

REVEAL

the world we live in

Issue #2 2020



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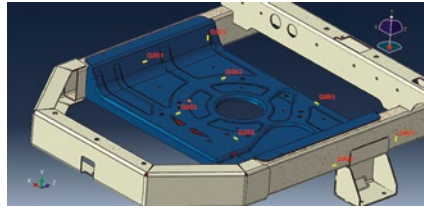
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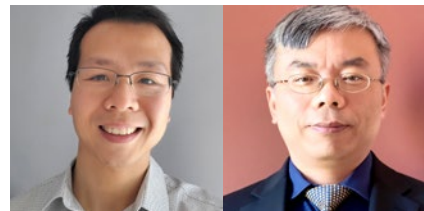
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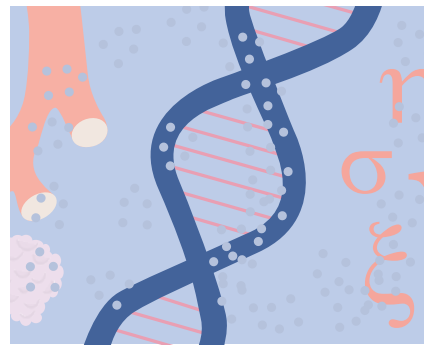
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THE IMPORTANCE OF COMMUNITIES



At Dassault Systèmes, communities have always been extremely important. Historically we have offered an abundance of opportunities for our customers to communicate and interact with us...and with each other. Why do we emphasize our communities? Because we are better together. Engaging with our customers, peers, and partners is the best way to share, learn, and grow. Now, in the era of COVID-19, community has never been more important. As we all sit isolated from our colleagues and teams, we need to find new ways to share our knowledge, experiences, and solve problems..

The pandemic this year has had a few positive outcomes as a result of our radically augmented daily lives. Our user network and online communities are growing. Our customers are interacting with our experts and our services teams are busier than ever. We are all sharing and supporting each other to keep business continuity—some good has come out of this global crisis.

It has never been a better time to explore resources and opportunities...to communicate in new ways. Our [SIMULIA Learning Community \[SLC\]](#) provides an online venue to share knowledge and network with other users. Here, you can find likeminded individuals who can answer questions, collaborate, offer tips or simply share a passion for simulation. Similarly, the CATIA User Community and BIOVIA Discovery Studio are additional brand-specific public communities that cater to every user level, from beginner to expert.

We also offer brand-specific topics and niche communities of interest for every age group. For example, [SOLIDWORKS Apps for Kids](#) introduces children to the world of 3D modeling and provides learning opportunities and activities that can be accessed anywhere, anytime. This is particularly

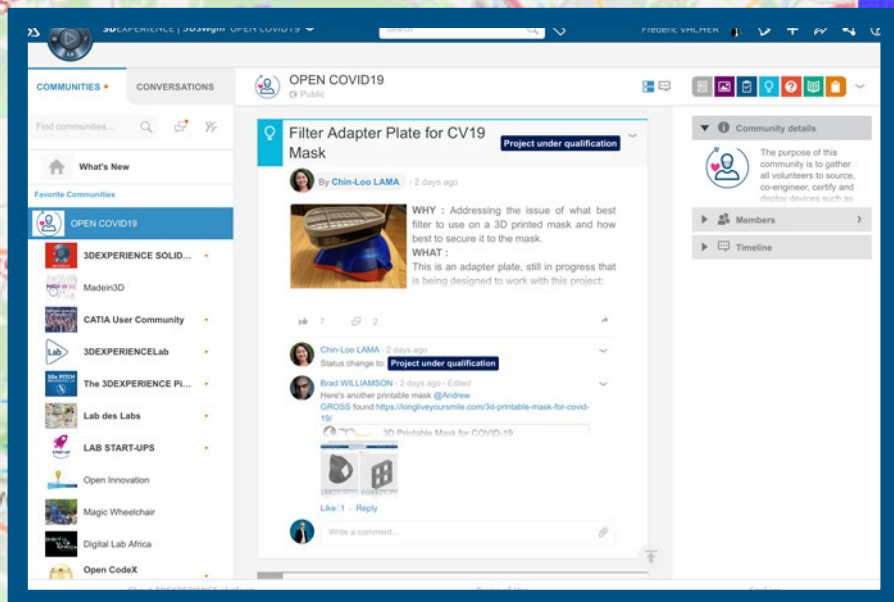
important as COVID-19 forces students into virtual, remote classrooms. This community allows kids to share their designs and collaborate on their improvement—working together to build their skills as the next generation of designers.

At the other end of the spectrum, our SIMULIA Champions program recognizes our expert users. A new initiative for 2020, the Champions program highlights our most active and influential simulation experts from around the world and across disciplines. This inaugural year of the program has been highly successful in introducing our experts to the wider SIMULIA community through blog posts and speaking opportunities. As the year draws to a close, we are now beginning the search for our 2021 Champions!

It's easy to feel helpless in the face of a crisis like COVID-19, but our [Open COVID-19 Community](#) allows designers, engineers and manufacturers to come together virtually to combat the pandemic. Members of the community have access to the SOLIDWORKS xDesign online environment to help them develop solutions such as the 3D printing of protective gear, simulation of open-source ventilators and more. The community has been extremely successful connecting engineers from around world to share ideas and talents to help solve COVID-related challenges. It has been heartwarming and encouraging to see the depth of knowledge and passion for humankind that has been expressed here.

At Dassault Systèmes, we greatly value our customer/users. You are an extension of our corporate community and we want to interact with you. Now is the time to follow us on social media, join our communities to share your knowledge and experience and connect with each other and our experts. Together we will work to build innovations for a more sustainable home, planet and future

CAGATAY SERIN
SIMULIA Marketing Leader



JC Fab Lab

<https://www.fablabs.io/labs/jcfablab>

Join the [Open COVID-19 Community](#)

3DEXPERIENCE LAB: REACHING OUT TO COMMUNITIES, CONNECTING RESOURCES

WHAT'S GOING ON IN THE WORLD RIGHT NOW?

Abhishek Bali: There are many things that are broken, many systems and many protocols. On the positive side, what I see is that it has given us, makers and creative people at the **3DEXPERIENCE** Lab and at all the other fab labs and makerspaces across the world, an opportunity to be more creative and to take innovative approaches to doing the same things that we would do normally. I see this as a design, engineering and a trust problem in some ways. We've been physically confined to our homes but our minds are not. Our minds are everywhere and they are solving problems right now.

In my role, I've been able to facilitate a number of innovations during the pandemic and being a part of the entire process has opened my eyes to a lot of possibilities.

THERE ARE MANY SHORTAGES HAPPENING RIGHT NOW. WHAT CAN YOU TELL ME ABOUT THAT?

Well, it's a supply and demand problem. When you design a system or a service, the first thing that you consider is the capacity that you are building out for. Due to the unprecedented nature and scale of COVID-19 pandemic, there is a high magnitude of load being applied on the existing healthcare system, and even on our telecom systems, and all the different systems that make our world tick. All factors of safety have flown out in thin air. At the same time, there is a problem with the supply that was allocated to that system

and because of that, there is a gap. Existing supply chain has only so much bandwidth in order to fill that gap. So, there have been a lot of innovations that have sprung up from across the world to fill this gap, especially in context of Personal Protective Equipment (PPE)

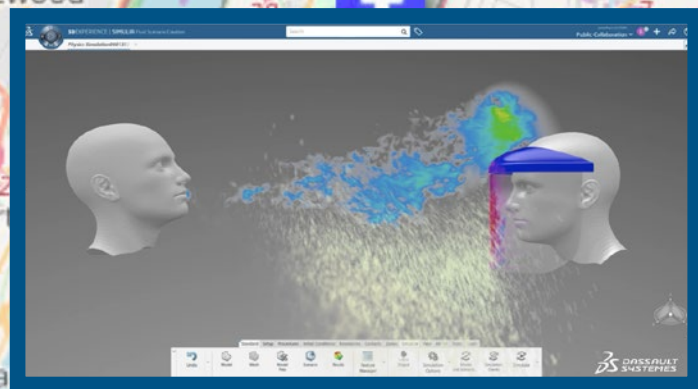
ABHISHEK, WHAT IS A FAB LAB AND HOW DOES IT WORK?

Fab lab is short for a digital fabrication lab or you can call it a maker space. It's a collection of digital fabrication machines, like laser cutters, 3D printers, vinyl cutters, CNC mills, etc. The basic aim is to facilitate anybody who wants to get into personal fabrication with tools and a physical space to build a prototype of their idea or a working product itself. Usually it is for personal use and not for mass production or for commercial purposes.

This is why additive manufacturing is a vital part of a standard Fab Lab, because 3D printers are a way for a maker to conceive of something in their mind, design it using a 3D tool such as xDesign, xShape, SOLIDWORKS, CATIA, and then create a physical manifestation of it by 3D printing it. This shows how Fab Lab and additive manufacturing are so intertwined.

HOW DO YOU SEE A FAB LAB HELPING WITH THE CURRENT CRISIS?

By definition, a Fab Lab gives you access to all of these amazing tools that help you take that journey, from concept to reality. So whether it's through 3D printing or vinyl cutting



or laser, for example. During this pandemic, we have witnessed an unprecedented amount of active involvement from makers across the world. Makers just sprung to action and self-organized into groups or worked in individual capacities to help out. It's amazing that across the world Fab Labs and maker spaces started producing all different types of PPEs. What that means is that they started modeling their ideas in a 3D software, most probably SOLIDWORKS and CATIA, or were able to download an open source 3D file and 3D print it using a 3D Printer in their neighboring fab lab. Fab labs became a hub for making faceshields and masks of various designs, and also distribution centers for local hospitals who ran out of PPEs.

They shared ideas in the public domain; so that a maker in New York could share their design with makers globally who are all trying to solve local problems at local hospitals. The right technology enables people to help each other without even knowing each other. These makers don't know the patients or doctors that they are helping.

HOW HAS DASSAULT SYSTEMES BEEN INVOLVED IN THESE EFFORTS?

Dassault Systèmes collaborates with the MIT Center for Bits and Atoms and the Fab Foundation. The Fab Foundation is a network of more than 2000 fab labs across the world. We provide them access to 3D Creator, 3D Sculptor and SOLIDWORKS that can help makers dream bigger and better, and bring their concepts to reality.

Also, the **3DEXPERIENCE** lab setup an open COVID community and a COVID-19 dashboard on the **3DEXPERIENCE** platform. The main objective of this community was to act as a single source of truth for all the makers, designers, and

engineers across the world who are trying to solve the same problem, and helping healthcare systems locally and globally to meet the needs that have arisen because of the pandemic. The community has around 350 plus members from across the world.

In this community, we maintain an ideation funnel where any maker, engineer, or designer working on any COVID-related projects, can make a post or share an idea and collaborate with anybody else in the community regardless of geographical location.

HAVE WE SEEN ANY RESULTS FROM THIS WORK SO FAR THAT YOU'D LIKE TO SHARE?

There have been amazing results as ideas move through the ideation funnel. As that idea moves along the engineering phase or the medical phase, the final stages involve simulation where, with the help of the SIMULIA team, we are running simulations on some key designs of facemasks and face shields that are being accepted by hospitals all around the world. We are not validating the designs but giving them tips on how to improve them based on simulation results. One of the key aspects in simulation is to make the invisible, visible.

IS THERE ANYTHING ELSE YOU'D LIKE TO ADD?

Dassault Systèmes and the **3DEXPERIENCE** Lab in particular, are passionate about helping makers and startups by providing access to online communities and tools that help create products that harmonize life and nature. I think that focus is very important and is the inspiration behind what we bring to the table.

[Learn more about the 3DEXPERIENCE Lab.](#)

REDESIGN PUBLIC SPACES, SAVE LIVES— HOW SIMULATION IDENTIFIES POSSIBLE COVID-19 TRANSMISSION

Research is unravelling how the coronavirus that causes COVID-19 spreads, and what organizations and businesses can do to protect their employees and customers. Simulation reveals the propagation paths of droplets and aerosols potentially contaminated with the virus, and verifies the effect of safety measures such as masks and ventilation changes.



From the first announcement of the discovery of a novel coronavirus in late 2019, researchers have worked to discover exactly how the SARS-CoV-2 virus that causes COVID-19 works and how it spreads. Early advice suggested the disease was not airborne, but the hard work of hundreds of scientists revealed the danger of microscopic droplets, 5 to 10 micrometers in diameter, breathed out by infected individuals. Thanks to their work, the World Health Organization now accepts that droplet transmission is the primary transmission vector, and smaller airborne aerosols and contaminated surfaces (also called “fomites”) can also spread the virus.[1]

This hard-won data is crucial to safely reopen society. With this information,

RISK FACTORS OF COVID-19

Because most droplets are relatively large, we know they can be caught by masks and by air filters. Because their weight means they fall to the ground relatively quickly, we know that without airflow they are concentrated within a couple of meters of the infected individual, hence the need for social distancing. And because they can be carried in the air, we know that the movement of the surrounding air can make a huge difference to the propagation of the virus, either safely removing it from a space or allowing it to propagate further.

These factors determine where outbreaks occur. Many clusters have been linked back to industrial facilities such as meat processing plants, where

studios, where people are speaking, singing or breathing deeply and most do not wear masks – it is known that in these conditions, a larger number of droplets and aerosols are projected in the air compared to talking or even to sneezing (larger droplets).

The air mixing in Heating, Ventilation and Air Conditioning (HVAC) systems can spread the virus through closed spaces. In fact, one of the first conclusive pieces of evidence for droplet transmission was a cluster of infections linked to a restaurant in Guangzhou, where the pattern of infections matched the flow of air from the air conditioning [2]. In the United States for instance, air conditioning is implicated in the rise in cases over the summer through the hot southern states – both because it brings



Figure 1: Droplets released by a sneeze, with and without a mask. The size and color represent the size of the droplets.

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we can design public spaces (from schools and hospitals to trains and planes, from offices to factories) in a way that minimizes the risk of viral transmission and inform the public about how to protect themselves. These measures can be tailored to the needs of each environment, so as to not compromise on other areas of safety and comfort. Companies and governments have a duty to their staff and people to keep them safe by any means necessary while maintaining a functioning economy and society.

workers are close together in poorly ventilated facilities, shouting to be heard over machinery. High recirculation inside these facilities causes concentrations of droplets to potentially increase over time. Increasing fresh air ratio can help, but the complex three-dimensional airflow in facilities can disrupt the proper refreshing of the air and leave areas of higher concentrations. Flow recirculation patterns can be good for thermal comfort (airflow mixing) hence we have a tradeoff.

Other cases of outbreaks have been linked to settings like choirs or fitness

people indoors and because it moves air rapidly around enclosed spaces. In some settings, HVAC cannot be switched off entirely: for example, to protect those who are vulnerable to heat in case homes, or where the construction of the building provides little protection against extreme temperatures. A solution needs to be found that keeps temperatures at safe levels while also minimizing virus transmission.

Despite this, there are still holes in our knowledge. Reliable data about viral loads and minimum levels for infections are not available yet in literature at the

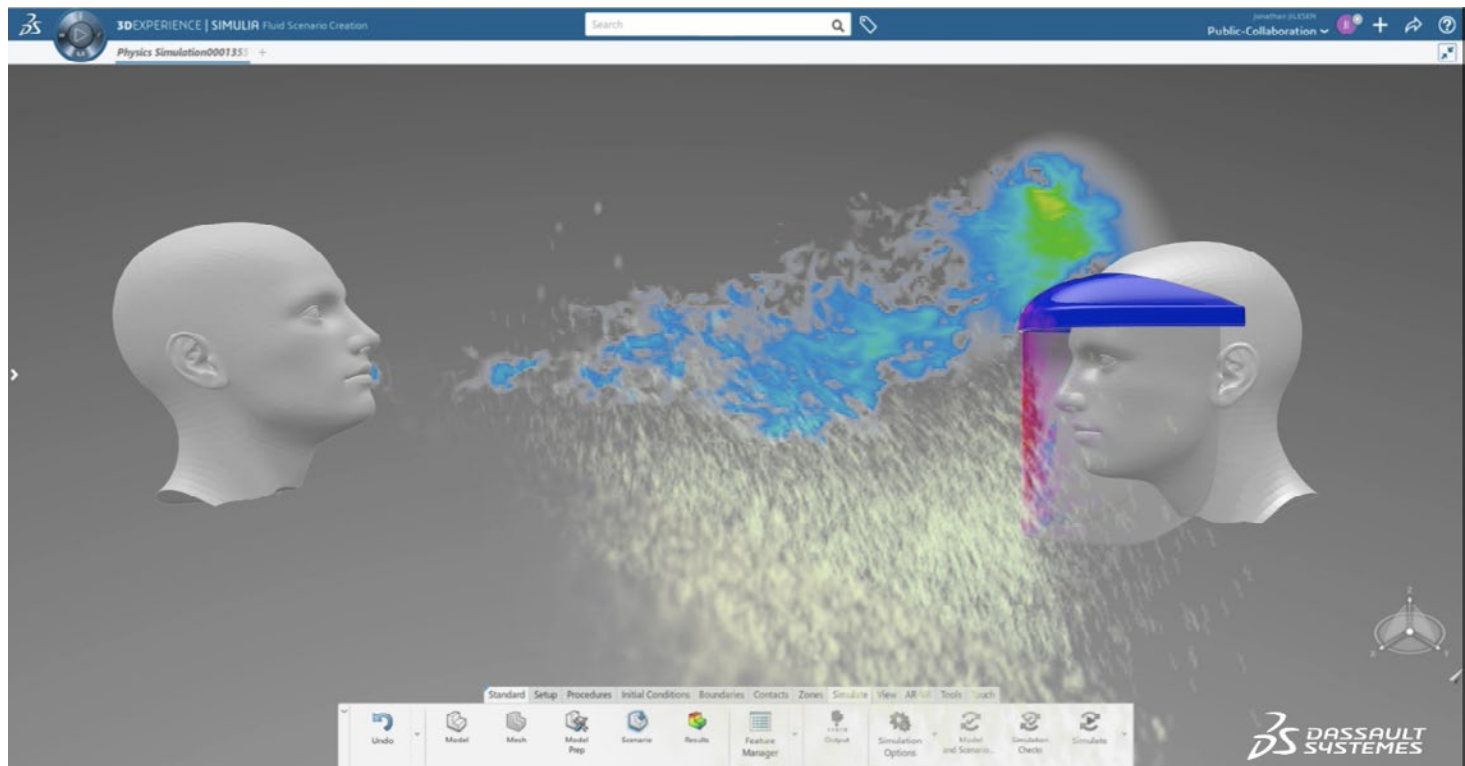


Figure 2: Sneeze simulation of a face shield, part of the **3DEXPERIENCE** Lab OPEN COVID-19 effort to optimize face shields. Both heavy droplets and light aerosols are shown – the droplets fall but the aerosols remain suspended in the air for a longer time, potentially traveling further than 6 feet. © 2020 Dassault Systèmes. All rights reserved. The simulation(s) by Dassault Systèmes and other technical or operational information represented in this article are presented as an illustration and are for informational purposes only. Any use of information presented in or derived from this article is at the viewer's sole risk and Dassault Systèmes disclaims all related liability.

time of this article. In addition, we may still underestimate some contamination paths like aerosols—new data is improving our understanding all the time. Simulation can rapidly re-analyze environments as new information comes to light and help resolve newly identified risks.

MITIGATION

Understanding these risk factors is what lets us know how to stop the virus. Face masks and other forms of Personal Protective Equipment (PPE) are now mandatory in many countries. The simulation in Figure 1 demonstrates how these make a significant difference to how far viral droplets can spread from an infected individual. It is important to choose the right kind of PPE for the situation—simulation can show that some kinds, such as the face shield shown in Figure 2, may not

be effective on their own where light droplets and aerosols can go behind the visor. Shortages of appropriate PPE have put staff at risk, hurt morale, and

3DEXPERIENCE LAB OPEN COVID-19

The open sharing of ideas and data is crucial to designing and manufacturing rapid solutions during the pandemic. Engineers, designers, makers and manufacturers around the world can work together and share ideas in the Open COVID-19 Community. For more information, see <https://3dexperiencelab.3ds.com/en/projects/fablab/open-covid-19>

limited an overwhelmed healthcare system's ability to treat COVID-19. Many manufacturers across a wide

range of industries have rapidly pivoted to producing face masks, filters, shields and even treatment devices such as ventilators. The rapid deployment of simulation allowed these companies to test and improve their designs and to prepare 3D printing processes to produce these components rapidly.

When considering buildings, it is important to prioritize spaces inhabited by vulnerable people. By now, we know that the elderly and those with pre-existing conditions are more at risk from the virus. On the other side of the coin, the possibility of asymptomatic transmission—which is harder to prevent through screening methods such as fever monitoring—among children in particular means that schools and childcare facilities also deserve special attention.

Better design of ventilation systems can redirect the droplets onto the



Figure 2: Simulation of a sneeze in an office. The colored air represents airflow from a HVAC system behind the sneezer. © 2020 Dassault Systèmes. All rights reserved. The simulation(s) by Dassault Systèmes and other technical or operational information represented in this article are presented as an illustration and are for informational purposes only. Any use of information presented in or derived from this article is at the viewer's sole risk and Dassault Systèmes disclaims all related liability.

ground faster or extract them as quickly as possible to filter them out or vent them away. Simple measures such as opening or closing doors and windows at carefully selected locations and adjusting the strength of HVAC can change the flow of air and minimize the transmission risk of the disease. For example, Dassault Systèmes worked with St. Francis Hospital in Marange-Silvange, France to help them optimize the HVAC controls to minimize the transport of potentially contaminated droplets from a ward of COVID patients to other wards by understanding how air flowed through its corridors [3].

Because the same simulation tools are used, HVAC engineers can analyze viral transmission, ventilation and heating/cooling at the same time. This means that HVAC configurations that mitigate transmission but also keep temperatures at safe levels can

be identified through simulation.

Adding filters to HVAC systems is one way to improve internal air quality.

CABIN COMFORT

HVAC simulation has been a important topic for SIMULIA since long before the pandemic. The tools that are now helping fight a virus have been previously used to design comfortable, energy-efficient climate-controlled environments inside vehicles, aircrafts and buildings. For more information about our Cabin Comfort offering, see <https://www.3ds.com/products-services/simulia/solutions/transportation-mobility/cabin-comfort/>

The filter pores need to be very fine to capture droplets, but without affecting air flow efficiency too much. Dirt and

humidity affect how the virus binds to the filter at the molecular level, which means specialist methods are needed to analyze how filters behave as they age. SIMULIA is collaborating with BIOVIA, another brand of Dassault Systèmes, to support HVAC manufacturers in designing effective, long-lasting filters. BIOVIA software can model filter materials at the molecular level and calculate the results of chemical processes in order to assess how the filter changes over time and in different conditions. The results of the BIOVIA analysis are fed into a fluid simulation with SIMULIA software to model airflow through the filter, considering pore size. Working together, SIMULIA and BIOVIA can offer the insights needed to create a filter that captures viral particles but also has acceptable airflow efficiency, and calculate its optimal placement in the HVAC system operating in a building.

WHO ARE BIOVIA?

BIOVIA is the brand of Dassault Systèmes specializing in life science and materials science. BIOVIA solutions create an unmatched scientific management environment that can help science-based organizations create and connect biological, chemical and material innovations to improve the way we live. To learn more, see <https://www.3ds.com/products-services/biovia>

Social distancing has been another crucial part of the pandemic response. Where distancing is not possible, building managers often add shields such as plastic windows and screens. These significantly affect the flow of air through a space, sometimes in unexpected ways. Simulation can identify places in the room where airflow is obstructed. In these areas, viral droplets will tend to accumulate. Rearranging the screens or adding fans to these areas can change the airflow – simulation shows whether this change could make the situation better or worse.

Similar shields are being used on trains and aircraft to divide spaces between passengers. These can be effective, but only if droplets cannot get over or around the edges of the screen. Simulation reveals airflow around these shields from talking or a cough and helps engineers to optimize the design of the shields given the real world conditions such as aircraft cabin recirculation.

Of course, not all businesses suddenly faced with these challenges had the right kind of simulation software and experience immediately, and many of those that did were not able to access hardware and other resources while working from home. The Dassault Systèmes cloud approach allowed customers to transition to home office with no hardware installation, while expert SIMULIA consultants support new customers to get started as fast as possible in order to make critical spaces like hospital wards and factory floors safe.

PUBLIC INFORMATION ABOUT COVID-19

The public face a barrage of information and disinformation about COVID-19 from every direction. Many are worried about how facilities like schools, care homes and hospitals protect those inside, whether they can use public transport or aviation, and whether it is safe to return to businesses as an employee or as a customer.

Simulation offers a way to cut through this fog of confusion. Dassault Systèmes has emphasized for a long time the importance of experience, and offers powerful visualization tools for presenting data. With an accurate model and an effective visualization, simulation results can show the physical processes of transmission in a clear, realistic way that requires no specialist scientific knowledge to understand. Simulations allow for the quantification of inhaled droplets or aerosols for people in vicinity of an infected person, with or without masks, but visualization is what makes that data comprehensible in an instant to the public.

Looking at a visualization of a simulation also helps architects, epidemiologists and health & safety consultants to identify exactly what the transmission routes are in a given space. Once they have identified a possible solution, they can then use the visualization to persuade management or government to implement the solution.

Attractive, easy to understand simulation images and videos can be used in internal communication with employees to demonstrate the effectiveness of PPE and other measures. They can also be used in customer-facing marketing material to show that coronavirus countermeasures are effective. This will be crucial to rebuilding customer confidence as the economy recovers from the pandemic, particularly for companies such as airlines, theaters and cruise lines serving the badly hit leisure and tourism sector.

CONCLUSION

The pandemic has revealed how much our daily lives rely on shared public spaces. From schools and hospitals to

shops and transport, almost every area of our society will need to be redesigned to minimize the risk of transmission while allowing some semblance of normality. The managers of businesses and services have a duty to protect their employees and the general public, and simulation is helping them fulfill this duty.

Depending on the space, mitigation measures may combine masks, distancing, screens, and changes to the HVAC system. With simulation, architects and facility managers can analyze the effectiveness of different solutions and find the best combination to keep people safe. New buildings should be built ready for the pandemics of the future, and existing structures retrofitted to protect their inhabitants.

Simulation can also produce clear visualizations showing how droplets spread through the air. These can be used to explain the science of transmission to the public, and to reassure employees, customers and investors that the protections work.

[1] WHO, 9 July 2020, "Transmission of SARS-CoV-2: implications for infection prevention precautions" <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>

[2] Jianyun Lu et al, April 2020, "COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China", Emerging Infectious Diseases, vol 26, issue 11, https://wwwnc.cdc.gov/eid/article/26/7/20-0764_article

[3] "Air Flow Simulation Used by 3DEXPERIENCE Lab OPEN COVID-19 Community to Reduce Virus Propagation Risk in French Hospital", <https://www.3ds.com/newsroom/media-alerts/air-flow-simulation-used-3dexperience-lab-open-covid-19-community-reduce-virus-propagation-risk-french-hospital/>

Given the need for a rapid response to emergencies, our teams are on alert on a global scale to answer requests to help create safer healthcare facilities, life environments, and life-saving equipment. Contact details can be found at: <https://discover.3ds.com/simulia-covid-response>



FLYING ON DEMAND

Imagine flying on demand, from the nearest airfield, for the price of a train ticket. That's the option that Omer Bar-Yohay, CEO of the electric aviation company Eviation Aircraft, wants for every traveler: a better regional travel experience that avoids congested roads by providing an affordable and eco-friendly air travel solution.

"We all struggle with transportation," Bar-Yohay said. "Today, if we want to travel 800 kilometers and there aren't any trains to take us to our destination, we are stuck in our cars for many hours. We want to change all that."

Bar-Yohay's solution? The Eviation "Alice," a nine-passenger, 100% electric-powered plane with a cruising speed of more than 240 knots (approximately 280 miles per hour/444 kilometers per hour).

"Because electric engines offer higher propulsion efficiencies and lower maintenance costs, they reduce the cost of flight by 90%," Bar-Yohay said. "Electrification doesn't only make us eco-friendly; it makes it possible for everyone to fly regional distances for an affordable fee."

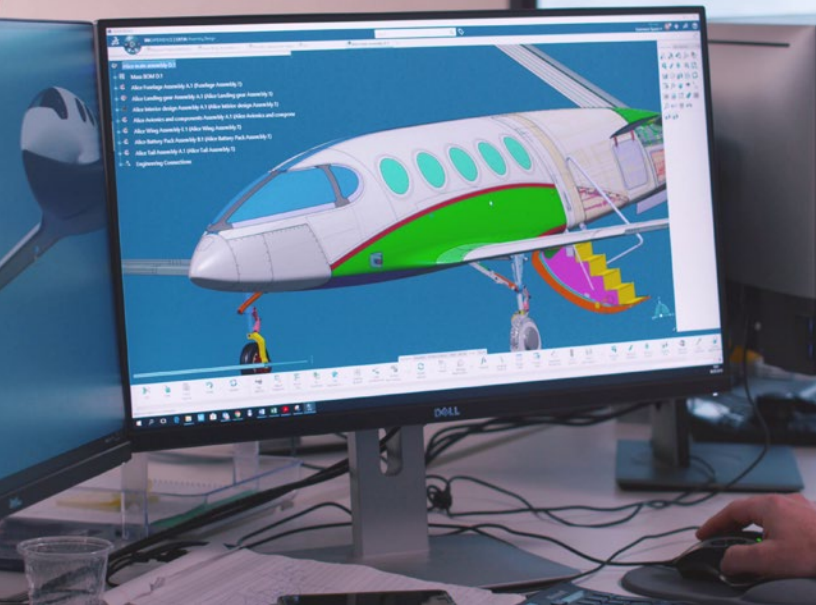
THE CLOUD IMPERATIVE

Creating the Alice would have been a monumental task for any company, and even more challenging for Eviation: more than 160 suppliers and partners located all over the world collaborated on the project.

"The propellers are made in the US, the plane's molds in Indonesia, the landing gear in Italy, other components in France," Bar-Yohay said. "Working with the Dassault Systèmes technologies enabled us to go from concept to prototype very quickly."

To link its far-flung stakeholders, Bar-Yohay chose the **3DEXPERIENCE**® platform on the cloud for its design and simulation applications, and powerful work-from-anywhere collaboration capabilities. Thanks to the platform, the company's contributors could exchange ideas, share knowledge and know-how, and collaborate across disciplines in resolving system interface issues as if they were located in a single room.

While cloud-based collaboration keeps everyone working in synch, the **3DEXPERIENCE** platform's change management capabilities are even more important to Lior Zivan, chief technology officer at Eviation. To explain why, Lior relates a story about fastening passenger seats to tracks on the floor of the Alice's passenger compartment.



3D design of the Alice commuter airplane powered by the 3DEXPERIENCE platform on the cloud.

“The 3DEXPERIENCE platform on the cloud is a scalable platform. [...] We can count on its scalability to accompany our growth. It’s the key to continuous innovation.”

— Omer Bar-Yohay, CEO, Eviation Aircraft

“The fasteners we wanted were not in stock, so we needed to change the part number to another one and then update the file of the model, which was already in production in France,” Lior said. “Thirty seconds after we made the change, the French manufacturer was alerted by the system to change what they were drilling. Everybody can keep track and see what has been changed, saving a lot of headaches in terms of configuration management.”

Using the platform on the cloud helped Eviation’s team ramp up quickly, thanks to its plug-and-play format, and gave the company access to all the latest software enhancements as they were released. Contributors also could work from anywhere and at any time, on demand.

“Everyone has to work on the same data sets, wherever they are, hand-in-hand, or else there will be considerable delays,” Bar-Yohay said. “Our teams, employees and subcontractors alike need to seamlessly collaborate on the cloud if we are to meet our deadlines.”

Ofir Laor, Eviation’s chief aerodynamics engineer, was pleased to discover that the platform works just as well when he travels as when he is at the Eviation offices. “Just recently, I traveled to Germany to meet with one of our subcontractors and all we had to do was connect to the cloud to access our designs,” Laor said. “I didn’t have to carry my data with me. It was so convenient.”

But what about data security and IP protection on the cloud? “We care a lot about data security,” Bar-Yohay said. “And data security is one of the reasons why moving to the cloud made sense. Building an aircraft is difficult enough. As a small company with already insane challenges, why should I add more challenges that I simply cannot take care of? I prefer leaving this to experts. And so far, we haven’t been disappointed.”

Adopting the 3DEXPERIENCE platform on the cloud also eliminates the need for Eviation to invest in time-consuming and costly maintenance for an IT environment. With no upfront IT hardware investments, no software to install and implement and nothing to maintain, the company pays only for the computing power and applications it needs and uses.

A HOLISTIC DESIGN APPROACH

The Alice, which is mainly made of composite materials, is fly-by-wire controlled and powered by three propellers: one on each wingtip and a third on the rear fuselage.

“We started from scratch and approached this plane holistically by designing and engineering all parts for minimum weight and maximum efficiency,” Bar-Yohay said. “Because all of our applications are integrated on the same platform, we could see how one part of the plane affected other parts and make the necessary adjustments right away. This interoperability provided us with considerable flexibility in our design approach.”

One of the biggest challenges, Laor said, was to system-engineer the aerodynamics and mechanical aspects of the plane’s design into a seamless whole—an even greater challenge given the project’s large number of independent contributors.

“We needed a strong and reliable solution to make sure there were no errors and that the aircraft subsystems were well-defined to the minutest detail,” Laor said. “We rely on CATIA for part design and for the precision of its surfaces, some of which are very complex. In effect, since an electric aircraft’s energy density is low, we must compromise as little as possible on the aerodynamic shape, which requires designing very creative and complicated 3D surfaces. Only CATIA can do this.”

Looking for the best aerodynamics, the engineers had to address the complexity of designing the wingtip propulsion unit to reduce drag.

“With a wingtip propeller, what we needed to figure out was what the nacelle and the propeller would look like, and how they should be designed,” Bar-Yohay said. “You cannot do this with eight engineers unless you have a very powerful simulation solution and you can iterate hundreds of times per week. Without SIMULIA XFlow’s high iteration rate and seamless integration with CATIA, we simply could not have designed the plane in such a short time.”

SIMULIA XFlow’s automatic lattice generation and adaptive refinement capabilities minimize user inputs, reducing time and effort in the meshing and pre-processing phase. This enables engineers to focus on design iteration and optimization.

Enabling many of the platform's coordination capabilities, ENOVIA helped Eviation to leverage multi-discipline and multi-site collaboration to build and validate a virtual 3D digital experience of the entire airplane in a configured and intelligent context. Form, fit and functional analysis, combined with business information and actionable insights, enabled Eviation's designers to visualize and validate that the final airplane met all requirements, complied with industry standards and regulations and exceeded customer expectations.

EXPERT SUPPORT

Systematics, a Dassault Systèmes business partner, provided Eviation with expertise and assistance in transitioning from its initial environment, in which engineers used disparate tools and had to perform integrations manually, to one where everyone was on a shared platform that could create a complete system of systems model for simulation and validation.

"We were on a very tight schedule; it was just too much to bear for a company our size," Bar-Yohay said. "So Systematics kind of augmented us. They gave us the technicians and engineers to work next to us. For example, they assisted us with migrating some of our designs from one format to another. In this sense, Systematics was very much a partner."

In parallel, Eviation needed to build a training program that would give its engineers capabilities for the long-term on an accelerated schedule.

"Thanks to Systematics, we've gotten there faster and more cost-effectively than I ever imagined possible," Bar-Yohay said.

A key aspect supporting the aircraft design is the ability to simulate its structural behavior. ADCOM, a Dassault Systèmes Israel-based partner dedicated to SIMULIA application, helped Eviation with the simulation of dynamic and static loads

"Without SIMULIA's XFlow high iteration rate and seamless integration with CATIA, we simply could not have designed the plane in such a short time."

— Omer Bar-Yohay, CEO, Eviation Aircraft

occurring during the flight with a high level of reliability, combined with an accurate prediction of composite behavior and optimization.

The **3DEXPERIENCE** platform on the cloud has enabled Eviation to develop an innovative airplane concept from the ground up.

"The aviation industry is probably one of the most difficult and conservative industries in the world," Bar-Yohay said. "The amount of money you need to do anything is simply insane, so everything has to work right the first time. It's difficult, but entirely possible with the right solution."

"I believe using the **3DEXPERIENCE** platform on the cloud helps us achieve our dream. Not only do we benefit from the same sophisticated solution as big players; its scalability is crucial for a startup like ours, because what we don't use today may be needed tomorrow. It's important to know we can count on this scalability to accompany our growth. It's the key to continuous innovation."

For More Information

www.eviation.co

www.adcomsim.co.il

www.systematics.co.il/en

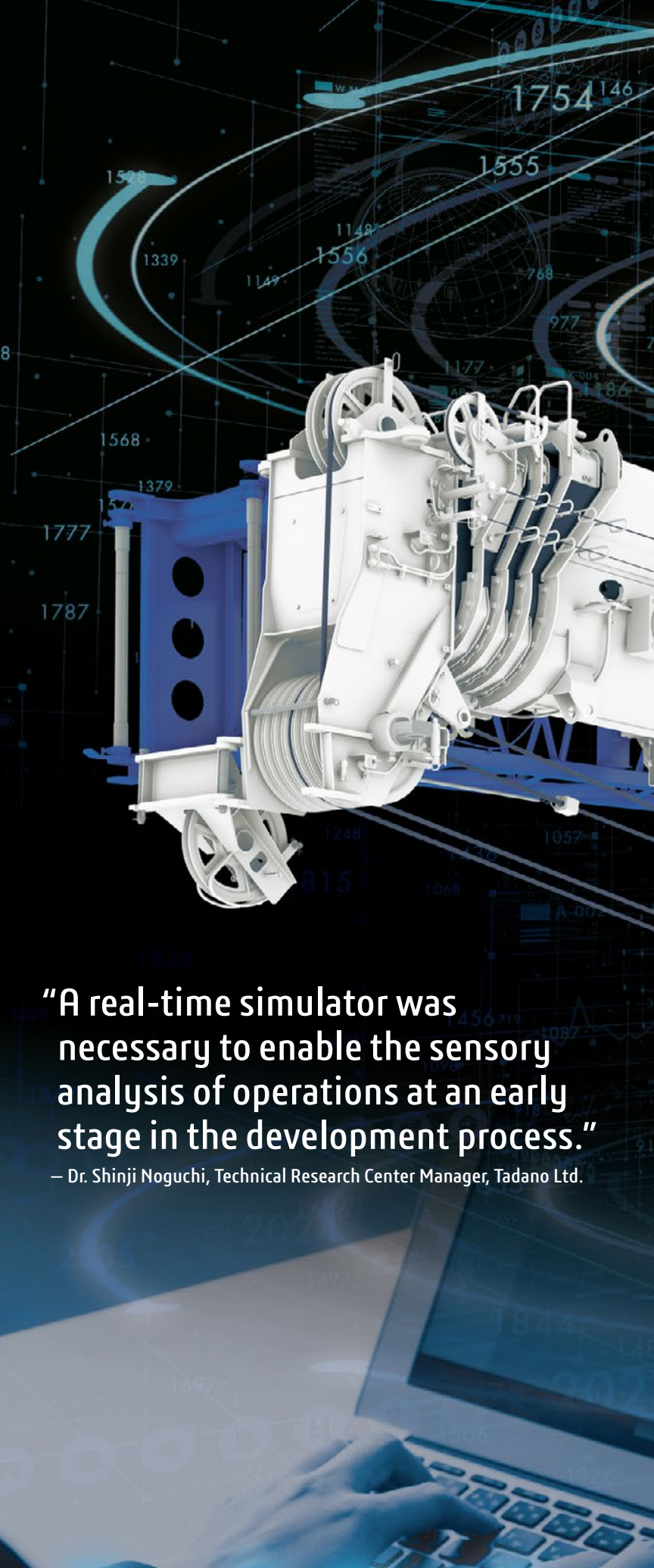


Alice commuter airplane assembly at Vannes, France.

LIFTING YOUR DREAMS

Tadano Ltd. is engaged in the manufacturing and sales of products including construction cranes, vehicle-mounted cranes, and aerial-work platforms. They celebrated their 100th anniversary in 2019 as one of the world's leading construction crane manufacturers. Currently, the group's business domain has been defined as machines for anti-gravity and aerial work called lifting equipment (LW), and it is engaged globally in locations including Europe, North America, South America, Asia, and Oceania. Among its construction cranes, Tadano is a global leader in the number of shipments of rough terrain cranes that are in high demand in Japan because they can maneuver rough terrain. Tadano offers work vehicles optimized for customer needs in the market through its abundant line of construction cranes, including the active use of M&As for the market roll-out of all terrain cranes that lift up to 1,200 tons and crawler cranes that have a traveling body equipped with a crawler belt device (crawler).

Tadano has leveraged its advanced technological capabilities including the development of Japan's first hydraulic crane named the OC-2 actively engaging in construction crane technology development. They have also aggressively invested in further technical innovation in order to respond as quickly as possible to the needs of the market through means such as establishing the Advanced Technology Research Division in 2017 as an independent organization under the direct supervision of the president to enable prompt decision-making. The Technical Research Center located in Takamatsu City, is where Kagawa Prefecture plays a central role in this R&D process. Under the Center's vision of "polishing skills and polishing usability" they are looking to achieve dramatic transformation in the construction industry in regards to safety and productivity. They have worked day and night to develop new technologies that resolve various social issues, including the use of advanced technologies to provide support in response to the lack of skilled operators because of a decrease in the number of construction workers, and also to reduce accidents at construction sites.



"A real-time simulator was necessary to enable the sensory analysis of operations at an early stage in the development process."

— Dr. Shinji Noguchi, Technical Research Center Manager, Tadano Ltd.





“It is not possible to change and evaluate parameters with actual crane. Only the simulator makes easy to change and confirm various simulation variables.”

—Hiroki Ichikawa, Technical Research Center, Technical Research Unit, Doctor of Science, Tadano Ltd.

A crane boom that is equal to an arm of a crane can cause boom crane deflection and load swing when it attempts to lift a load. To understand the physical property of a load swing and how cranes are actually used at construction sites, it is essential to consider the control method of a load swing. However, designers are not able to enter construction sites where cranes are at work due to hazardous areas. Therefore, as explained by Shinji Noguchi, Technical Research Center Manager, “We have worked to quantify the line of sight of well-experienced crane operators during their work through measurement and analysis. Although sense is important when people operate things, this is not something that has been sufficiently incorporated in product development up until now.” According to Kazuya Tanizumi Technical Research Center Chief and Doctor of Engineering when considering development time, “Evaluation based on the sensibilities of the person operating a crane is of course only when that person actually gets on the crane and operates it. For this reason, a lot of time has been necessary just for evaluation, including

prototype manufacturing and test environment preparations. Therefore, it was necessary to develop a simulator that would enable sensibility evaluations at an earlier stage in the product design and development process.”

DEVELOPMENT OF A REAL-TIME CRANE SIMULATOR THAT ENABLES SENSORY ANALYSIS

The simulator was required to accurately model a crane boom and reproduce that behavior in real-time. For this reason, what caught the interest of the company was the multibody simulation software, Simpack, as offered by Dassault Systèmes. According to Tanizumi, “We considered multiple software products in the product selection process. While there were products capable of real-time simulation in the case of a rigid body, there were no products besides Simpack with its advanced technologies that enabled the accurate reproduction of the crane boom deflection that is important when simulating a construction crane. In addition, it was only Simpack that made real-time simulation of a human sensory analysis possible.”

Being able to generate a physical model for simulation based on accurate design information was another important point that led to the selection of Simpack. According to Noguchi, “What we wanted was not a simple simulator such as those that are used in training by operators, but a high-precision development tool with a high level of reproductivity. Our engineers need to be able to generate and analyze a physical model for structures based on accurate design information.”

NOT ONLY ACCELERATES THE SPEED OF R&D, BUT CAN ALSO BE USED AS A COMMUNICATION TOOL

The simulator was built with the support of Dassault Systèmes and it was used to develop a model for major types of rough terrain cranes that are a mainstay product of Tadano. The actual simulator was developed in an integrated manner that includes hardware, such as the cabin that is ridden by operators, operating levers, an overload preventive device called an AML, and displays along with a large one that visualizes the Simpack calculation results in real-time. The simulator makes it possible to directly operate Simpack and confirm the results, including making changes to parameters such as crane conditions and load weight, executing the simulator, and displaying results. Because intermediate files are not required, it is possible to change the type of crane and run a simulation even without any model knowledge. The simulator has contributed to a reduction in manpower hours, which has reduced the product development period from one year to about six months with the release of new functions accelerating.

The simulator is also used as a tool for the development department to understand the ideas of the research department. Tanizumi praises Simpack, stating that "Although there were cases in which it was difficult to convey the functions in new design proposal up until now, virtual experiences using the Simpack simulator have improved the understanding of the people involved compared to before and helped facilitate development in many cases."

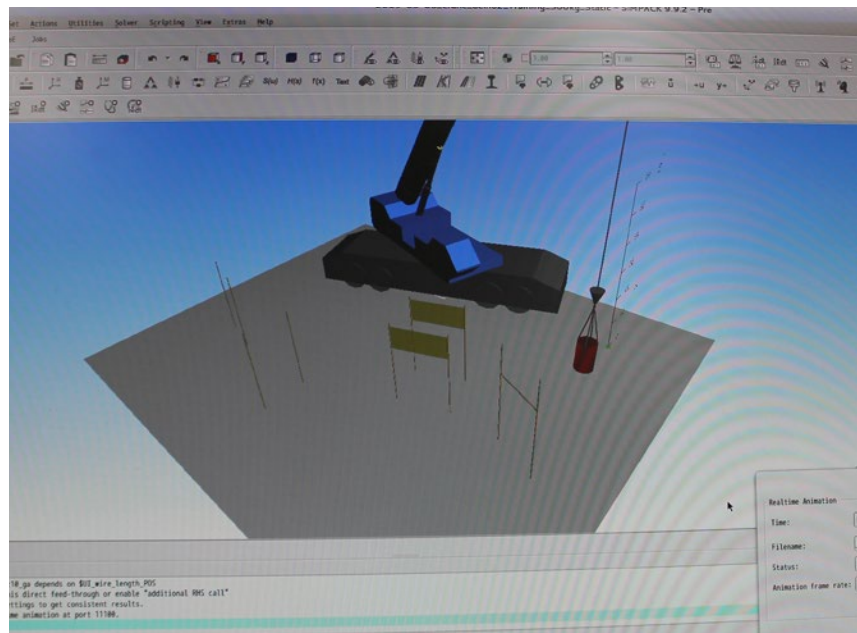
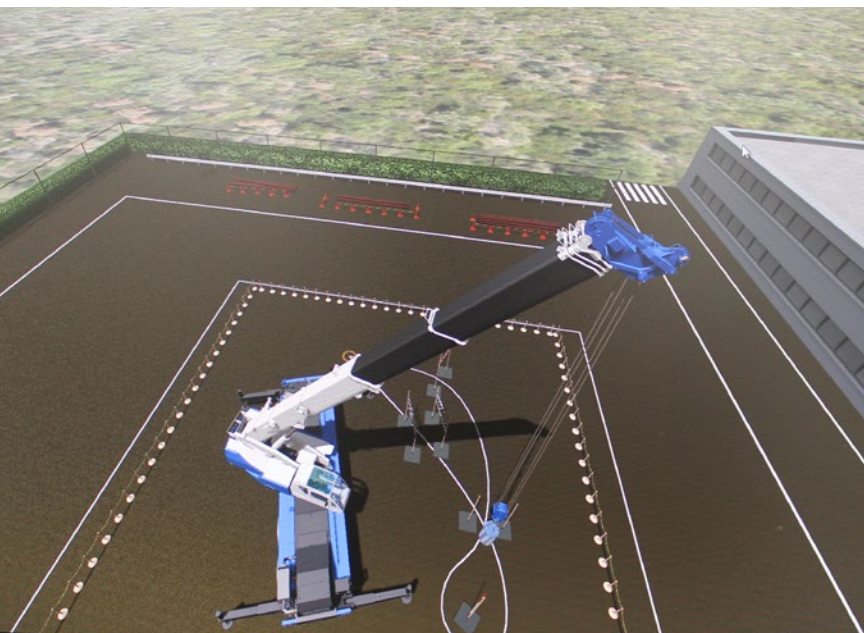
"It is necessary to remodel boom from the model in order to change and evaluate crane parameters. These modifications are simple with Simpack because the GUI and simulator are directly linked."

— Kazuya Tanizumi, Technical Research Center Chief and Doctor of Engineering, Tadano Ltd.

EXPANDING THE SCOPE OF USE WHILE DEVELOPING MODELS FOR MAJOR TYPES OF CRANES

As explained by Dr. Hiroki Ichikawa, Technical Research Center, Technical Research Unit, who is currently developing new hydraulic valves for systems, "There are plans to create a hydraulic valve simulation code, link it with Simpack, and create co-simulations in real-time. I hope that motion response evaluation for the mechanism including hydraulic characteristics (a crane model created with Simpack) will make it easier to find areas for improvement with the valve." Ichikawa relays that, "In addition, there are also plans for coupling with MATLAB that is broadly used in control system design, and I also hope that Dassault Systèmes will provide ongoing support going forward regarding the response that is required to expand the scope of utilization."

For More Information
www.tadano.com



Ariens Zero Turning Radius Mowers and the Triple-Bottom Line

By Mathew Weglarz, Principal Engineer, Ariens Co. and Tim Hunter, Ph.D., President, Wolf Star Technologies, LLC

Ariens is a manufacturer of high end and industrial zero turning radius mowers. Ariens faced a redesign challenge to an existing line of zero turning radius mowers. The mower has a steel engine plate positioned below the seat on the mower. Bolted to the engine plate are the transmissions and the engine. The transmissions were running too hot and it was determined that the engine plate needed modification to provide increased access to cooling air. The engine plate was redesigned to improve airflow to the transmissions, but still maintained the required structural integrity. To tackle this challenge, Ariens engaged Wolf Star Technologies to assist with the redesign and to provide decision-ready data to the team.

The mower is subjected to a proving ground course consisting of a very rough profile and must perform several maneuvers with the mowing equipment engaged. This creates an extremely complex profile of loading that cannot be analyzed by traditional means. Conventionally, the structure would be fitted with accelerometers. From the acceleration data, loads would be determined. This is very difficult in practice as the masses associated with those accelerations are difficult to determine. Alternatively, the structure could be fitted with load cells in key areas. In many cases it is difficult to capture all the load cases acting on the structure in this manner.

Since traditional methods are impractical, Wolf Star Technologies employed their True-Load software to turn the engine plate into a load transducer to determine the operating forces acting on the structure induced by the complex loading profile. This loading profile in turn was used to drive the redesign process on the engine plate.

The first step of the process is to apply unit loads to the FEA model. It was determined that the appropriate unit load cases would be 10Gs in X, 10Gs in Y and 10Gs in Z directions (Figure 1). This would be able to characterize any arbitrary excitation of the structure.

From these three unit load cases, True-Load determined that there were 8 optimal strain gauge locations on the structure (Figure 2). Once applied to the structure, these 8 strain gauges would be sensitive to the entire loading profile.

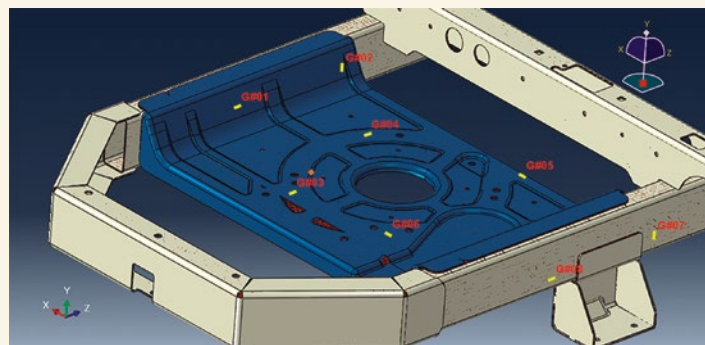


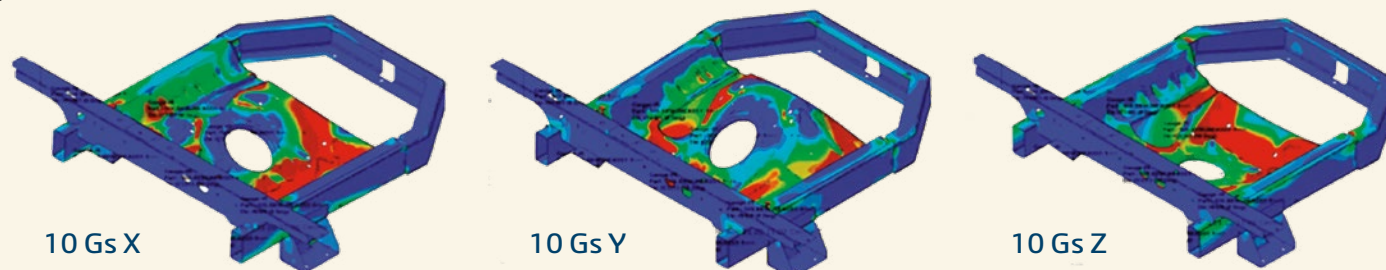
Figure 2: True-Load Gauge Placement.

Strain Gauges were applied on the structure per the True Load specified locations. The mower was driven over the proving ground and strain data was collected. True-Load processes the strain data through the True-Load/Post-Test module to calculate the operating forces from the strain data. True-Load/Post-Test automatically creates correlation plots showing the simulated strains at the gauges plotted against the measured strain from the proving ground (Figure 3).

Ariens had attempted the first redesign using their internal engineering guidelines for engine plates. The first prototype was on shaker test when Ariens started the project. The unit had failed at 1,200 hours on a 10,000-hour shaker test. The loading data was collected, and the initial failed model was run in fe-safe® using the loads calculated from True-Load. The loads from True-Load together with fe-safe durability calculations, predicted a life of 1,000 hours. This is a perfect correlation in the fatigue world and revealed that the loads determined from True-Load were correct.

In conjunction with the engineers at Ariens, we rapidly went through five design iterations of configurations. These iterations included configurations with varying sheet metal thickness, material, and hole patterns. (Figure 4). All iterations used the True-Load determined loads and fe-safe to analyze the structural integrity. The fifth iteration provided the necessary airflow and better durability than the initial design.

Figure 1: FEA Unit Load Cases.



COST COMPARISON (Figure 5)

Without True-Load			With True-Load		
Cost	Duration	Description	Cost	Duration	Description
Initial Costs			Initial Costs		
	1 Day	Initial FEA		1 Day	True-Load/Pre-test (use existing FEA)
			\$80	1 Day	Strain gauge existing tractor
				1 Day	Testing—Data collection
				1 Hr	True-Load/Post-test—Calculate loads
Cost per Iteration			Cost per Iteration		
\$30,000		Prototyping/testing		1 Day	FEA/True-QSE/fe-safe
	6 Weeks	Procuring			
		Guess at loads for inputs			Known loads—Right design decisions
Cost of 5 Iterations			Cost of 5 Iterations		
\$150,000	30 Weeks	Engineering looks 'dumb' Lack of confidence Lost time to market	\$800	8 Days	Amortized True-Load Cost (\$25K) + Gauges High confidence Look like a hero

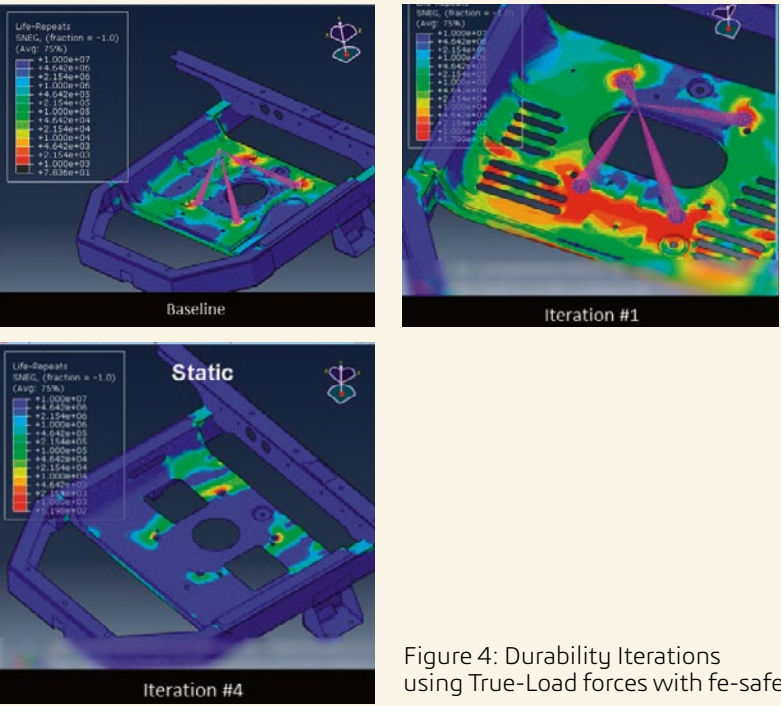


Figure 4: Durability Iterations using True-Load forces with fe-safe.

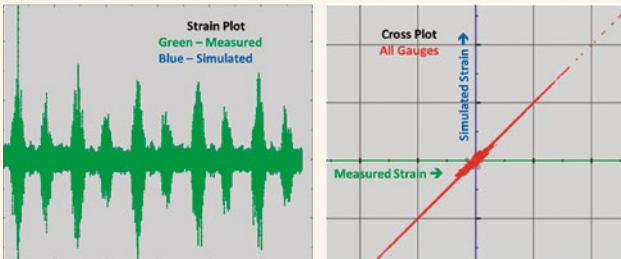


Figure 3: Cross Plot – Simulated Strain vs Measured Strain.

The engineers at Ariens concluded that they were able to reduce cost and decrease time to market. Figure 5 summarizes the cost and time efficiency of using True-Load in the design cycle. Ariens was able to increase their speed to market by 25x and reduce costs by orders of magnitude using Abaqus, fe-safe and the True-Load software by Wolf Star Technologies. True-Load was able to calculate operating forces from strain measurements on their proving grounds. These strain correlated loads drove design changes in a mission critical product update. This efficiency improvement in product development has 5x the implications on reduction of the environmental footprint from product development: reduced raw material, reduced energy.

Ariens was able to hit the triple-bottom line by implementing True-Load with Abaqus and fe-safe to deliver products to market faster and more efficiently. If an engineer can determine the actual stresses acting on their structure, designs can be delivered quickly and on time using the advanced simulation tools provided by the Abaqus, fe-safe, and True-Load platform.

[Learn more about Wolfstar Technologies.](#)

SIMULIA CHAMPIONS

SIMULIA experts come from all over the world, from numerous different disciplines. In 2020, SIMULIA has decided to recognize some of those experts who are using their knowledge and skill to advance the future of simulation. The SIMULIA Champions Program acknowledges the contributions of these individuals and awards them not only recognition but speaking opportunities, training, mentorship opportunities and more. Several of these Champions have also been given the chance to tell their stories through interviews on the SIMULIA Blog. Here we have taken some extra time to get to know two of our Champions in more depth.

Fifteen years is a long time in tech. When Huan-Yang Chen started using CST Studio Suite in his research as a college student, 3G was the state of the art in cellular technology and the iPhone was still years away. Today, as Principal Engineer for Zebra Technologies, Chen still uses CST Studio Suite to design 5G and other antennas for integration into a huge range of smart devices.

Zebra Technologies started as a data company focusing on barcode printing, but as logistics technology advanced, so did Zebra. Zebra builds enterprise-level data capture and automatic identification solutions for many leading Fortune 500 companies. From improving delivery times and accuracy to offering visibility into device health, or efficiency in your hospital, Zebra provides solutions and products that successfully tackle daily business challenges. Many of its products include integrated antennas for various applications, including RFID scanning, wireless charging and Internet of Things connectivity. As the number of antenna systems increase, the challenge of integrating the antennas into devices grows.

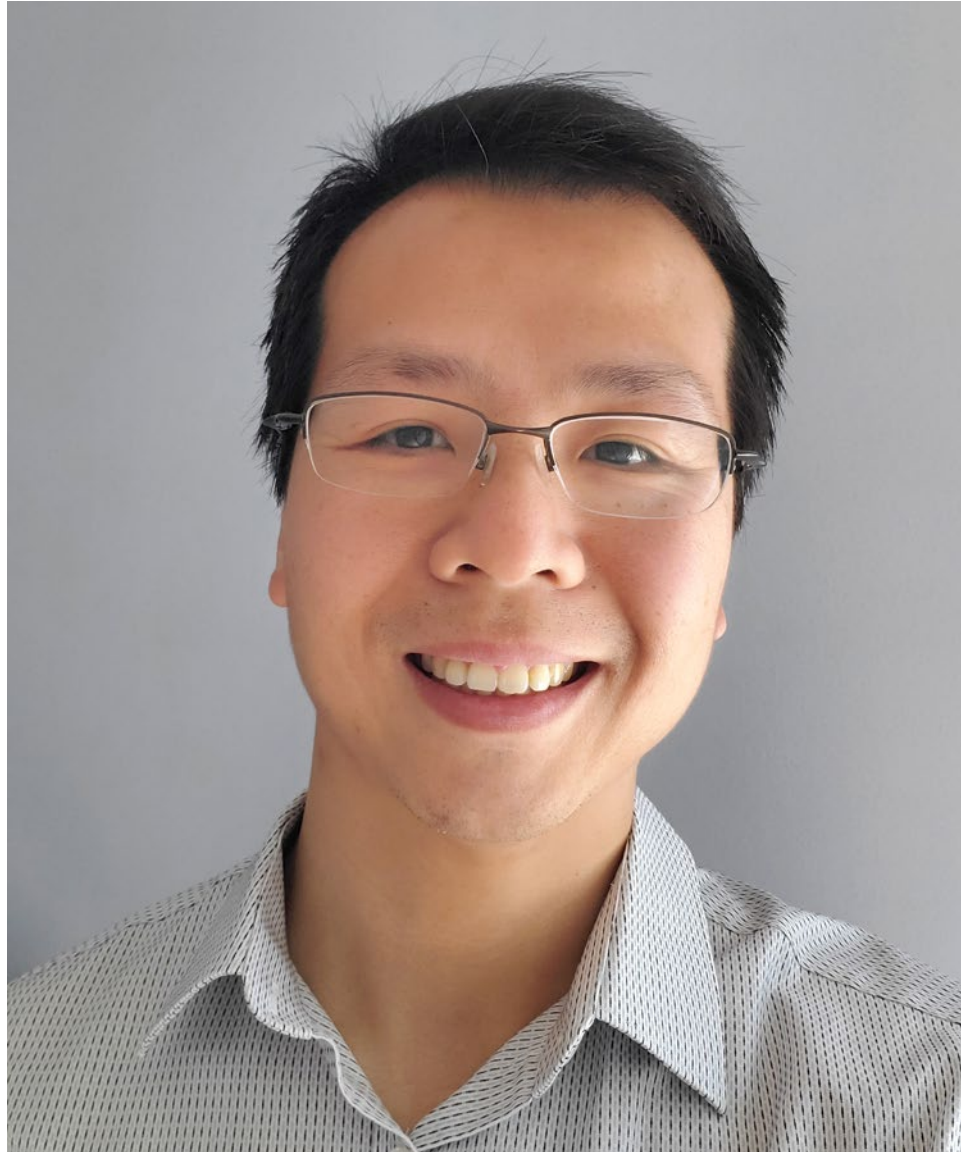
One major industry trend Chen has seen in the past decade is Big Data. Connected devices can generate a huge volume of data. Inventory management now requires a wide array of networked sensors, from barcode and RFID scanners to

cameras to temperature sensors. “We have to collect more and more data effectively, and then analyze that so that we can drive business decisions very precisely and in time.”

Related to this is the evolution in wireless connectivity. Wi-Fi, Bluetooth, and cellular technologies like 5G are needed to transmit the data from portable devices and sensors out in the field to the central servers. “The design complexity has increased dramatically, and there’s a lot of interference,” says Chen. “Our job is to ensure we package all these antennas in a compact form factor, without unacceptable interference between the radios.”

To tackle this challenge, Chen uses electromagnetic simulation in CST Studio Suite. “We get a lot of insight and data out of simulation. For example, the near-field distribution, E-field [electric field], H-field [magnetic field], and current distribution around the antenna and all the components,” says Chen. “With measurement, we see the results, like total efficiency and performance. But with simulation we can understand the real cause if we are failing at some frequencies or bands.”

“In the old days, we built a lot of prototypes before identifying the optimized design or somewhere close. With simulation, using parameter sweeps, it will be much faster and



Huan-Yang Chen, Zebra Technologies

much easier for us to achieve that. At the system level, it can even help us to achieve some results before any physical device is available."

Chen has used CST Studio Suite across different employers, ever since he was a student. He tells us he stuck with the tool over the years "because it's very user friendly, the design is actually very intuitive compared to other tools I have used." Chen goes on "I actually have fun. A lot of fun using CST."

Looking to the future, Chen plans to continue using CST Studio Suite to meet the new challenges of 5G and Big Data. "Especially for 5G, we have tons of data we need to post-process properly and in a fast fashion. How can we come up with a very practical and reasonable way for post-processing

to accelerate and expedite the whole design and development cycle? That's definitely one of the key things I hope I could achieve in the future." Another goal is to expand design to take into account the operating environment, in order to reduce the risk of interference and further improve performance. We can provide not just the module-level simulation, or even device-level simulation, but also the system-level simulations along with the environment modeling for wave propagation."

To thank Chen and acknowledge his years of experience and advocacy of CST Studio Suite simulation, he has been named a SIMULIA Champion.

Continued on page 18



Dr. Feng Feng, Collins Aerospace

You may or may not have heard of Collins Aerospace, but if you've flown in an airplane anytime in the last few years, you've been impacted by its expertise. The Raytheon Technologies subsidiary was formed in 2018 by combining UTC Aerospace Systems and Rockwell Collins, and today, its products can be found on every aircraft currently making flights.

According to Dr. Feng Feng, Technical Fellow in Structural Discipline with Collins, the company would not have been able to achieve that impressive statistic without simulation.

"We had aircraft before World War II, so we would have airplanes, but [without simulation] those aircraft would be heavy and short of life, and add lots of pollution to the air," Dr. Feng says. "Most of the parts will fail in a short amount of

time and we cannot create very high-performance products. I don't think we can create the designs for aircraft without simulation now."

Dr. Feng is also one of the 2020 SIMULIA Champions, a group of individuals who are using their expertise to advance simulation technology and educate others. In addition to working with simulation to create better aircraft components, he also helps develop curriculum and improve training processes for Collins Aerospace, as well as participating in a workplace mentor/mentee program. He has a strong desire to share his knowledge, both within his company and without, and wants to continue educating tomorrow's engineers for years to come, both in his current position and possibly as an adjunct professor.

Dr. Feng has a long history with simulation software, going back to his time at UCLA, where he earned a Ph.D in Solid and Structural Mechanics after completing his Bachelor's and Master's Degrees in China. He deepened his knowledge of simulation software, particularly Abaqus, when he began working for SIMULIA as an Advanced Application Developer. He credits much of his expertise in Abaqus to his time at SIMULIA, where he stayed from 2005 to 2008 before moving on to Collins Aerospace.

That expertise has served Collins Aerospace well. Dr. Feng points to the company's main goals for its aircraft: lighter weight, longer life and overall better quality, which can all be achieved by using simulation. He also mentions additive manufacturing, which is playing an increasingly significant role in developing stronger, lighter aerospace parts with more complex geometry. Simulation is a driving force behind this technology, as additive manufacturing is a delicate process that requires careful planning ahead of time to avoid failed parts.

Regardless of the technology used to make the components, whether it is additive manufacturing or more traditional methods, Collins Aerospace relies on simulation to optimize geometry and validate parts, cutting traditional turnaround times by 60 to 80 percent and reducing material by 10 to 30 percent, according to Dr. Feng.

He gives an example of a heat exchanger, which is a critical part in air management and engine cooling. The design of the component is highly complicated, requiring a system of tubes that separate hot and cold air. A heat exchanger can be at risk of thermal fatigue, causing the part to crack or fail.

"We want to make sure that this heat exchanger will not fail in the aircraft service life," Dr. Feng says. "We have to use very sophisticated simulation to handle this work. So we run the transient thermal analysis and transient stress analysis, then we run the fatigue analysis."

This is only one of the workflows that Collins Aerospace developed using Abaqus. Future workflows, says Dr. Feng, will become more complex and include deep learning, a kind of artificial intelligence process based on artificial neural networks. He sees automation as the future of manufacturing—not necessarily robbing human beings of jobs, but making their work easier and more effective.

"The future work I really want to do is to combine machine learning and deep learning with optimization, to automate processes and finalize designs," he says. "This is a long-term goal."

Dr. Feng's other goals include the creation of energy-saving and environmentally-friendly designs. One of the biggest challenges for the industry right now, he continues, is the challenge facing every other industry right now – the COVID-19 pandemic. Collins Aerospace and the rest of the aerospace industry are struggling with how to make aircraft safe for passengers. People just aren't traveling by air right now, and that hurts the industry – although, Dr. Feng comments, it helps the environment as the air becomes clearer. Ultimately his mission is to keep people flying and the industry booming

while maintaining the healthier environment that we are seeing right now. This will require new technologies that support lighter aircraft, longer life, and less fuel. Simulation and additive manufacturing, just as two examples, will be instrumental in helping companies move in the right direction.

A passion for new technology is what drives Dr. Feng, what pushes him to get up and go to work every day. Technology is constantly changing, and he is excited to be at the forefront. Collins Aerospace is not alone in its use of simulation technology to design and validate its components; the aerospace industry as a whole is seeing a major shift in the way it manufactures.

Abaqus has played a significant part in that shift, Dr. Feng says. "In the past, we noticed that an enormous amount of time was spent in handoffs among designers, CFD analysts, and structural analysts, and conversion of data from one software to another one," he explains. "Besides the improvement of communications and geometry precision from designs, Abaqus customization and scripting capabilities have also played an important role in streamlining and automating our standardized processes. It significantly improves the efficiency of the entire process."

According to Dr. Feng, Collins Aerospace is a firmly customer-centered company, with its priorities focused around how it can make life and travel easier for the average person. Right now much of that energy is centered around passenger safety in the coronavirus era, but the company isn't losing focus of its other goals, which include designing aircraft that are better for the environment and safer overall for consumers.

Dr. Feng's experience with simulation goes a long way toward achieving those goals. With 12 papers and 15 patents to his name, he has achieved much in his more than 20-year career, and has helped his industry make great strides in creating better, safer, and more environmentally friendly products through simulation. He credits SIMULIA products in particular for helping him to make those strides.

"I believe that the SIMULIA package ensures important customer benefits on superior performance, significant cost reduction, and robust products using automation, customization, and optimization, which are (and will be widely) adopted and implemented in simulations in the industry," he says. "The SIMULIA package outperforms most of the commercial tools available in the industry because of its unique and fully functioning advanced features listed above working together as a whole."

To learn more about the Champions Program, visit
[www.3ds.com/products-services/simulia/
champions-program/](http://www.3ds.com/products-services/simulia/champions-program/)

SUSTAINABILITY IN LIFE SCIENCES

Recent years have seen the maturing of the healthcare industry, including tremendous advances in medicines, devices, and sensors, but also some high-profile scandals, including product recalls, ineffective treatments, and the opioid crisis. These not only have dire consequences for patient safety but also threaten the sustainability of medical products and the way they are created and brought to market.

Historically, medicine was a relatively small, care centric field—a patient’s personal doctor would have direct control over most areas of care. The rise of healthcare as a true product based industry has completely reshaped this relationship, with long and complex supply chains behind even relatively basic products and massive regulatory oversight.

This translates into a very top-down ecosystem. For a medical device to reach the patients that need it, it has to first pass through regulators with differing rules in all of the markets in which it will be sold. Then procurement departments of hospitals must stock it (typically with input from insurers and/or government payer agencies), before finding its way into the hands of the doctors who will use it, following extensive education and training protocols.

The complexity of this value chain means that information rarely flows efficiently back up to the top. Historical product knowledge is centralized within the teams who created the products. Real-world clinical experience typically stays in the minds of the physician, technicians, or even patients. When someone changes jobs or retires, their knowledge and experience go with them, leading to further loss of information over time.

Patient outcome monitoring is limited, meaning that problems are not always identified quickly enough. Combined with the competitive pressure to bring

new products to market at the lowest cost, efficacy, or safety issues are too often discovered in devices that are already widely used. This in turn requires recalls that are expensive and extremely damaging to the confidence of both patients and doctors.

The current life sciences ecosystem is therefore not sustainable, and changes are needed if the medical industry is to remain healthy. Essential components of an effective transformation include improving the information flow between providers, regulators, and manufacturers, improving education and knowledge retention schemes, and pioneering *in-silico* virtual testing of devices and treatments to reduce the risk and improve outcomes. Dassault Systèmes SIMULIA software and the **3DEXPERIENCE** platform offer a potential solution for healthcare professionals and engineers with the tools they need to master these challenges in the future.

SIMULATION

With so much riding on its output, why has healthcare become unsustainable? At the core is our understanding of Life Sciences, an inherently multi-disciplinary field. Expertise in biology and chemistry as well as physics, from structural and fluid mechanics to electromagnetics is necessary to innovate safely and effectively. Developing effective, reliable treatments means mastering all of

ASPECTS OF SUSTAINABILITY

In life sciences, “sustainability” can be defined as having both environmental (develop and manufacture without unsustainable material consumption or waste) and economic (protecting growth by ensuring that current products will not harm future profitability) impacts.

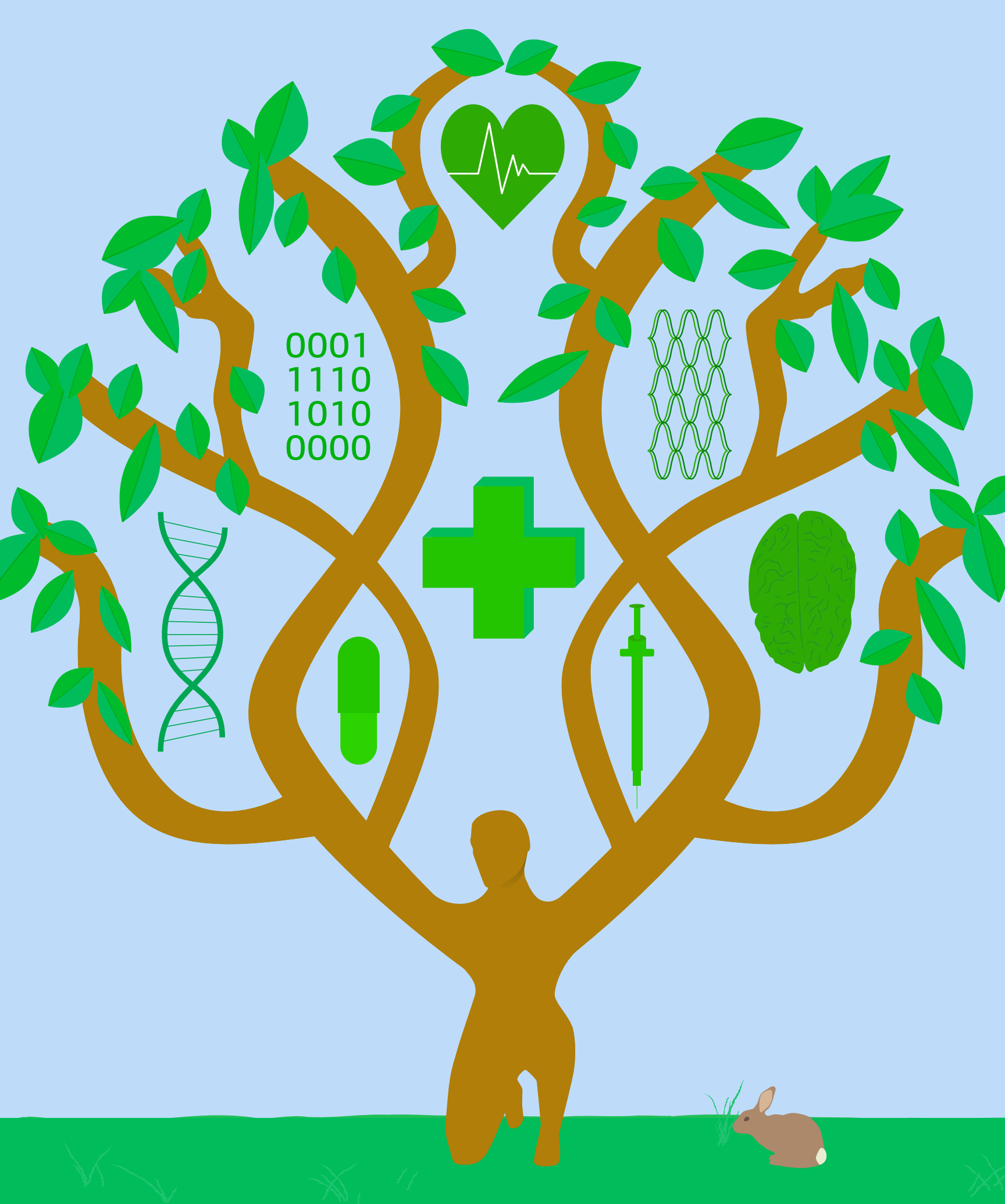
Minimizing

- Energy and material consumption
- Medical waste
- Testing on animals and humans
- Clinical failures and recalls

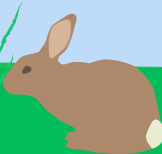
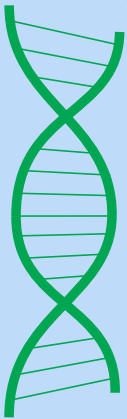
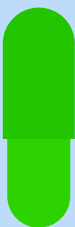
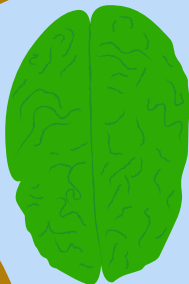
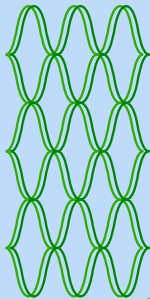
Maximizing

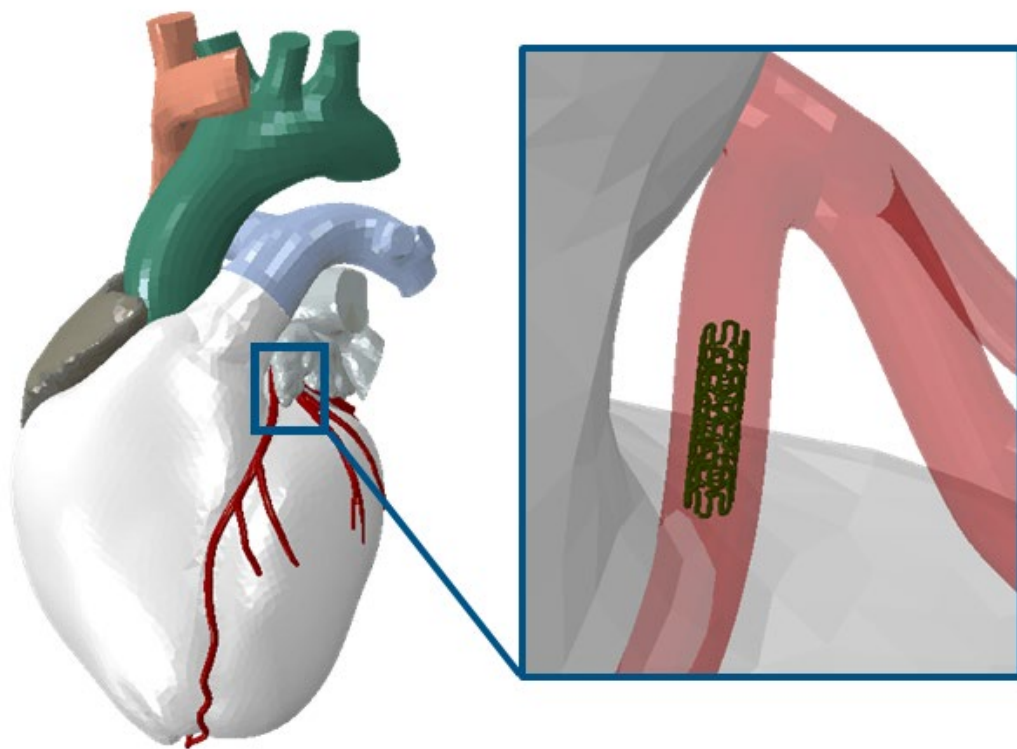
- Knowledge and experience preservation
- Impact on society
- Cost effectiveness

these disciplines— not just in isolation, but together. How can that be possible? The Living Heart Project, founded by Dassault Systèmes, was an experiment to unite researchers, clinicians, industry, and regulatory bodies like the US Food and Drug Administration (FDA) to build a sustainable way to address the #1 cause of death, heart disease. Its success serves as an example of the kind of collaboration necessary to develop a



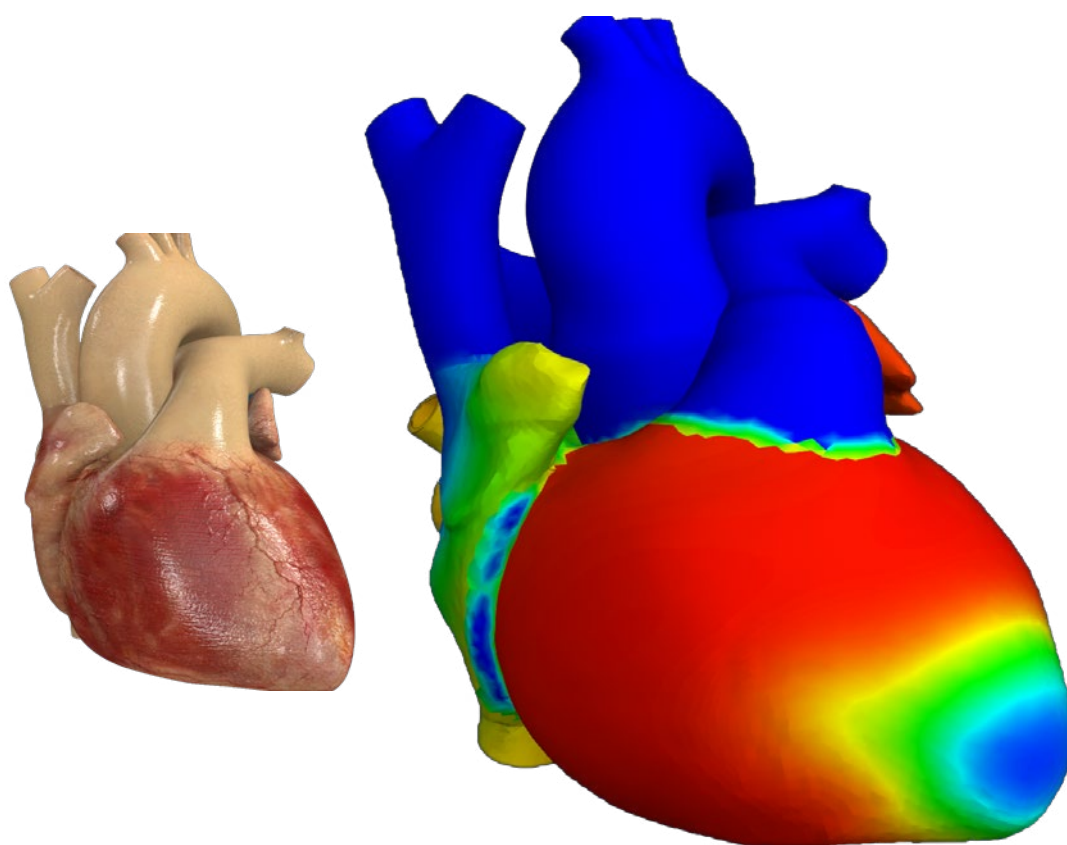
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Philipp said he was able to
 “reduce the maximum strain by
 35%, the alternating strain
 amplitude in a fatigue life
 evaluation by almost 50%,
 and better distribute strains
 overall.”

—Philipp Hempel, engineer, Admedes



“Visualizing biology through
 finite element simulations
 allows them to gain a better
 insight into the things that
 they would otherwise just
 memorize, for example,
 reading the traces of an
 electrocardiogram.”

—Professor Dr. Ellen Kuhl,
 Living Matter Lab at Stanford University

sustainable, modern medical ecosystem. The project aimed to architect an ecosystem, based on a widely available platform to translate cardiovascular science to clinical practice.

At the center of this ecosystem is the creation of a library of virtual twin models of the human heart that captures the full behavior of the organ in incredible detail. Building these models meant capturing the collective knowledge of all aspects of heart function, from the electrical conductivity in the ion channels to the mechanical response of the cardiomyocytes and of course the detailed dynamics of the blood flowing through the valves and chambers. These models establish a unified foundation for cardiovascular in-silico medicine and serve as a common technology base for education and training, medical device design, testing, clinical diagnosis, and regulatory science. Most importantly they provide a concrete mechanism to capture, retain, communicate, and use medical knowledge that is truly sustainable.

Moving reliance from animal or human testing (*in-vivo*) to virtual testing (*in-silico*) enables designs and novel interventions to be developed and optimized in thousands of virtual patients to ensure safety and efficacy. Rapidly finding the optimum treatment dramatically lowers time and cost, as well as cutting the laboratory and material waste needed to create and test prototypes.

Admedes Schuessler GmbH, a leading contract manufacturer of nitinol and other metal-alloy medical implants and components, leveraged the Dassault Systèmes Living Heart Human Model to extend the lifespan of implantable nitinol stents. These metal stents have singlehandedly served to extend the life expectancy of people around the world. However, this places great demands on the lifetime of the device.

Using the SIMULIA software for structural simulation and optimization, Admedes engineer Philipp Hempel was able to increase the durability under real-world conditions by accurately

calculating the strain within stents operating in a virtual beating heart. No longer limited by costly trial-and-error approaches, this allowed automatic design optimization to significantly improve the stent strength. Philipp said he was able to “reduce the maximum strain by 35%, the alternating strain amplitude in a fatigue life evaluation by almost 50%, and better distribute strains overall.”

Reducing the risk of failure both cuts waste, improving environmental sustainability, and also protects the reputation of the company, ensuring economic sustainability.

Prosthetics and joint implants are examples of applications where physical simulations can be used to create designs that improve patient comfort and range of mobility while reducing the risk of repeat procedures due to device failure or insufficiency. Simulation supports personalized medicine: the patient’s anatomy serves for ideal device selection or when appropriate, the prosthetic modified to optimize its performance and ultimately the patient’s quality of life. Simulation informs pre-surgical planning by providing a virtual, yet personalized environment for understanding complex patient physiologies and for testing surgical treatment paths to ensure the best option is chosen.

A key paradigm to obtain sustainability is getting it right the first time. The complex interactions between the systems of the body and various treatments from separate fields of medicine represent significant challenges. Devices and treatments that appear to work in the lab may fail in practice due to unforeseen real-world effects. For example, powerful magnets and radiofrequency fields used in MRI imaging mean many patients with metallic implants cannot be scanned for safety reasons. All devices must be screened for this test. Multiphysics MRI simulation using EM and thermal simulation (including bio-heat simulation to model the body’s own cooling mechanisms) reveals the level

of heating of implants expected during imaging. Bringing together different disciplines helps patients with these implants get the care they need, implant manufacturers can develop designs that are less prone to heating, while MRI operators can calculate a safe field strength for the patient. Performing these tests in-silico not only allows for optimal designs but can now be used directly for regulatory approval.

DATA INSIGHT

Today, for companies to stay competitive through sustainable product innovation, they need to utilize the expertise of professionals across many different fields. The complete lifecycle of the product needs to be considered, which necessitates effective communication between researchers, manufacturers, hospitals, and even regulators.

Sustainable development in medicine is complicated by operational and logistical difficulties, conflicting priorities, and scarce resources. But, these obstacles can be overcome by establishing mutual goals between various experts and stakeholders, sharing their perspectives, and connecting need with the capability to yield breakthroughs in the marketplace.

To break down these silos, however, specialists from sometimes very different fields need to find common ground. They have to be able to share their data in accessible formats, view it in a way that can be easily understood, and work collaboratively on designs and experiments. Sharing data can offer new insights and understanding of how the body works and how interventions perform. Using virtual patients, a wealth of information can be revealed that you just cannot get from a human. Working in the virtual world, cross-disciplinary teams can work together to get an intervention from the drawing board into practice faster and with reduced risk of recalls.

Managing complex medical data is no easy challenge. Data must be identifiable in its contextual form, which often means an actual patient.

Confidentiality and safety need to be paramount, and the data transfer needs to be secure and always up to date. This requires a “single source of truth”—a central data storage that can be accessed by any stakeholder with the correct authorization, which is constantly updated when new information is received. Data stored can be easily searched and reused, preventing the waste of time and resources.

For Dassault Systèmes, the solution to this challenge is to develop a reliable standard for in-silico testing on the **3DEXPERIENCE** platform, a collaborative, data-driven, model-based environment. Every modification to the digital model and related information is propagated automatically and every change and decision is associated with the right model. The **3DEXPERIENCE** platform

provides digital traceability between the final design and the final tested and released version of the product, required for trust and regulatory approvals.

With in-silico testing, studies that currently take years could be reduced to days, and the amount of testing on animals and patients dramatically reduced. With schemes like the Living Heart Project, Dassault Systèmes is showing that the **3DEXPERIENCE** platform can improve the robustness, response time, and transparency of the medical device review process. Ultimately, this will enable regulators full digital access to all relevant information, and people required to make rapid, science-based, informed regulatory decisions.

In the end, a patient-centric approach will enable companies to create solutions

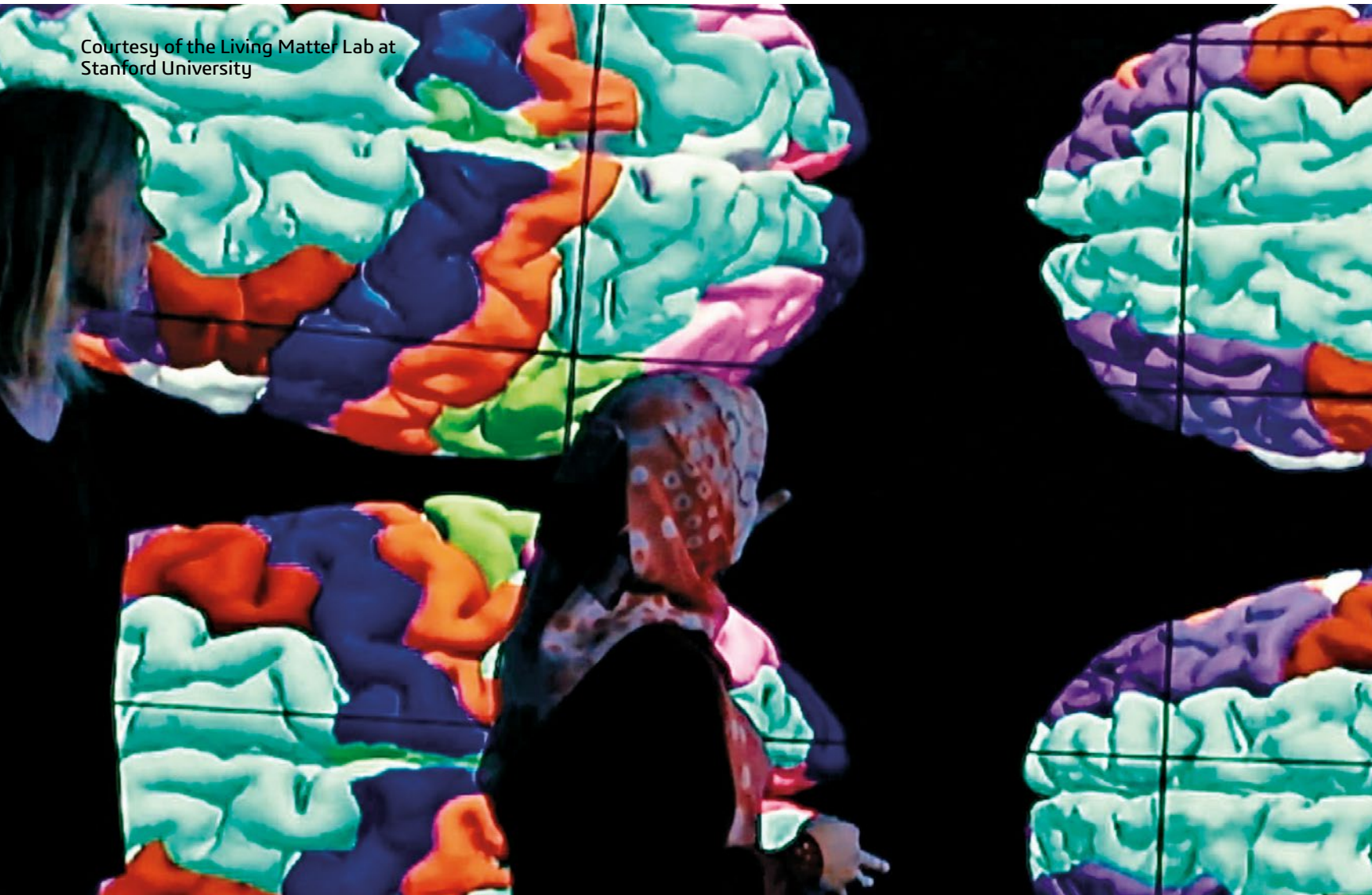
that are safer, of higher quality, and are more sustainable. Insights gained from patients will result in better drugs and devices that are more effective and safe. This will in turn improve patient outcomes, shorten hospital stays and reduce incidences of product recalls.

EDUCATION

Building a sustainable life sciences ecosystem is not a short-term project. The knowledge we have today is the product of generation after generation of researchers and clinicians building on the work of the past. Ensuring that the ever-growing mass of information and experience is passed on to future engineers and physicians is vital to continued progress.

Modeling and Simulation have served in the engineering world as a

Courtesy of the Living Matter Lab at Stanford University



method to capture and communicate complex concepts and is now finding an increasing role in the medical classroom, supplementing traditional lectures, lab work, and dissections with virtual models presented in a way that is engaging and informative. Realistic visualization and virtual reality bridge the gap between the computer screen and the real patient.

One institution that is breaking new ground in the use of simulation in teaching is the Living Matter Lab at Stanford University. The students of Professor Dr. Ellen Kuhl use personalized finite element models (sometimes of themselves) to predict the interplay of form and function throughout the human body (see inset box).

By using simulation to understand such real-world examples of human body form and function, the Stanford students

are demystifying the human body while expanding their own horizons as to what they can do with their careers as future engineers—helping to make simulation an every-day occurrence.

With engineering and medical students working in the Living Matter Lab, Mechanical Analyst from SIMULIA has been a powerful tool in helping them understand one another. “When our engineering students take their first course with our group, they don’t know much about the biology,” says Kuhl. “They often know that there is a problem and they can describe it by an equation, but they don’t really know what it means. By using finite element simulations they can explore the function and visualize what’s happening, for example by looking at an electric wave traveling across the heart.

This helps them better understand the biology behind it.”

“On the other side, medical students are used to memorizing information but often don’t ask themselves, ‘why is that?’ Visualizing biology through finite element simulations allows them to gain a better insight into the things that they would otherwise just memorize, for example, reading the traces of an electrocardiogram.”

With a new generation of engineers and doctors trained in simulation and experienced with multidisciplinary collaboration, the future looks bright for a truly sustainable life sciences industry.

For More Information
<https://ifwe.3ds.com/life-sciences>



ACADEMIC PERSPECTIVES ON SUSTAINABILITY

Researchers, professors, students and others working in academia are at the forefront of shaping the future of our world and in many cases, they are using simulation, design and engineering to do so. In this section of *REVEAL* Magazine, we hear directly from academics about their perspective on important trends and topics and learn about some of the work they are doing to create the future.



ELHAM SAHRAEI

*Assistant Professor, Director,
Electric Vehicle Safety Lab (EVSL)
Temple University*

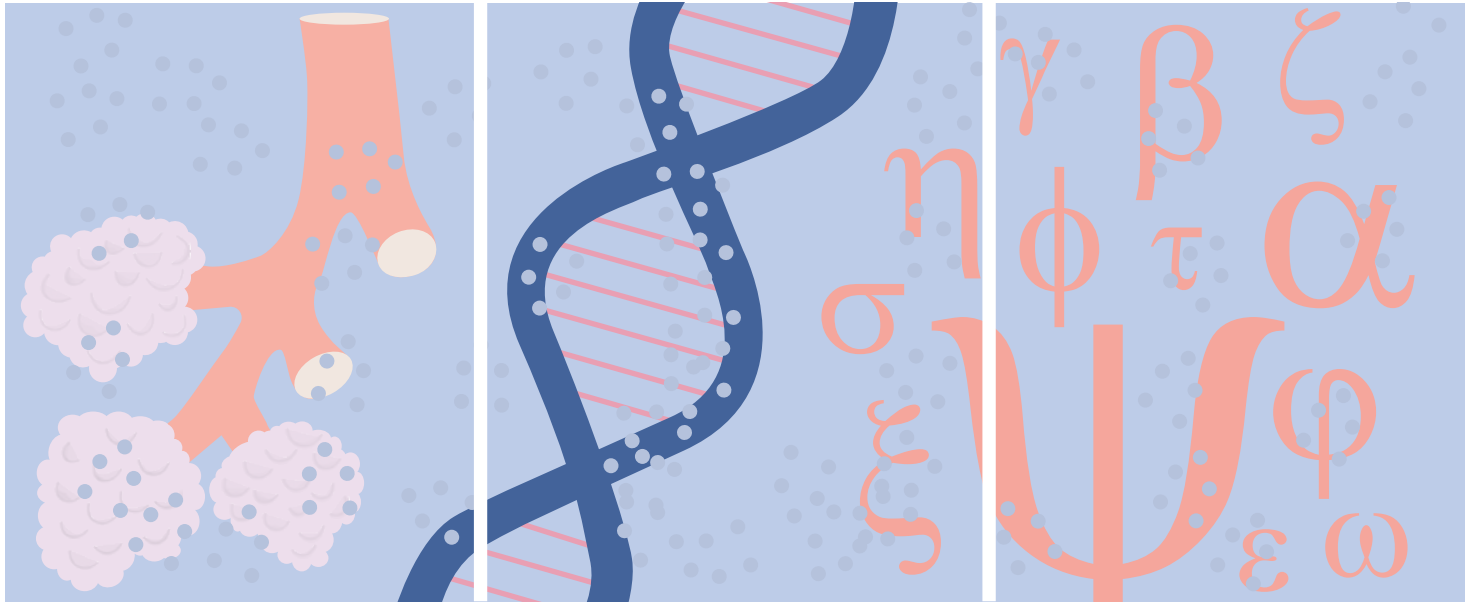
As we move towards EV and other forms of sustainable transportation, the demand for lithium-ion batteries is rapidly increasing. You have done extensive research on the mechanical properties of these batteries and studied various failure scenarios. How do you see FE modeling and validation helping to mitigate potential risks associated with using lithium-ion batteries, especially in the case of electric vehicles where they are subject to various loading scenarios? Besides the possible safety concerns of these batteries, are there other challenges you see for their sustainability, i.e., sourcing the raw material, recycling, etc.?

Modeling can provide guidance in two ways. First in product design, EV manufacturers can use FE models of batteries to design low weight and efficient battery packs and protective structures around them. FE models provide understanding on the mechanism and location of a potential safety issue under a specific testing scenario. Manufacturers can expand their test envelopes by using FE modeling, as the physical tests on battery packs are often expensive and time consuming, and therefore limited in number. Second, once the product design is complete, the FE models can be used to simulate real world accident conditions and evaluate the response of the battery in such cases.

The safety concern is one of the most important concerns for any battery-operated equipment, but safety itself has a broad meaning in case of batteries, especially in mobile applications such as EVs. Safety concerns can arise due to abusive thermal, electrical, and mechanical conditions or due to manufacturing defects generated in the battery even before it is installed in its final location. In EV applications, possible additional issues are vibration, crash, impact or shock due to road accidents. Therefore, FE modeling is needed to understand the multi-physical aspects of the batteries under various loading scenarios. One of the concerns about most EV applications of the batteries is the over design of the protective structures which adds so much weight and volume that significantly reduces the energy and power density of the batteries at the final product level. This is often due to lack of understanding on the mechanisms of failure of batteries. FE modeling can shed light on such issues and assist manufacturers for more efficient products.

Other challenges such as availability of raw materials, range, sustainability and recycling are also important concerns for EV manufacturers however, our focus with FE simulations is mostly geared toward answering issues in safety of these products.

To learn more about Dr. Sahraei's work, visit:
<https://sites.temple.edu/evsl/>



MONA ESKANDARI, PH.D.
*Assistant Professor in the
 Department of Mechanical Engineering
 at UC-Riverside*

Medicine and engineering have historically been separate areas of study with little cross-over. But that seems to be changing as we see the two disciplines working together more and more to create new innovative solutions to old problems. How do you think linking mathematical models with real tissue structures in studying lung function health and illness will lead to new discoveries and treatments in lung diseases?

Lung disease is the leading cause of morbidity and mortality worldwide, propelled by the rise of air pollution and vaping crises. By viewing medicine through an engineering lens, we can gain critically needed insights into lung mechanics to help reverse this trend. In the bMECH lab, we work closely with UC-Riverside's School of Medicine to create new evaluation techniques for the clinical community to improve patient outcomes through early diagnosis, optimized interventions, and treatment assessment.

By linking our extensive tissue characterization experiments to mathematical models, we have overturned a long-standing assumption fundamental to airway biomechanics; we discovered smaller bronchi are drastically less compliant than proximal counterparts. This necessitates reconsideration of how we perceive the role of distal airways during breathing, and informs the development of a new generation of mechanical models. Constructing the first constitutive relationship representative of the bronchial network has empowered our understanding of the interplay between

function and form, and how form dominates over tissue content in governing airway function. Our finite element simulations of tissue specimens paired with histological imaging yield important insights regarding the influence of fiber morphology and microstructural reinforcement on the material response. This is particularly significant because the degradation and remodeling of substructures caused by the onset and progression of disease will transform mechanical tissue behavior. Our computational models investigate how these modifications compromise the structural integrity of the airway wall, helping us focus on mitigating lumen obstruction and challenges to breathing.

It is exciting to explore the multi-scale and adaptive response of biological systems through a medically-driven engineering framework. Our simulations have quantified and distinguished the mechanical differences in lung anisotropy and regional heterogeneity; we will continue to develop these models for healthy and diseased lung tissue, ultimately laying the foundation for constructing predictive technologies for pulmonary healthcare advancements.

Eskandari, Mona, Tara M. Nordgren, and Grace D. O'Connell. "Mechanics of pulmonary airways: Linking structure to function through ν , biochemistry, and histology." *Acta biomaterialia* 97 (2019): 513-523.

To learn more about Dr. Eskandari's research, visit:
bmech.ucr.edu

BUILD SIMULATION SKILLS AND KNOWLEDGE WITH 3DEXPERIENCE EDU SPACE



3DEXPERIENCE Edu SPACE, formerly known as Companion Learning Space, is a learning portal created by Dassault Systèmes to host an extensive course library for learners of Dassault Systèmes products and solutions. Having a comprehensive set of online resources available 24/7 can be a significant game changer in our industry. On any given day, you might be faced with a new simulation problem that requires you to gain quick application knowledge and the only training being offered is at a time that conflicts with an important meeting. Maybe you learned a lot from a training class two years ago and now it's time to refresh and update your skills because the product has new functionality. Unfortunately, your company has travel restrictions. All of these situations are just part of doing business in today's most innovative companies. What resources will you have at your fingertips when you are in a hurry to get started on a specific application or project?

3DEXPERIENCE Edu SPACE provides every user of Dassault Systèmes software with material addressing all these situations. Improve your simulation skills...at your own pace, anytime, anywhere...The content is delivered through a dedicated learning portal that allows you to easily navigate through and manage your courses of interest and track your progress.

COMPONENTS

The Public Cloud Companion for SIMULIA portfolio includes specific training content for the SIMULIA products providing:

- Lecture notes
- Videos
- Hands-on exercises
- Case studies
- Self-assessments
- Interactive guided tours

HIGHLIGHTS

- Be trained on SIMULIA applications at your own pace
- Access a rich database of exercises on a wide variety of industrial cases and functionality
- Get course contents updated at each new release

BENEFITS

- Stay current with all products & releases
- Continuously sharpen your simulation skills
- Decrease travel time and expenses
- Access everywhere, any time

Recently, several updates were made to the **3DEXPERIENCE** Edu SPACE. These updates include:

- 13 new training courses, including CST
- Approximately 180 new workshop demo recordings (completing 4 and adding 23 new courses)
- 5 new interactive guided tours
- Quizzes on 3 courses (Introduction to Abaqus, Isight, Modeling contact and resolving convergence issues)
- Voice over in 2 courses

3DEXPERIENCE Edu SPACE consists of 106 courses with over 1000 learning components. Approximately 460 workshop demo videos illustrate the setup and run of the workshop examples now available for not only the major traditional courses but all Abaqus Advanced and 20 **3DEXPERIENCE** courses.

Major courses including Introduction to Abaqus, Isight, Simpack, Tosca Fluid, Tosca Structure and Modeling Contact and Resolving Convergence Issues now are equipped with the following:

- Voiceover/lecture recordings providing verbal explanations to lesson content
- Interactive guided tours enabling the user to click through a simulated GUI environment following a guided procedure
- Quizzes emphasizing the most important topics in the corresponding lecture
- Workshop demo recordings to complement detailed step-by-step instructions

To access **3DEXPERIENCE** Edu SPACE:

<https://learningspace.3ds.com>

For more information about Companion, please contact your DS Education Partner, Sales Representative or email:

Learning.Companion@3ds.com

Training section:

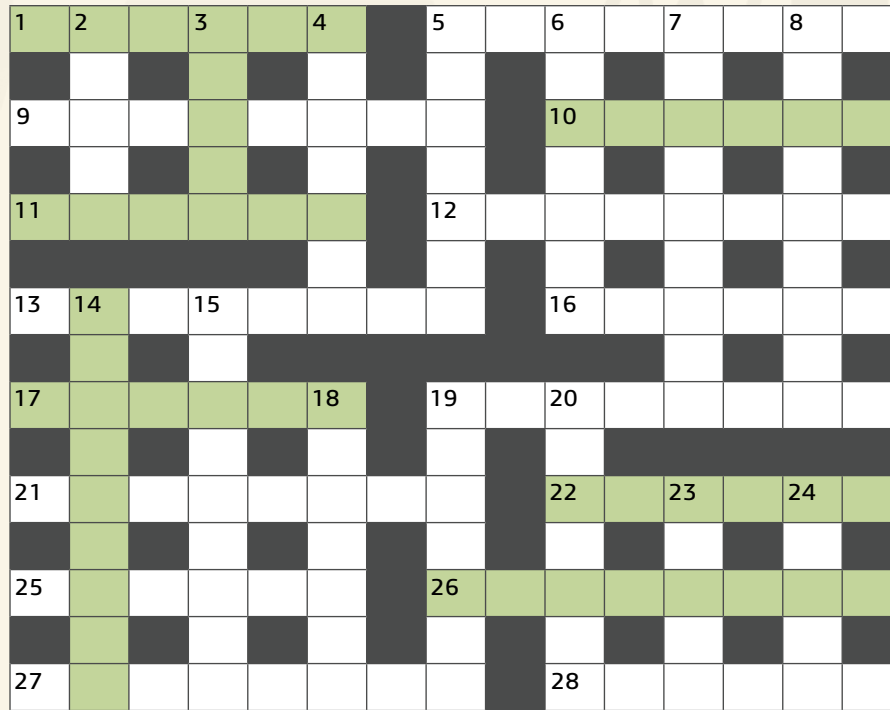
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ACROSS

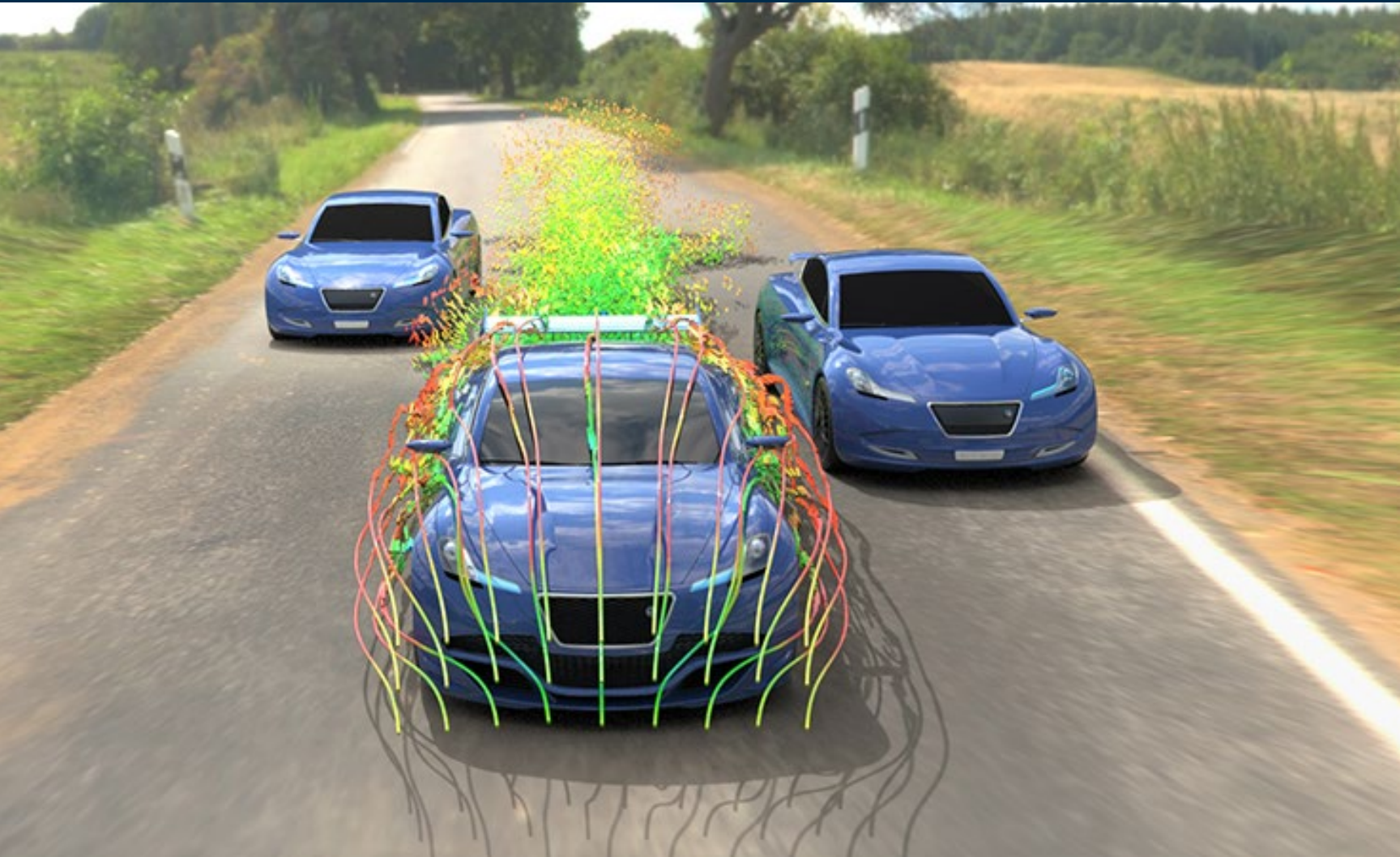
- 1 Expansion [Goal 8: Decent work and economic_____] (6)
 5 Bowed, in a ladylike way (8)
 9 Sport combining skiing and shooting (8)
 10 Aim of medicine [Goal 3: Good_____ and well-being] (6)
 11 E in physics [Goal 7: Affordable and clean_____] (6)
 12 London-to-Paris train (8)
 13 Produces alcohol or cheese, for example (8)
 16 Starts eating (4,2)
 17 Need [Goal 2: Zero_____] (6)
 19 University term (8)
 21 Change of appearance (8)
 22/26 Goal of feminism [Goal 5:_____ and women's empowerment] (6,8)
 25 More minute (6)
 26 See 22
 27 Money charged on a loan (8)
 28 Dehydrate (tomatoes, for instance) (3,3)

DOWN

- 2 Time in charge (5)
 3 Dihydrogen monoxide [Goal 6: Clean_____ and sanitation] (5)
 4 Peaceful (usually followed by "days") (7)
 5 Admit to (7)
 6 Taken back on (7)
 7 Leo and Pisces, say (4,5)
 8 Send to trial in another country (9)
 14 Teacher's duty [Goal 4: Quality_____] (9)
 15 Make iron attractive? (9)
 18 R in a car (7)
 19 Snake (7)
 20 Large bottles of champagne (7)
 23 Polymer used to make fabric (5)
 24 Go inside (5)

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