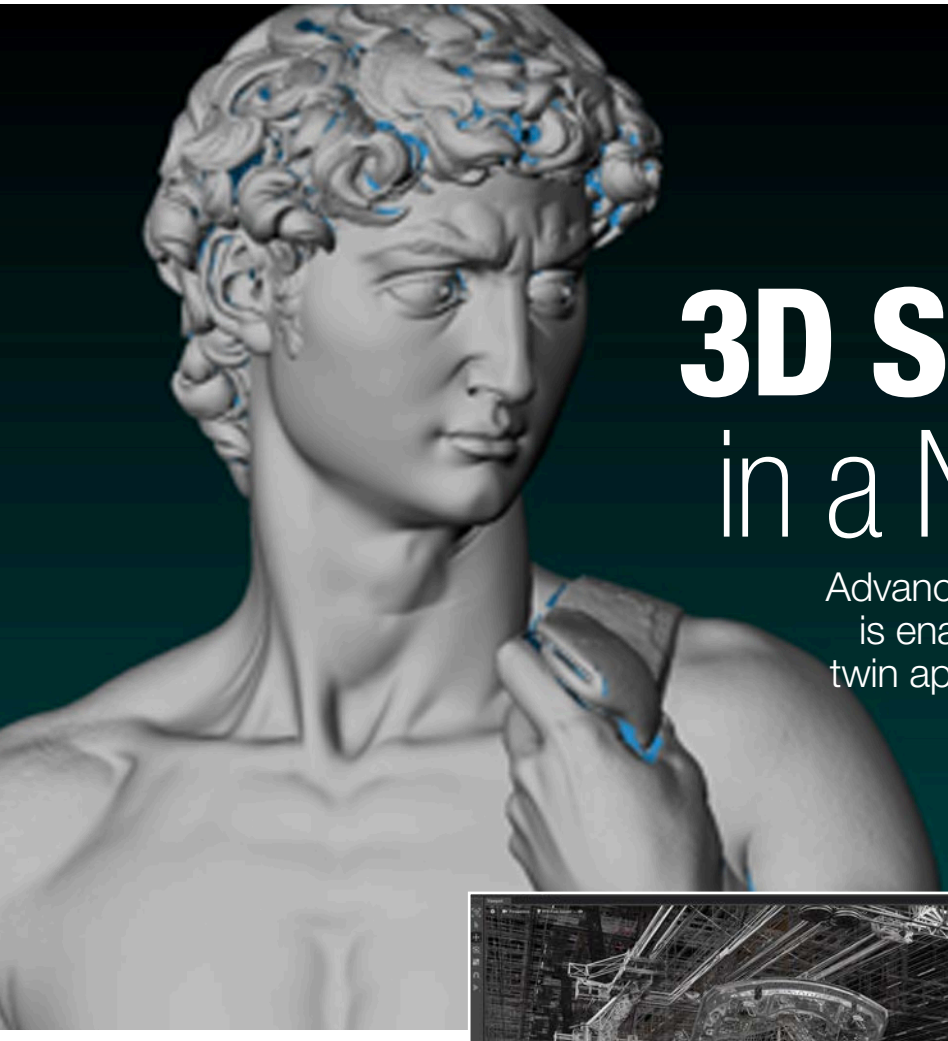
Because of its iterative nature and the need to run complex finite element analysis tasks in the background to identify stress regions, GD software usually benefits from cloud computing and GPU acceleration. Autodesk's GD in Autodesk Fusion 360 leverages the AWS cloud and NVIDIA GPUs. The combination makes it possible for users to "run hundreds of simulations in hours, instead of requiring days or weeks," the company states.

A large part of Live Parts real-time interactive nature comes from GPU acceleration and cloud-hosted architecture. The software runs in virtual machines powered by NVIDIA GPUs, allowing users to access the features anywhere from any device with an internet connection.

In April, highlighting the new RTX GPU products, NVIDIA writes, "Based on NVIDIA Ampere architecture, the RTX A5000 and A4000 integrate second-generation RT Cores to further boost ray tracing , and third-generation Tensor Cores to accelerate AI-powered workflows such as rendering denoising, deep learning super sampling and generative design." DE

Resources

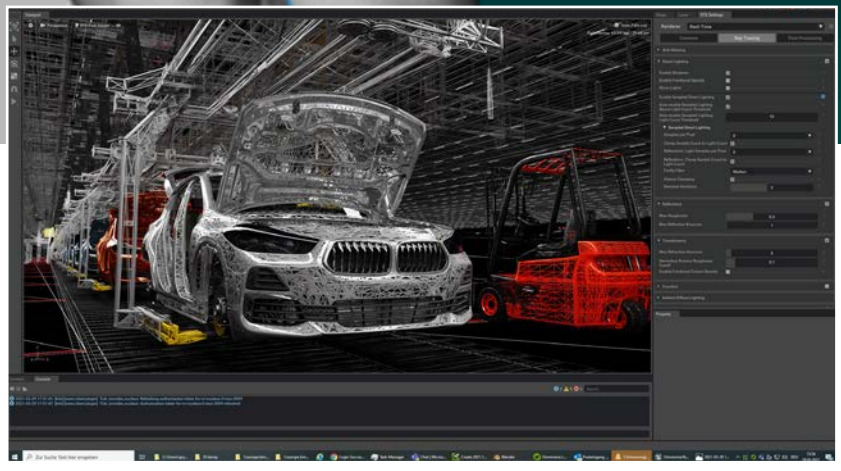
Biomimicry Institute
Autodesk
Desktop Metal Live Parts
Ask Nature



A replica of Michelangelo's David was created with 3D scanning. *Image courtesy of Hexagon.*

3D Scanning in a New Light

Advanced 3D scanning software is enabling large-scale digital twin applications and new types of reality capture.



BMW uses Omniverse to build a virtual factory plan. *Image courtesy of NVIDIA.*

Recent innovations in 3d scanning workflows are transforming the workflow for reality capture. 3D scanner companies have developed a new generation of lightweight, highly portable scanners that can be used by operators with little or no scan experience. There are also automated and robotic scan solutions. Together these improvements have enabled scanning of very large parts and assemblies, as well as entire buildings and campuses for architecture applications. In addition, the scanners are being used for historic preservation, reverse engineering, quality control, measurement, and other applications.

Combined with additive manufacturing, 3D scanning has enabled the recreation of obsolete parts for legacy machinery and vehicles, advanced reverse engineering uses and even some novel applications. At the Italy Pavilion at Expo 2020 Dubai, a full-size, 3D-printed replica of Michelangelo's David was on display. That replica was created based on 3D scans made with the Hexagon AICON StereoScan neo structured light scanner and a Leica Absolute Tracker with handheld scanner.

These scans of more complex assembliesand larger physical areas create ever more expansive volumes of scan data. The scan data can be exported into CAD and BIM applications, and can be used to create high-resolution renderings. Increasingly, the software used to process the data from these high-performance 3D scan solutions relies on more powerful GPU compute resources in workstation-grade computers

FARO provides 3D SCENE software that turns 3D scans into 3D visualizations that can be imported in a variety of point cloud and CAD formats. Users can also create virtual reality views. The software requires a dedicated graphics card with at least 8G of memory. For stereo rendering and viewing, users need NVIDIA graphics; VR rendering requires an NVIDIA 1080GTX or similar GPU. The software supports Oculus Rift S and HTC Vive VR headsets when SteamVR is installed.

FARO also provides the SCENE WebShare Cloud, which lets users store and share 3D scan data internally and externally via a web browser. Projects can be downloaded as 3D point clouds or high-res panoramic images, and used directly with Autodesk and Bentley Pointools products, as well as other CAD and BIM tools.

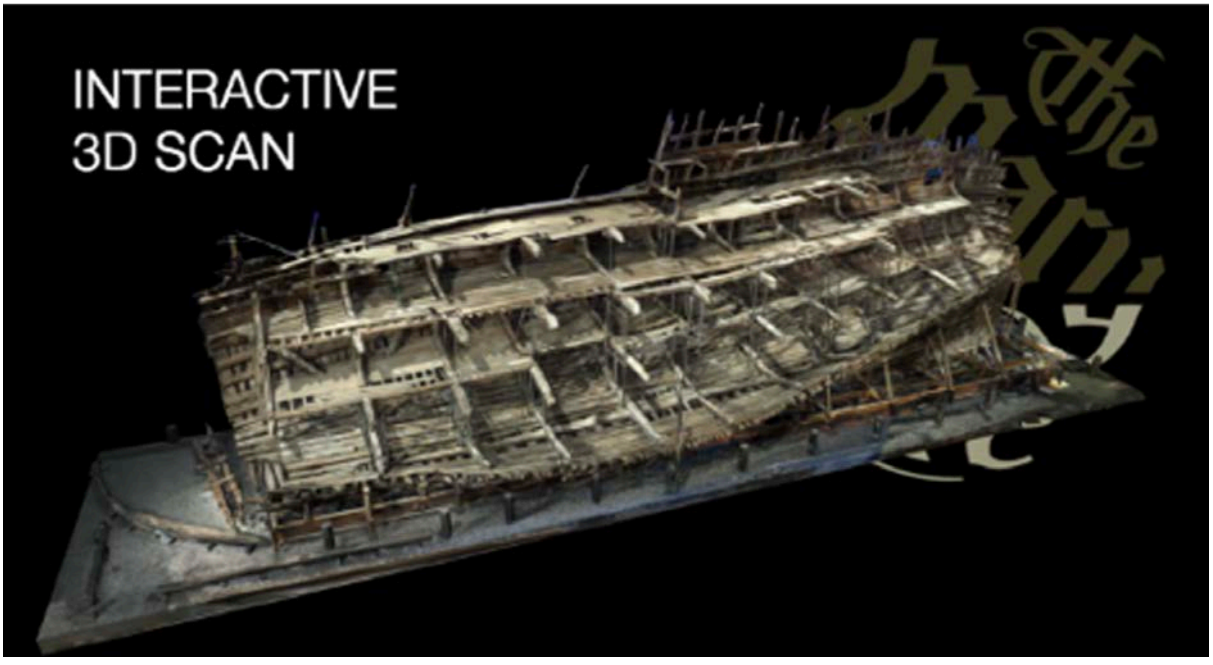
structural deviations. The 3.5 version of the software now provides automated design-geometry adjustment and repair tools that can be used to correct and/or offset issues that stem from the manufacturing process itself. Moldmakers, casting shops and additive manufacturing (AM or 3D printing) providers can employ the software to detect and visualize material and/or design defects or distortions—and then employ capabilities to correct their CAD designs, compare values against nominal limits and ensure that final part quality meets applicable industry standards.

Recommended graphics cards for VG Studio Max include the NVIDIA RTX 4000/5000/6000.

Creaform, which provides scan-based measurement, metrology and quality control solutions, also increasingly relies on GPU power for its solution set. The minimum system requirements for the HandyScan Black, Go!Scan Spark, and MetraScan Black solutions include the NVIDIA RTX 5000 (other solutions require the NVIDIA Quadro T1000).

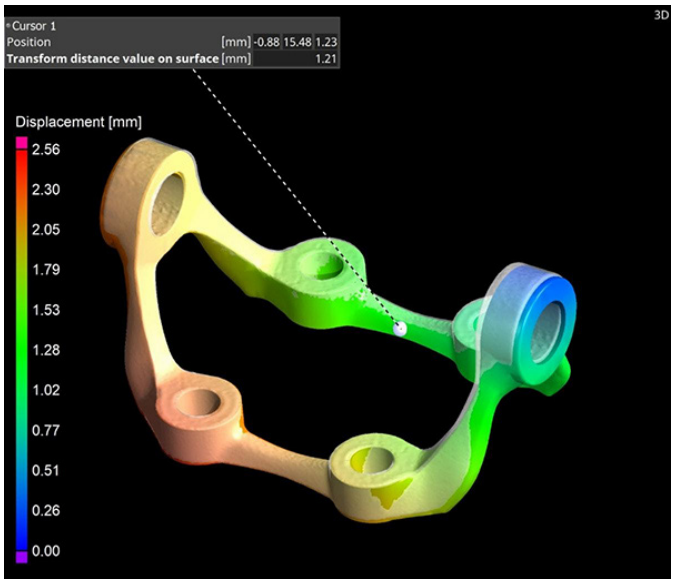
Large-Scale Digital Twins

At the recent NVIDIA GTC conference in April, the company announced that the cloud-based collaborative design platform Omniverse had emerged from Beta and was being applied to enterprise and manufacturing applications. Omniverse allows users from different locations to meet in virtual space and collaborate on designs or solve engineering issues using raytraced 3D objects.



FARO SCENE software was used to process scans and images of the warship Mary Rose. You can see an interactive scan here. *Image courtesy of FARO.*

In addition to 3D laser scanners, there has also been an increased use of CT scanning for reverse engineering and part inspection. Volume Graphics has released an updated version of its tomography data analysis suite, which is used in conjunction with this type of scanning. The software is used to evaluate parts for



A new compensation mesh color overlay in Volume Graphics' industrial CT software version 3.5 helps users to clearly visualize, analyze and annotate any displacements in the compensation mesh. *Image courtesy of Volume Graphics.*

BMW uses the Omniverse to build digital twins of its automotive plants. Dr. Milan Nedeljkovic, a member of the BMW board of management, participated in the GTC keynote.

"For the first time, we are able to have the entire factory in simulation. Global teams can collaborate using different software packages, using Revit, CATIA, and point clouds," he said. "BMW regularly reconfigures its factory to accommodate new vehicle launches ... An expert 'wormholes' [travels virtually] into the Omniverse using a motion capture suite, records task movements, and another expert can adjust the line design in real time. Two planning experts can work together to optimize the line in Omniverse. We want to be able to do it at a scale in simulation."

Scanners rely on GPU power. *Image courtesy of Creaform.*

The scans used to help create these digital twins were completed with the help of NavVis, a german company that provides global scanning services for creating factory digital twins.

Another company that is enabling factory digital twins is a recent startup called Prevu3D (based in Montreal). Nicolas Morency, founder and CEO of Prevu3D, launched the company four years ago. With a background in mechanical engineering, Morency wanted to create a solution to easily create digital models of machines and factories.

In order to efficiently document a facility, he knew that 3D scanning/reality capture would be critical. "But 3D scanning is so massive that few people use it efficiently," Morency says. "How could we make this high-value data accessible to more engineers and project managers? We looked at how to process files into high-fidelity mesh textured models."

With a full facility scan, the Prevu3D software allows users to navigate 3D models, measure and annotate the models; cut, move, duplicate and export parts from the model; simulate new machinery installations; and share the models with other stakeholders via the cloud.

"This can help an engineer do pre-design work," Morency says. "One issue users have faced with AutoCAD is that a non-technical user had a hard time getting any insight. When using reality capture, you can get a grasp of what the engineer is talking about. You can engage other stakeholders in the discussion."

Morency sees potential in combining this type of solution with the NVIDIA Omniverse platform. One of the key challenges of doing simulation is the hard work of modeling the environment by hand, he says. Very few facilities are really documented right now. Few people have an A-to-Z workflow to capture and process and deliver a high-quality meshed environment with the level of detail required for the system to do something meaningful with it.

By using software like the Prevu3D solution to deliver reality data to Omniverse, users can enable better and faster simulation while skipping the expensive process of manually modeling these environments. DE

Thomas Unterluggauer, Creative Manager CGI, KIA Design Center Europe, using Varjo's XR device to perform automotive design review. *Image courtesy of Varjo.*

A New Way to View **and Fix the World**

When your experts and technicians cannot travel, AR/VR applications could be their eyes and ears.

During the height of the COVID shutdown last year, the use of remote experts—virtual expert visits enabled by AR/VR technologies—emerged as a solution to address the shortage of technical experts due to travel restrictions. In a March 2020 report titled "Transforming Frontline Operations with Augmented Reality Technology," the research firm LNS wrote, "AR enables a variety of high-value use cases such as remote expert access, digital work instructions, and in-context training that not only contribute to operational performance improvement, but also directly help to address the workforce skills gap challenges that threaten to hold back manufacturing and other industrial sectors" (made available through PTC, www.ptc.com).

Remote Viewing

Epson, a household name in the printer business, has also entered the AR/VR market. In 2019, it launched the Epson Moverio smart glasses with the AR software Moverio Assist. The company probably didn't anticipate how the package might find new uses during the pandemic a year later.

Targeting the field technicians, the company wrote, "by 'seeing what the field technician sees' in real-time, remote experts can provide the appropriate audio or text instructions, PDF service manuals or tutorial video links to help expedite repairs" http://epson.com/moverio-assist-virtual-remote-assistance-inspections.

AR-powered applications like Moverio Assist let the expert remotely guide a field technician with real-time instructions and advice, allowing them to render services without travel. The use case is particularly helpful for engineering and manufacturing, where repair and assembly operations often involve intimidating knowledge of the assemblies and access to 3D CAD documents.

Varjo XR-3, the latest generation AR device from Varjo. *Image courtesy of Varjo.*

Mary Lakaszcyck, a technician with ASRC Federal Data Solutions, a subcontractor to Orion manufacturer Lockheed Martin, demonstrates a pair of augmented reality (AR) goggles inside the high bay of the Neil Armstrong Operations and Checkout Building high bay at NASA's Kennedy Space Center in Florida on Jan. 16, 2020. *Image Courtesy: NASA/Cory Huston.*

Lightweight 3D model viewers, a regular feature of Product Data Management (PDM) and Product Lifecycle Management (PLM) solutions, are also gradually moving toward AR/VR. In 2019, Terex, a U.S. manufacturer of drilling machines and construction equipment, partnered with the 3D collaboration software developer Vertex to improve collaboration with its customers.

"We've given the ability to view and interact with 3D models to a more diverse group of users within our customer base to satisfy their needs for design reviews," said Ryan Kloos, Sales Application Supervisor, Terex. "By providing more detailed information for customers to review, that minimizes confusion and rework. We've found that with Vertex, the customer experience has vastly improved and we can accelerate our cycles." (For more on this use case, read "Connecting Service to Design" by Randall Newton, November 2020, DE.)

These use cases exemplify how engineering data, maintained as detailed CAD models, are now finding new uses among the front-line technicians with limited exposure to CAD. The use of AR/VR-powered remote applications have been gradually replacing the paper manuals and PDF instructions, but the pandemic appears to have accelerated the shift. The trend is of interest to software developers like PTC, Autodesk, Dassault Systemes, and Siemens, which offers both CAD and PLM products.

Space Viewing

For some field workers in refineries, manufacturing plants, and power plants, a lightweight tablet loaded with animations and annotated 3D models might serve as repair and instruction manuals, but for the crews working on the Orion spacecraft from NASA, a different solution is require

Lockheed Martin's solution to this was Hololens 2 headsets from Microsoft. "They didn't have to refer back to a computer screen or paper drawings during that entire activity," said Shelley Peterson, Lockheed Martin Principal Investigator for AR. "Out on the shop floor they can put on the HoloLens 2 device, power it up, and it has all the content that they need to figure out how to do that task overlaid right there on the structure."

Peterson estimated that AR reduced touch labor by 90%. As a result, "We're now completing 8-hour activities in just 45 minutes," she added. Hololens 2 is also part of the headgear offered by Trimble XR10, targeting those in the construction industry. Hololens 2 Industrial Edition is priced $4,950

In automotive and aerospace, AR/VR-based design review and training is gaining ground. Varjo, which counts Kia and Volvo among its customers, recently made public the details of its involvement with Boeing for the Boeing Starliner project, jointly developed by Boeing and NASA.

The spacecraft launch into orbit involves a complex sequence of commands. Part of the astronaut training is practicing these operations in simulation over and over to eliminate potential mechanical and human errors during the real event.

"When the first crewed mission aboard CST-100 Starliner takes place, the crew will have banked hundreds of training hours for each phase of the entire mission—including launching, docking, re-entering the atmosphere and landing phases—using Varjo's human-eye resolution VR devices.," the company wrote.

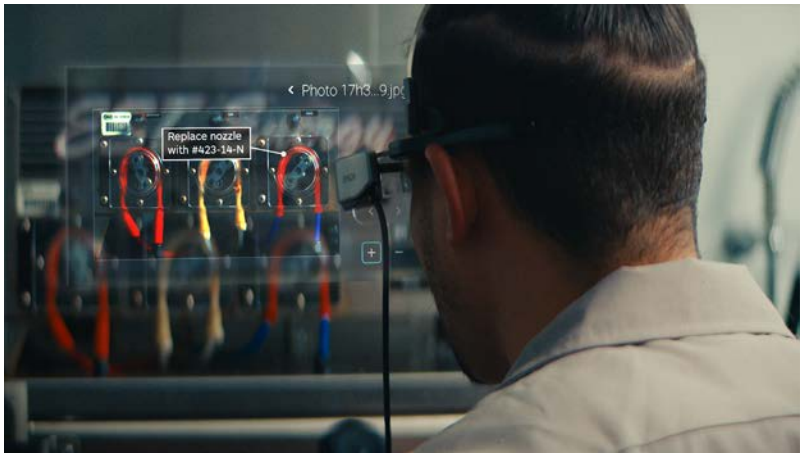
Varjo's latest generation hardware XR3 and VR3 requires NVIDIA RTX GPUs to run. For software developing interactive VR content, Dell offers VR-ready workstations in its Dell Precision product line featuring NVIDIA RTX GPUs. VR-ready products are configured to ensure optimal VR experience with low latency, high refresh rate, and high memory to accommodate real-time interaction with large models.

Epson offers smart glasses with Moverio Assist software to enable remote expert dispatch. Image courtesy of Epson.

According to the researcher LNS, "Research shows that organizations that are Industrial Transformation (IX) Leaders are more likely to implement a variety of Connected Worker technologies than IX Followers, including AR and other digital technologies that are closely related and often part of an AR solution." DE

Resources:

PTC
EPSON
Vertex
Varjo
Microsoft Hololens



Epson offers smart glasses with Moverio Assist software to enable remote expert dispatch. *Image courtesy of Epson.*

GPU support has accelerating rendering performance in KeyShot 10.
Image courtesy of Luxion.

KeyShot GPU Rendering: Sky is the Limit

Luxion's Henrik Wann Jensen discusses the importance of GPU acceleration for rendering.

In 2019, Luxion raised the bar on rendering when it announced its KeyShot product would support GPU-accelerated ray tracing via NVIDIA technology. Since then, the software's real-time rendering performance has only become more impressive. With the recent release of both KeyShot 10 and the NVIDIA RXT A6000 GPU, designers have access to previously unheard of capabilities.

We spoke with Luxion Co-founder and Chief Scientist Henrik Wann Jensen to talk about these enhancements and the value of real-time rendering for engineering organizations.

What were the key driving factors that led KeyShot to support GPU acceleration?

We originally stuck with the CPU because the algorithms we had were doing really well did not map well to GPU. In 2018 I attended SIGGRAPH and in Vancouver and was invited to a keynote by Jensen Huang, CEO of NVIDIA, where he announced the company's RTX hardware.

For the first time, you could have an output of a billion rays per second, which is a fantastic number for anyone doing ray tracing. I spoke to a lot of people from NVIDIA at that conference and asked if this was really possible. They said yes, it was really that good, and it gave me confidence.

We had been dipping our toes in to see what we could get with the GPU, and we had found that it did not give us enough benefits before. It was not able to compete with the CPU at the time. In 2018, the graphics cards came out with 8GB of memory and performance was fantastic. NVIDIA released some programming models to support it, and we were ready for it. We had been preparing internally the algorithms that could map to the GPU. We were up and running in less than a year.

The latest version of KeyShot shows additional improvements related to GPU acceleration. Can you describe some of the features and benefits available in the new release?

In 2018 we started out with the OptiX 6 library, and that presented some challenges for us, but NVIDIA then released OptiX 7, which was a better fit for our needs. We re-implemented everything for KeyShot 9. In the meantime NVIDIA released improvements in OptiX 7.2, and the software keeps improving. In our first release, we had to make certain shortcuts that let us just do brute force on a GPU. For some of the more advanced algorithms, we just leveraged brute force to do that. For KeyShot 10, we optimized some of those algorithms.

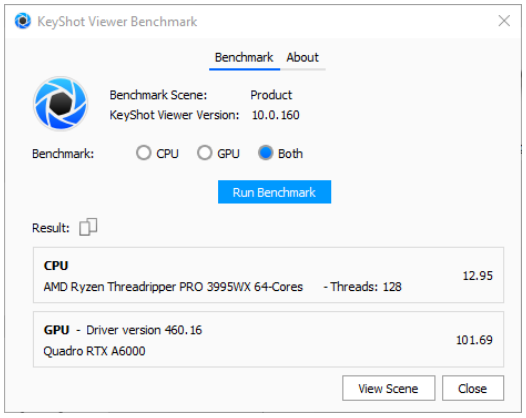
One in particular is the rendering of caustics. We have a really sophisticated algorithm that is super fast on the GPU. We have done things to more closely map to and leverage the fact that the GPU can run with thousands of threads in parallel. We have been able to get some good performance out of the GPUs. The Ampere GPUs that came out, area beasts. The RTX A6000 card we found is 100X faster than the 8core i7 processor.

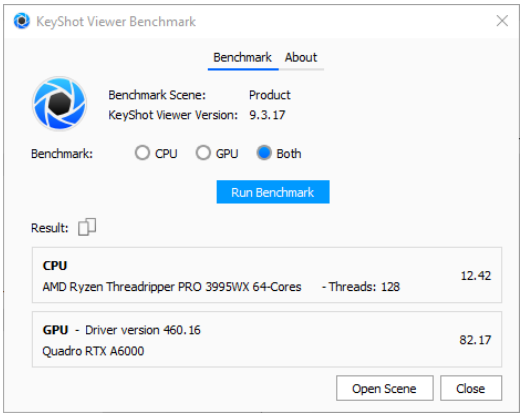
The new release, in combination with the latest GPU from NVIDIA, has enabled some pretty amazing productivity improvements, according to users we have spoken to. Can you talk about how the software/hardware combination affects performance, and why users might want to upgrade?

Rendering is all about speed. As you get more speed you can do more. The customers we work with that have gotten faster computers and hardware, they do well. We have a lot of customers that do animations. If you do animations, anda have 1,000 frames, it takes that much longer. If it took a minute to render a frame, now it is 1,000 minutes. If you can accelerate that, it is helpful. Performance is just getting so good it enables a really smooth workflow. In KeyShot we have always had a really smooth workflow, but you can really take it up a notch when you have complex scenes and have these super fast GPUs.

version of RealCloth compared to KeyShot 9. In KeyShot 10, we took that to the next level and allowed RealCloth material to represent cloth, but to make cloth out of curved threads, so you can render individual threads in clothing. That is incredibly heavy computational work, but you get this detail that is ridiculous. You get detail you cannot model in a CAD system. You have that compute power available and you can put it to good use.

Because we have users that do these close ups of textiles, now have a new way of doing that. Without that compute power, it would be too slow. Now you can still do this and have this amazing performance. What is so great about the new GPUs and faster CPUs, is they allow us to push the envelope all the time and push for even more realism and more detail. We have continued to push those boundaries, and it is something our users appreciate.





Benchmark data showing the improvements in KeyShot 10 vs. KeyShot 9, using the NVIDIA QUADRO RTX A6000 GPU.

Can you explain the role of both the CPU and GPU in terms of the types of tasks within KeyShot where one would be more useful than the other? Are there workflows in which the CPU is preferable?

We still have some advanced algorithms that do run on CPUs. There are certain lighting scenarios where CPU might still outperform GPU because of those algorithms. Operations like importing and processing geometry, the whole flow to set up a scene, those are controlled by the CPU. Rendering is done on the GPU, which receives the data and sends back images very quickly. The CPU still has a role to control all of that. In some cases the GPU may not have enough memory, so with the CPU you can tap into hundreds of gigabytes or terabytes of memory.

Has the ability to access the power now available in both newer CPUs and GPUs changing the way your customers use KeyShot? How are workflows evolving?

The hardware has allowed us to push the envelope. So in KeyShot 10, for example, we released a much more sophisticated

Where do you see the next frontier in rendering performance? Given what is possible now, what other types of improvements or features are customers going to look for or need in the future?

Right now we are funding research looking at the use of ray tracing for virtual reality, which is still beyond the capability of current graphics cards.

In VR you have 2 or 4 million pixels and then you have to ray trace that at 90 or 120 frames per second. That is a ridiculous number of rays. We want to look at that and examine what you can do there that can go beyond classic rasterization techniques? Can we get this hyper realistic ray tracing rendering to run in real time, in a set of VR goggles? And when you move your head around, it follows you? That will be quite fantastic.

Imagine if you could have a photorealistic experience in VR, but it looks and behaves very natural. That would be groundbreaking and help VR take off to the next level. It is still a niche, but if you add that element, that could elevate the experience. DE

Larger, higher-resolution displays can improve engineering productivity. *Image courtesy of Dell Technologies.*

A New Look at Workstation Displays

Higher resolutions, better color and more connectivity options can boost engineering productivity.

A new generation of workstation-class monitors can improve ergonomics, increase user productivity and improve the connectivity dynamics of having more than one work environment. In the engineering space, there are now a wide range of display options that can enhance workflows that are increasingly dependent on real-time rendering, simulation, and accurate visualization.

Modern displays can provide significantly higher resolutions and larger work spaces that are critical for rendering, multi-tasking, and other activities. Research has confirmed the increased productivity of using multiple task windows in both single- or dual-monitor configurations. In a Wichita State University study, participants were first assigned tasks to do on a dual-screen setup, then moved to a single 17-in. screen for similar tasks. By the end of the study participants "were often observed to show disappointment" when asked to use the single monitor.

In a Georgia Institute of Technology study, participants were able to complete tasks nearly 2.5 minutes faster using a dual-monitor setup. If one employee gains 5 minutes per hour doing such tasks, that adds up to an hour a day per employee.

A recent study from Dell measured the productivity of attaching a second monitor to a notebook system. "Give a notebook user a flat 27-inch monitor and their productivity improves 38%," says Vinay Jayakumar, a Dell product consultant for commercial displays. In the same study, Dell measured the use of a curved screen as the second monitor for notebook users. A 34-in. curved monitor offered a 42% increase in productivity.

Graphics industry research firm Jon Peddie Research (JPR) also has noted similar productivity boosts, measuring the impact of more screen real estate on graphical computing. In three studies in the past 10 years, companies using dual-screen displays reported higher productivity and higher usage satisfaction.

"Our studies have found that in some cases productivity can be increased by 50% or more with multiple monitors," says Jon Peddie, president of JPR. "Realism and the details revealed with more display area not only improve understanding in a visualization, but increase enjoyment. It's tiresome to have a constrained view of the world; it's like looking at the world through a tube or a pair of binoculars."

Flexible Options

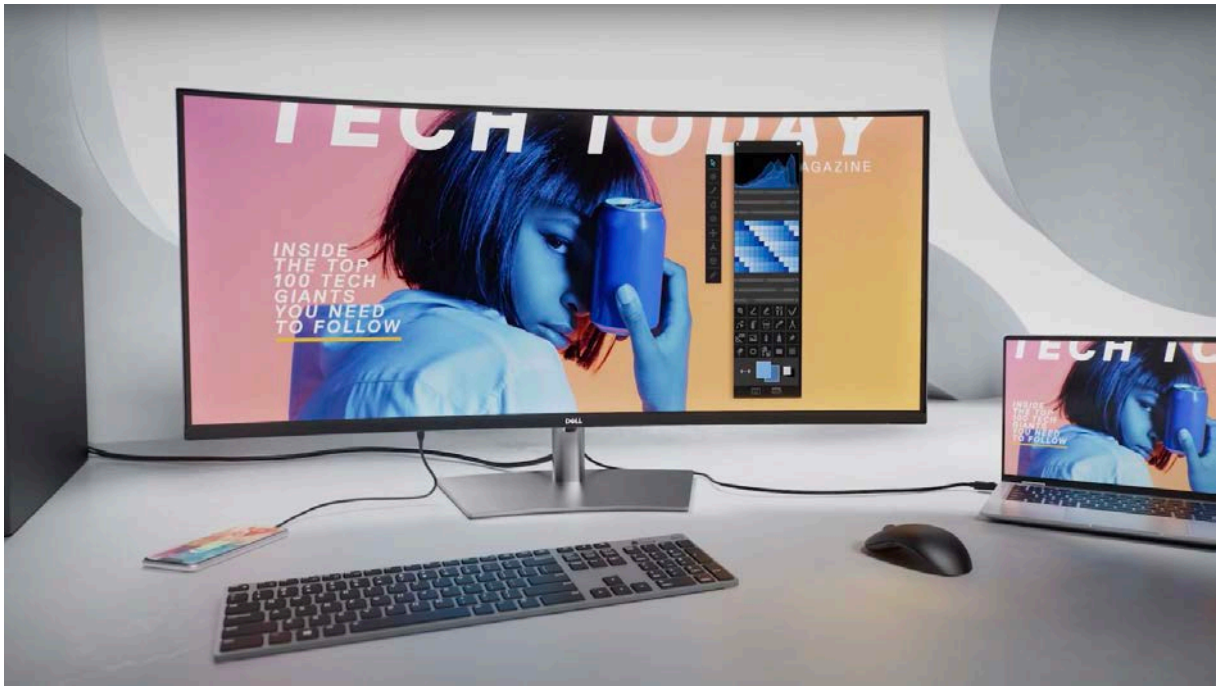
According to Matt Magnum, Team Lead for Global Commercial Displays at Dell, monitor advancements are closely paired with the continued evolution of professional workstations like the Dell Precision line.

Matching the right monitor to the workstation, however, requires an understanding of the applications being used and the work environment. Those decisions depend on the hardware in place, the size of the work environment, how files are managed (centrally or resident on the workstation), rendering loads, and if the engineer is using a desktop only or fixed workstation in concert with a mobile device.

Monitor needs also change right along with workflows and data requirements. "Once people put a display in place, they tend to treat them like a piece of furniture," Magnum says. "We do have more customers now that recognize the benefits that the higher resolutions and new shapes, connectivity and color spaces can provide."

"I think our workstation customers understand that going cheap on the display is really just shooting themselves in the foot," Magnum says. "If you are using a seat license that costs $100,000 a year for a big project, having a poor display doesn't help anybody. Having that extra resolution or multiple displays gives you more ways to work more flexibly, more comfortably and more efficiently."

In the case of Dell, its UltraSharp monitors not only offer high resolution and a large color gamut, but can also be linked to multiple computers simultaneously. The company has also provided more flexibility for users that need multiple displays, offering single stands that can support two monitors, as well as the Dell UltraSharp 49-in. curved monitor, which can provide multi-display functionality in a single unit.



The new Dell UltraSharp 40 4K curved monitor provides an effective resolution of 5120x2160 and 33% more space than a standard 32-in. 4K monitor. *Image courtesy of Dell Technologies.*

New Features Enhance Productivity

The improved resolution of new monitors can enhance the performance of rendering and visualization in engineering. "Monitors really improve workflow," says Danny Payne, CEO of Orbital Computers. He says one of the most important innovations for engineers is software support for 4K resolution (4096x2160 pixels). When Windows 10 and monitors with 4K resolution became mainstream, they were used primarily for gaming and video production.

"Engineers would buy a 4K monitor but their CAD program would not scale elements properly to support the monitor," adds Payne. Because 4K monitors offered quadruple the resolution of the previous generation, but the software wasn't supporting the increase, drawings and models would appear one-fourth the size the user expected. But now, all CAD vendors are directly supporting 4K and the results are spectacular. "Once you use 4K for CAD, it is impossible to go back to [high definition]," says Payne. "Everything looks so much sharper, diagonal lines in particular.

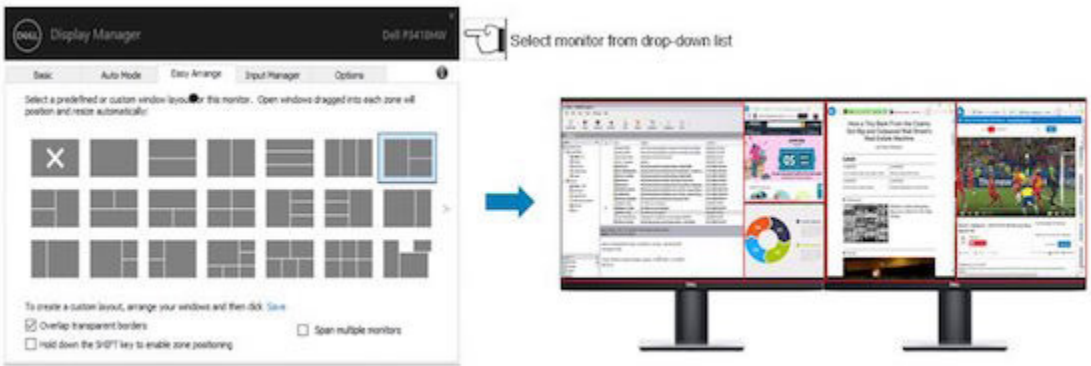
Since then, new 8K monitors have also been released, but Magnum cautions that higher resolution can come with diminishing returns depending on the use case. "Higher resolution gives you a bigger work space, but once you get into very high densities the users can be less comfortable to look at," he says. "The human factor is really important."

The expanded color gamut is also important, particular as more engineers are directly involved in frequent rendering of designs throughout the product life cycle. Dell's UltraSharp Monitors provide detail up to 1.07 billion colors, and enable users to create images in HDR10 (on UHDA Premium HDR10-certified models).

As Magnum describes, the expanded color gamut gives engineers a "bigger box of crayons" to improve the quality of their output.

"These days, more and more content and products we create are going to be evaluated and consumed in a more consumer-based visual environment," Magnum says. "The software tools available now are much more powerful, and the GPUs have incredible capabilities with ray tracing and rendering. Being able to build within those expanded color spaces and know that, even in a review, everything is going to look right will prevent problems down the road."

Display connectivity options have also evolved in ways that can improve workflows. It is typical today for workstation-class monitors to come with USB-C connectivity. USB-C technology allows for a single cable to provide audio, visual, data transfer and electric power.



Dell Display Manager

"Our vision is that the monitor is the hub," says Dell's Jayakumar. This allows for the mouse, keyboard and an [external] solid-state drive to be hooked to the monitor, instead of the computer. "It makes for a clutter-free environment," he notes.

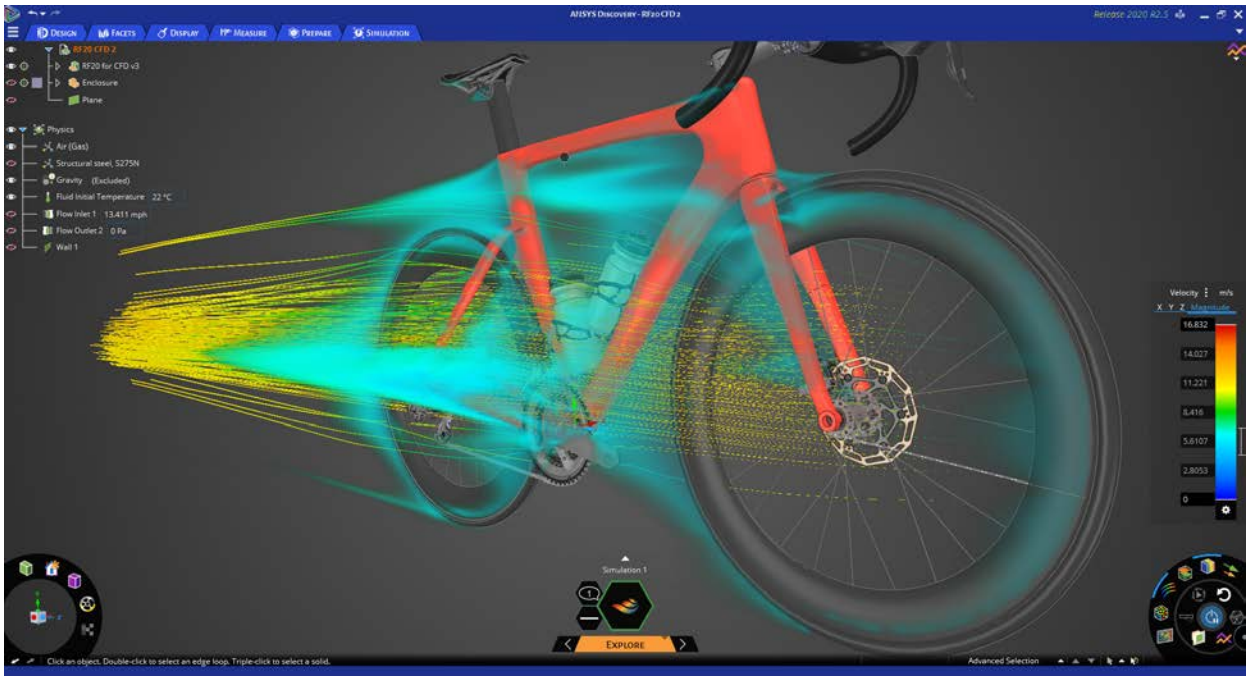
"Having the simplicity of the USB-C port is worth the compromise in terms of the absolute number of pixels you can push," Magnum adds. "USB-C is built on the DisplayPort platform. As they both advance, the bandwidth compromises are going to be minimized."

Modern monitors can also provide more workspace flexibility. Dell offers a software tool called Display Manager with its workstations that allows users to better organize the workspace on the display in ways that can help enhance productivity.

Bigger, Brighter Future for Displays

According to Magnum, engineers can look forward to even more advancements in display technology moving forward. For one, there is a push to adopt fash-refresh technology in commercial displays. While fast refresh is typically associated with gaming setups, engineering applications could also benefit from the ability to scroll and scan across images and files without blurring. Increased use of VR technology within design applications could also benefit.

He adds that industry adoption of technologies like USB-4 and Thunderbolt 4 will provide even more display flexibility. "Customers can look to us to continue innovating on display performance and really pushing the envelope of what is possible," he says. "You will see higher resolution, better contract, and a lot of effort to make the monitor the central hub of the engineers daily work." DE



A simulation of airflow around the new RF20 bicycle done in Ansys Discovery Live.
Image courtesy of Predator Cycling.

Built for Speed

Custom bike builder sees gains in simulation and rendering with the new NVIDIA RTX A6000 GPU.

As powerful as modern GPUs have become, it can be difficult for many end users to imagine how much more performance they can really gain from an upgrade. When the team at Predator Cycling in Mt. Juliet, TN, were approached by NVIDIA to preview the new NVIDIA RTX A6000 GPU, co-owner Aram Goganian was skeptical he would see much improvement.

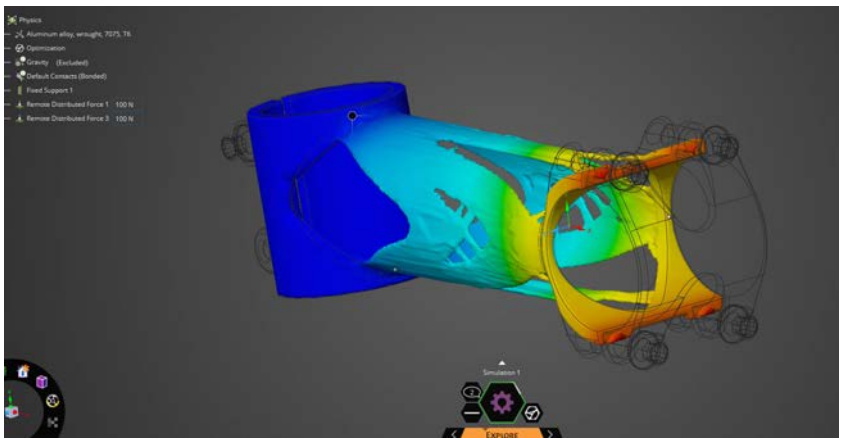
"I did not think things could get faster," he says. "We had been using an NVIDIA Quadro RTX 6000 for a while, and I really did not think I needed more GPU power. We got the A6000, and the performance improvement has been unbelievable. We can solve for larger meshes and get better results, and we are able to multitask while we are running simulations, which we could never do before."

Predator Cycling is a custom bike manufacturer that specializes in custom composite bicycles. All of the products are made in-house, and Predator even manufactures its own tooling and molds on site.

A render of the RF20 bike done in KeyShot. *Image courtesy of Predator Cycling.*

Predator does CFD simulations for pre-design models using Ansys Discovery Live. Models are designed in Autodesk Fusion 360, then go back to Discovery Live for validation. The company uses ANSYS Mechanical for composite simulation and ANSYS Fluid for CFD validation of the final design

They also use Luxion KeyShot for renderings. The improvements in KeyShot were even more dramatic, with 2x to 6x performance improvements. "That was the biggest jump we saw in terms of speed. The raw power of the A6000 is incredible," he says.



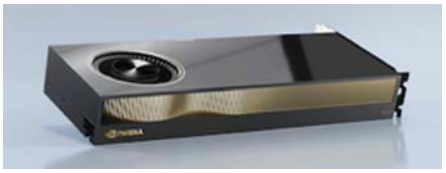
The use of the RTX A6000 allows Predator Cycling's team to multitask -- working in Ansys Discovery Live, Autodesk Fusion 360, and other applications simultaneously. *Image courtesy of Predator Cycling.*

Luxion, which makes the KeyShot product visualization tool, claims that tests have shown close to triple the performance using the NVIDIA Ampere architecture. The integrated benchmark in the KeyShot Viewer reached 34.7 on the NVIDIA Quadro RTX 6000 and 88.8 on the NVIDIA RTX A6000. In the upcoming KeyShot 10 release, the performance on the A6000 was even better at 95.6, which indicates the A6000 is 95.6x faster than the CPU baseline.

The RTX A6000 GPU has been in place for about a month, and Goganian reports it has opened up new possibilities for the company. "We are not thinking as small when it comes to simulations," he says. "Instead of just simulating a small section of bicycles, we can throw the entire model in there, every component and mesh the whole thing."

"With Ansys, Discovery Live used larger and larger meshes when we switched over. The actual compute time was about the same, but the meshes were 5GB bigger, so we were computing much larger files in the same amount of time."

Multitasking is also now possible. "I can run Discovery Live while I have Fusion 360 open for modeling, and screen share on Google at the same time with no drop in performance," he says. In that case, Goganian was on a call with a client, and was able to show them a simulation in real-time via screen sharing. "I could not explain what we were doing clearly enough, so I just showed him the simulation live on the screen and it worked," he says.

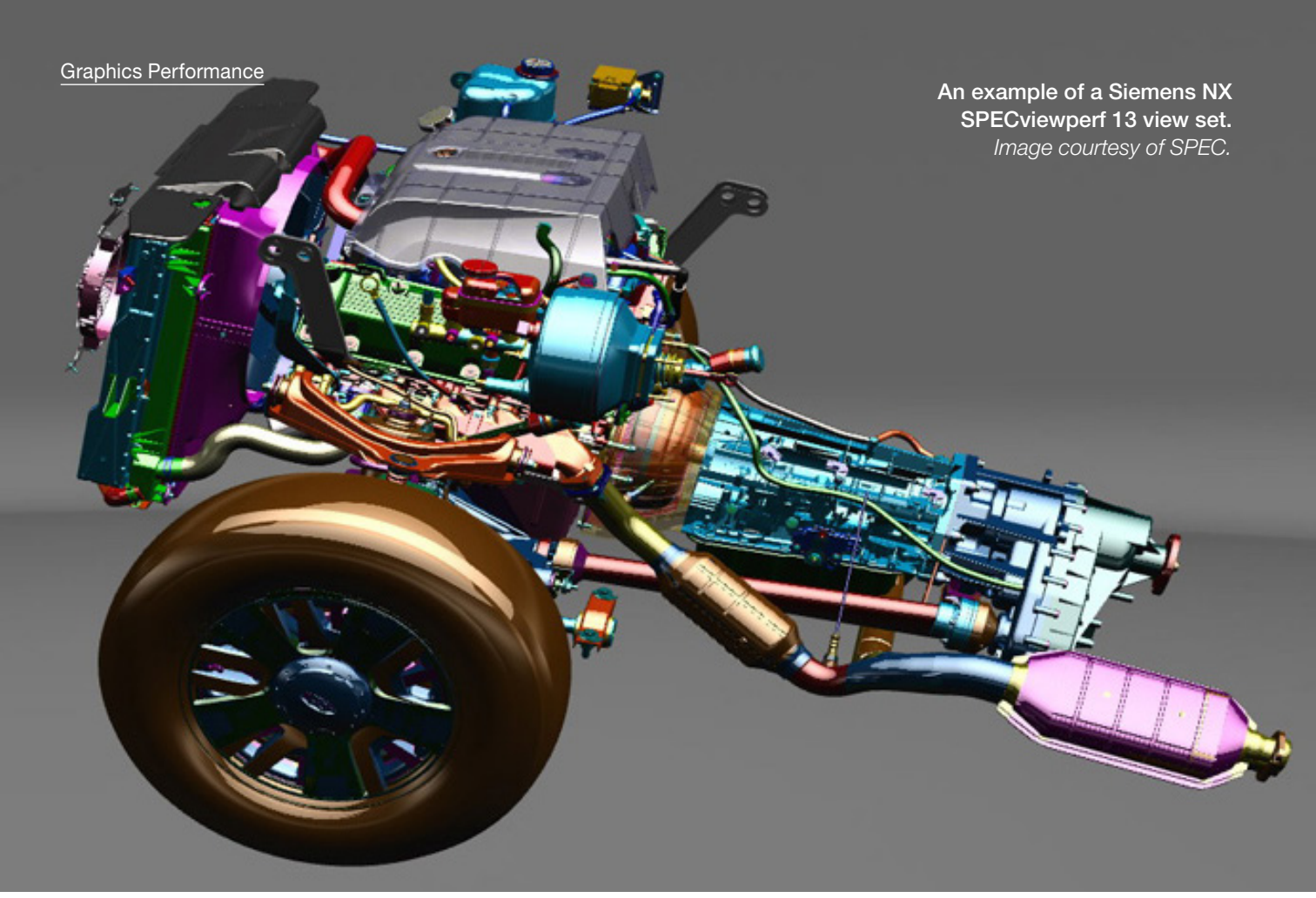


The RTX A6000 was officially rolled out at the NVIDIA GTC virtual conference in early October alongside the NVIDIA A40 GPU. The GPUs are built on the Ampere architecture and feature new RT Cores, Tensor Cores and CUDA cores that can accelerate graphics, rendering, compute and AI significantly faster than previous generations.

According to NVIDIA, both new GPUs benefit from the following features:

- Second-Generation RT Cores: Delivers up to 2x the throughput of the previous generation, plus concurrent ray tracing, shading and compute.
- Third-Generation Tensor Cores: 5X training throughout compared to the previous generation, while hardware support for structural sparsity doubles the throughput for inference, with support for new TF32 and BF16 data formats.
- New CUDA Cores: Delivers up to 2x the FP32 throughput of the previous generation for significant increases in graphics and compute.
- 48GB of GPU Memory: The largest memory available in a single GPU, expandable to 96GB using NVLink to connect two GPUs.
- Virtualization: With the addition of NVIDIA virtual GPU software such as the NVIDIA Virtual Workstation the new chips can support graphics workloads and powerful virtual workstation instances at scale for remote users.
- PCIe Gen 4: Provides twice the bandwidth of the previous generation, accelerating data transfers to the GPU for data-intensive workloads like data science, hybrid rendering and video streaming in PCIe Gen 4-enabled servers and workstations.

RTX A6000-based workstations are expected next year from leading OEMs. DE



An example of a Siemens NX SPECviewperf 13 view set. *Image courtesy of SPEC.*

Does Your **Workstation's Graphics** Performance Measure Up?

The SPECviewperf benchmark is an important tool for gauging the graphics performance of an engineering workstation.

As more and more design and engineering applications increase their graphics performance and take advantage of GPU acceleration, configuring a workstation that is optimized for those applications has become more complex.

"You need to buy a system that is the right balance in its configuration," says Scott Hamilton, technical marketing operations manager for Dell's specialty product group. "If you buy a big CPU or GPU and don't put enough memory in the computer to supply cdata to

the other components, then you are not going to have a great experience overall."

While there is usually plenty of information available online gauging computer performance when it comes to standard consumer or office applications, engineers have unique workloads that are sensitive to that balance in compute power. With the wrong hardware, simulation or rendering tasks could slow down significantly, and erode productivity.

Benchmark data can help companies make apples-to-apples comparisons between workstations, CPUs and GPUs. While hardware and software vendors usually provide some of this information, there are independent, third-party resources as well. When it comes to graphics performance, the SPECViewPerf 13 benchmark can be a helpful guide in determining which workstation is right for a given engineering application.

SPECviewperf SOLIDWORKS view set. *Image courtesy of SPEC.*

The SPECviewperf 13 benchmark is a global standard for measuring graphics performance for professional applications. Data for both Windows and Linux machines is available for a variety of applications, including 3DS Max, Siemens NX, Solidworks, Creo, and Maya.

The benchmark is managed by the Standard Performance Evaluation Corporation (SPEC), a non-profit that was created to miatin standardized benchmarks and tools. Its Graphics and Workstation Performance Group (GWPG) includes major hardware providers like Dell and NVIDIA.

While there aren't results for every application available, Hamilton says the SPECviewperf data is still a good measuring stick. "The benefits to the workstation user is an understanding of how the graphics subsystem is going to perform relative to the software," Hamilton says. "Ideally you would have a report specific to the software you are using, but in some cases you can use that as a guide to evaluate a similar piece of software."

Because the benchmark provides a range of results based on a given application, users can see if a given test matches the type of workflow they are likely to encounter during normal use of the workstation. "That allows you to correlate whether that view set is the appropriate one to use to help make your decision," Hamilton says.

The benchmark also provides insight into relative performance, because in most of the benchmarks there is a predictable scaling of performance as you move up the graphics card stack from a given vendor. For certain applications and use cases, the benchmark can also illustrate where there may be a diminishing return on a given investment.

"If you are comparing two GPUs, you may discover that a lower-cost card gives you 90% of the performance you need, and with the best price-performance ratio," Hamilton says. Moving up to a more powerful GPU will accelerate performance, but in some cases not enough to justify the additional expense.

One Piece of the Puzzle

While the SPECviewperf benchmarks are a valuable source of information, they need to be utilized in a broader context. Whenever possible, users should try to test their actual application on the hardware to gauge performance, and reference additional materials that might have applicable test data. (You can read more about what SPECviewperf can and cannot do here.)

Hardware vendors like Dell and NVIDIA also publish their own benchmark data. For example, NVIDIA provides benchmark data that makes it easier to compare the relative performance of its Quadro GPUs for SOLIDWORKS. Dell also provides guidance on its Precision workstations via certification with a wide range of design and engineering software systems.

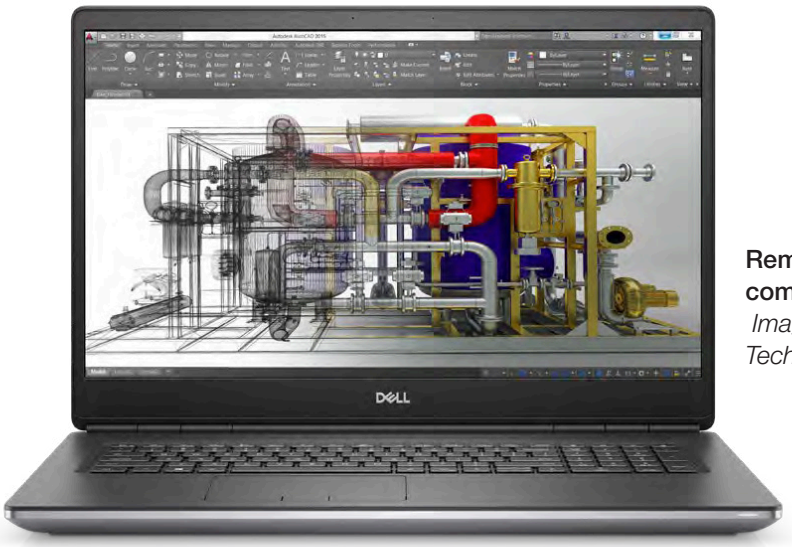
There are other independent benchmarks that can be helpful as well. FurMark, for example, is another OpenGL benchmark that uses fur rendering algorithms to measure GPU performance.

"If you take into account benchmarks that are as close as possible to representing a typical workload, then I think you'll come up with a better end result," Hamilton says.

It's also important to have a balanced system. Graphics performance isn't the only spec that will drive hardware selection. Underpowering the workstation when it comes to memory or CPU will degrade performance, while overpowering in any of those areas might be a waste of money.

How the workstation is used will also affect these decisions. You can't just consider the performance of one application. "An engineer may do design work in SOLIDWORKS, and then run finite element analysis in Ansys," Hamilton says. "How do they use the system during the design lifecycle? You may design a component in a CAD application, then close that down and move to Ansys Mechanical to do stress analysis. If you are doing those independently, you are only putting one demand on the workstation at a time. In other models, you may configure the workstation so you can perform both of those tasks at the same time."

It's also important to buy a workstation that can meet your future needs. A lot can change of the typical three-year refresh cycle for an engineering workstation. Consider a workstation that allows you to upgrade memory or move up to the next class of GPU down the road. "You might want to buy a higher end system you have that extra headroom for future usage," Hamilton says. DE



Remote work will be more common for engineers. *Image courtesy of Dell Technologies.*

Work-From-Home Workstations

Configuring the right workstation when engineering leaves the building.

The recent COVID-19 pandemic has fundamentally changed the way many of us work. According to an April 2020 MIT survey, 34% of respondents said they had transitioned to working from home in the previous month. When you consider the 15% who said they'd been working from home before the pandemic, the study indicates that nearly half the U.S. workforce is working remotely to some degree.

For engineers, that transition could be challenging. Engineering software puts high demands on computer and network resources. The office has the workstations, servers and network infrastructure to properly support engineering. When those engineers leave the building, they can't just log into their applications from the family laptop.

In the early part of the year, many firms reacted by sending desktop hardware home with their staff, but without much planning. "When this started, you had people leaving the office with trunks full of computer equipment, or downloading as much as they could and taking the files home," says Gary Radburn, director of VR/AR and client virtualization at Dell. "Nobody considered the safety of the data or whether you are all going to be able to work

from the same model revision. Things can get very out of kilter quickly."

Mobile Workstation Fix

For organizations considering a remote work fix for the long haul, an investment in mobile workstations is a key step. Modern mobile workstations provide the connectivity and compute power necessary for most engineering, design and simulation applications.

While there are a variety of remote work options, including the use of virtualization or remote solutions that allow you to access a desktop system remotely using a mobile workstation, those have to be planned for and implemented before an emergency.

The most seamless approach is to move from tower to mobile workstations, which now have enough computing horsepower to match the performance of tower and desktop systems.

These workstations can be easily customized and configured to optimize specific workflows (CAD functions, finite element analysis simulations or photorealistic rendering, for example), providing enhanced performance in a multi-CAD environment.

When equipped with NVIDIA Quadro GPUs, there are workstations available that have been certified for many of the leading design and engineering software packages that leverage GPU acceleration to greatly improve performance. Ansys Discovery Live for instance, leverages the NVIDIA CUDA infrastructure for massively parallel computing to enable real-time simulation.

A mobile engineering workstation with a multi-core processor can handle single-threaded CAD tasks, along with any other work the engineer may need to do. With the addition of a modern GPU, the increase in available cores can enable parallel intensive tasks like photorealistic rendering and simulation.

Mobile Configurations

Mobile workstations like those available from Dell can be configured with a range of powerful NVIDIA Quadro GPUs, along with enough CPU power and RAM to handle most engineering tasks. The specific configuration that is for you will depend on your workflow.

"If battery considerations are important, buy the biggest battery and don't buy more than a four-core CPU," says Allen Bourgoyne, a senior product marketing manager at NVIDIA. "Heavy graphics users need top-of-the-line CPUs and GPUs [graphics processing units]. These systems are wildly configurable. Every engineer can get exactly what they need."

Updating to the latest multi-core processors and GPUs (in conjunction with upgrading your simulation software) can generate a 4X to 9X improvement in simulation speed. There are a few general guidelines for equipping a mobile workstation with enough features to handle typical design and engineering scenarios.

GPU: Most of the major CAE simulation software packages are now taking advantage of GPU performance to accelerate performance. The NVIDIA Quadro RTX series (3000, 4000, 5000) are certified for many of these applications, and (depending on the software and the model) can cut solve times in half in some instances.

CPU: Many standard CAD and CAE packages are not multi-threaded, so users that work exclusively with those tools are best served using a processor with fast, single-thread performance. For simulation and rendering, Increasing CPU core count can increase performance; those benefits are compounded when combined with a fast GPU.

RAM: Smaller data sets may be handled with 8GB to 16GB of RAM, but the general rule of thumb is to invest in as much RAM as you can afford. This is especially as the size and complexity of models is increasing. Some simulation tools may also require much larger amounts of RAM to ensure optimal performance.

Storage: Solid-State Drives (SSDs) provide up to 10X faster performance compared to a standard Hard Disk Drive (HDD). With prices coming down, an SSD is well worth the investment.

The newly released Dell Precision 7550 and 7750 are good examples of mobile workstations that offer optimal configurations for engineering applications. Both models are available with 10th Gen Intel Core and Xeon 8-core processors with up to 128GB of 2933MHz memory and 6TB of storage. They can be equipped with up to NVIDIA Quadro RTX 5000 GPUs, and support virtual reality, 3D CAD, data science and AI applications.

Remote work requires more than just a well-built mobile workstation. Some use cases may require remote access to workstations located back at the office. Dell works with Teradici, maker of PC-over-IP (PCoIP), a display protocol that encrypts and transports pixels to user devices. Existing rack-mounted and deskside workstations are equipped with a PCoIP card; the remote user then connects directly to the required computer.

Dell Precision workstations include Dell Optimizer for Precision, which leverages Artificial Intelligence (AI) software to learn how users work and then adapts to optimize system and application performance. For organizations with a large remote workforce, having a remote management system in place to handle security issues, updates, and software licensing is a must. If engineers can't bring the devices back to the office for updates, a management tool allows IT staff to cnetralling update software and install patches for an entire fleet of workstations at the same time.

To learn more about mobile workstations and remote engineering scenarios, download the new white paper, Engineering From Home. DE