

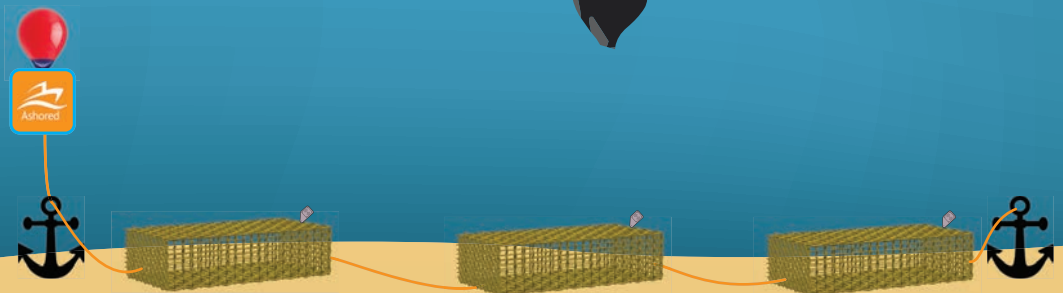
Design ENGINEERING

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A DEADLY CATCH

Ashored Innovations' ropeless trap helps prevent marine animal entanglement



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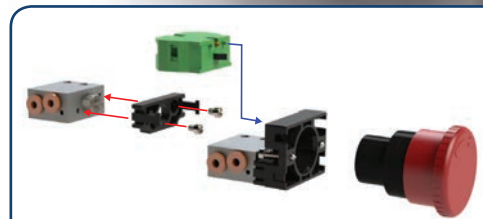
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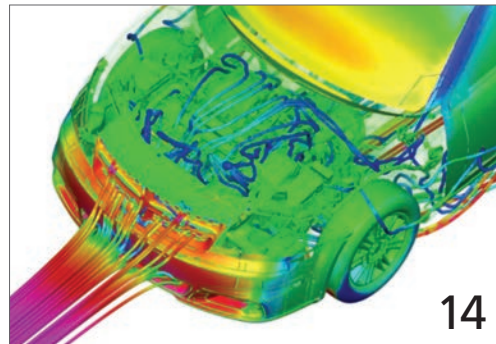
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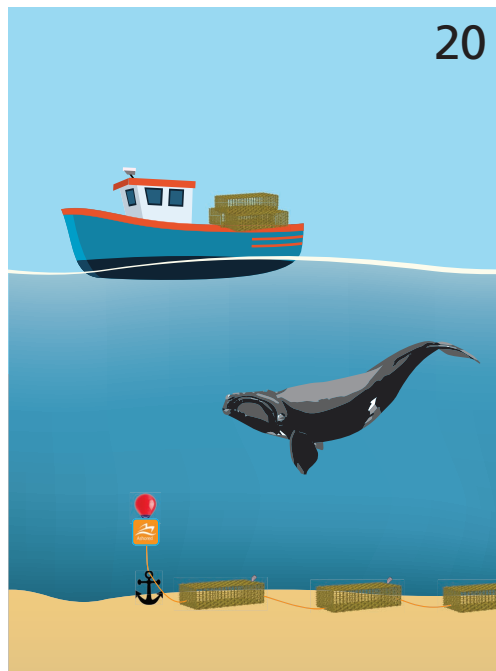
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The Canadian Kg



The year the modern kilogram was defined as a cylindrical hunk of platinum and iridium, the Eiffel Tower opened to the public, van Gogh painted *The Starry Night* and the Wall Street Journal published its first broadsheet. Since 1889, the International Prototype of the Kilogram (IPK), also known as Le Grand K by its French keepers, has been locked away, sealed under three glass bell jars, quietly defining the mass (and weight) of everything.

Problem is, the last time the IPK was checked by the alpha metrologists at the International Bureau of Weights and Measures in Paris, it had mysteriously lost weight – approximately 50 millionths of a gram – compared to its “identical” sister cylinders. In fact, all the copies had drifted, albeit microscopically, in one direction or another.

That may mean little to the price of apples, but such fluctuations are unacceptable to the high priests of measuring things. To be fair, when measuring mass on a nano or astronomical scale, small discrepancies stack up quickly. So, in 2005, the International Committee for Weights and Measures (BIPM) agreed that the kilogram, like all the other International System of Units (SI), should be based on an immutable constant of nature rather than a physical object.

For the kilogram, that law of nature is Planck’s constant (h), a proportional value that describes the ratio between the energy in one quantum of electromagnetic radiation – aka a photon – and the frequency of its associated electromagnetic wave. All well and good but in order for h to become the basis for kg, the BIPM required that three separate measurements of test masses agree within an infinitesimal level of uncertainty. That, it turned out, was a bit of a challenge.

Pulling that off required the use of a Kibble balance (or Watt balance), named for its British inventor, Bryan Kibble, that measures mass by placing an object on an electric coil suspended in a magnetic field. Measuring the amount of current, in Watts, needed to keep the coil in balance allows physical mass to be quantified in purely electrical terms – in other words, mathematically determined SI units.

While highly precise, the scale’s accuracy depends on the extent to which Planck’s constant is pinned down. Expressed in terms of energy multiplied by time, the constant had been determined, up until recently, with an uncertainty of approximately 70 parts per billion. Unfortunately, that was too squishy for the BIPM, so scientists in more than a dozen countries did their best to refine the constant’s value.

It was small team of Canadian metrologists at the National Research Council Canada (NRC), however, who gradually sharpened Planck’s constant down to a smidge over 9ppb. To do so, the NRC scientists had to progressively upgrade their Kibble balance’s hardware, while also factoring in fluctuating gravitational pull due to the motion of the moon, the few layers water molecules any surface and even minor earthquake activity on the other side of world.

Thanks to the NRC’s exacting efforts, combined with those of the German National Metrology Institute and the U.S. National Institute of Standards and Technology, the BIPM officially voted to accept the new kilogram definition in November with official adoption scheduled for May 20, 2019. The hope is that the new value will last longer than the last, making the kilogram, in part, Canadian for the coming century and beyond. Even better, everything, including me, will be infinitesimally lighter by next spring. It’s a small step but every little bit helps.

Mike McLeod

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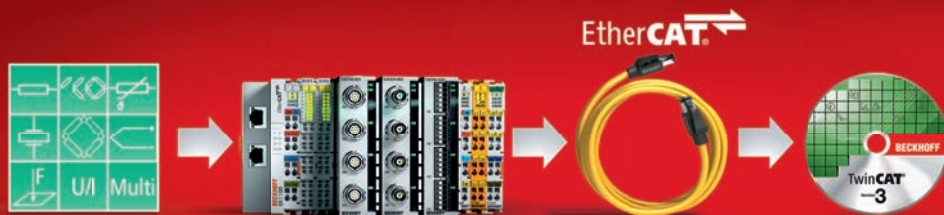
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UofT “Smart film” offers design-to-PCB in minutes



Frustrated with often week-long turnarounds for custom printed circuit boards (PCB), two University of Toronto engineering students have created a process called Printem that allows users to create functional circuit boards in minutes using a common desktop printer.

Created by Varun Chadalavada and Gowtham Ramachandran, Printem works similarly to the Polaroid film that inspired the UofT duo. At its heart, the process relies on a flexible, photosensitive copper-based film. To design the desired conductive traces, users print a negative image of their circuitry onto the Printem film using a standard desktop printer.

The black ink acts as a mask; when the film is exposed to UV light, a layer of photosensitive adhesive sticks the desired pattern to the film's bottom layer. Peeling away the film's top layer leaves behind the copper circuit on the film's plastic substrate.

From there, components can be affixed with solder or conductive glue. Most importantly, the copper traces are as conductive as conventional PCBs and much more so than conductive inks or other prototyping processes. Printem circuits are also quick to create, taking only the design and printing time, plus two minutes of UV exposure.

While quickly printing PCB prototypes is a boon for electrical engineering tinkerers like themselves, Chadalavada and Ramachandran say Printem's real potential is in making the process “substrate agnostic.” In this way, users could affix copper traces to any surface, even flexible ones like fabric or skin. In addition, the UofT pair says their process could employ materials other than copper.

“We’re starting with copper because we see a huge need in the rapid prototyping space to create circuits,” Chadalavada says. “But, eventually, we can use the exact same process with

different functional materials like OLED. As an end user, without any engineering experience, you could print a design with OLED material, create a display or patterned light with different colors and deploy it anywhere like a sticker.”

Currently, Printem has earned a top spot on the James Dyson Award top 20 international shortlist, which puts them in the running for winning the title and the \$50,000 grand prize.

www.printem.io

www.jamesdysonaward.org

ArcelorMittal reinvests millions into Canadian steel plants

In October, the Canadian arm of the Luxembourg-based steel manufacturer ArcelorMittal, announced that it would be investing a total of \$205 million into its Quebec and Ontario plants as a result of funding from the Canadian government.

Allocated from the Strategic Innovation Fund, \$49 million will be directed towards the ArcelorMittal Dofasco plant in Hamilton to modernize its facilities, and thereby boost productivity and competitiveness. According to the company, the projects will generate 4,700 jobs in Hamilton and an additional 1,700 in Contercoeur, Quebec.

Governmental support for the manufacturing industry, steel in particular, comes in the wake of a recently signed USMCA deal meant to replace NAFTA at the end of the year. Despite the steel tariffs currently in place, Canada agreed to a quota on tariff-free auto shipments as a part of USMCA, a move some industry experts see as a potential solution to the tariffs issue. <https://canada.arcelormittal.com>



The ArcelorMittal Dofasco Inc. steel plant in Hamilton ships 4.5 million net tons of flat carbon steel annually. (Photo credit: ArcelorMittal.)

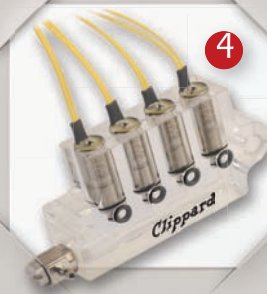
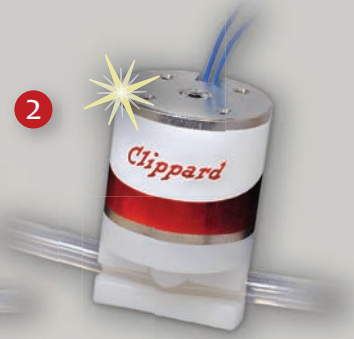
CRIQ to 3D print jaw implants for Quebec hospitals

The Research Center Industrial Du Québec (CRIQ) announced that it has installed an Arcam EBM Q10 plus, a metal AM machine by GE Additive, to produce patient-specific, 3D-printed jaw implants.

This news is the latest move by a medical partnership between CRIQ and the University Hospital of



Photo credit: Quentin Schneider, 3D modeling lab, CHU de Quebec



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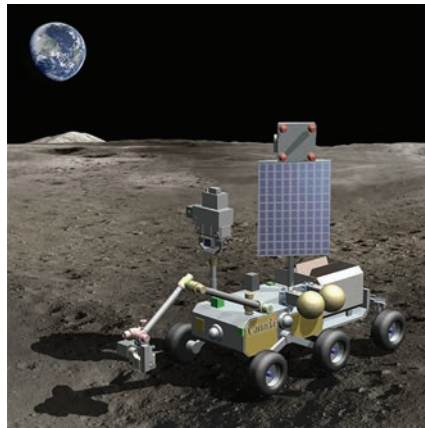
Quebec (CHU de Quebec). In 2017, following medical certification of additively manufactured mandibles by Health Canada, the partners launched an \$2.8 million initiative to open a 3D printing medical centre in Quebec City. The objective is to extend the facility include all hospitals in the region to provide point-of-care service for the customized prosthesis.

Under the terms of the partnership, CRIQ's Director of Industrial Equipment, Francois Gingras will work with cranio-maxillofacial surgeons at five hospitals where CRIQ is the regional medical partner. In addition, the research organization will handle the supply chain for the implants, from design and printing to post-processing and sterilization.

The researchers say additive manufacturing will slash turn-around times to produce the implants to approximately three weeks, half the time needed for traditional manufacturing. CRIQ is

expected to begin full production of its 3D printed implants by January 2020. www.criq.qc.ca

MDA to design lunar rover concept for CSA



The Canadian Space Agency has selected MDA to provide the conceptual design for a lunar rover tasked with preparing for human missions on the lunar surface.

As part of MDA's concept, the rover would be engineered to travel up to 600km over its lifetime in the harsh lunar environment. It will be driven via tele-robotic control but also feature an advanced autonomous mode, relying on artificial intelligence controlled from the proposed Lunar Gateway and from Earth.

In concept, the rover would conduct expeditions on the moon's far side near South Pole region. Carrying a suite of science instruments up to 120kg, the rover would employ a robotic arm to collect samples. The rover would then return to its lander and deposit the samples into an ascent vehicle that will carry them to the Gateway. The samples would later be returned to Earth for analysis to improve the understanding of the lunar surface as well as prepare for an extended human presence beyond low Earth orbit.

For this study, MDA is partnering with Magellan Aerospace, Mission Control Space Services Inc. and Deltion Innovations Ltd. The rover concept design forms part of a larger study that includes contributions from the European Space Agency, the Japanese Space Agency and the Canadian Space Agency, with the objective of preparing technologies and operations for landing astronauts on the surface as early as the late 2020s. www.mdacorporation.com

LeddarTech opens Automotive Center of Excellence in Toronto



Quebec-based LeddarTech recently announced plans to expand its operations with an R&D office in Linz, Austria and an Automotive Center of Excellence in Toronto, Canada.

According to the company, the Toronto Automotive centre will support development of "active safety and autonomous driving solutions, with core expertise that includes vision sensors and



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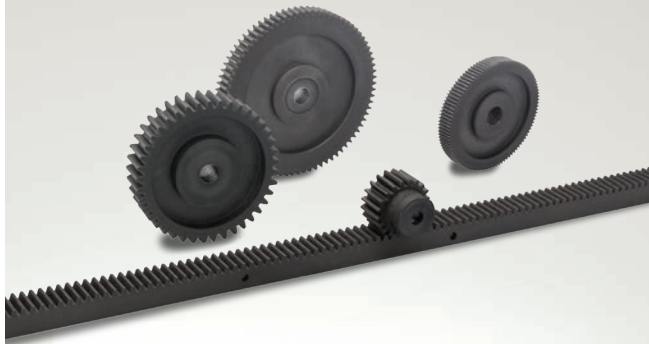
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Additionally, the Austrian R&D facility will focus on micro-electronic activities in support of the company's LeddarCore systems-on-chip (SoC) integration programs.

Founded in 2007, LeddarTech specializes in proprietary Light Detection and Ranging sensors or LiDAR technology. The solid-state sensors measures distance by illuminating targets with pulsed laser light and measuring the time it takes for reflected pulses to return to the sensor. The technology is capable of generating three-dimensional maps of its surroundings, making it popular in autonomous vehicle development. <https://leddartech.com>

Canadian webstore releases food safe PLA for 3D printing



Well-known Canadian AM materials webstore, Filaments.ca, recently released a filament that's fully food-safe, extending the range of 3D-printing abilities to the kitchen. Sourced from bioplastic manufacturer NatureWorks LLC, the True Food Safe PLA is created using raw materials and color pigments that follow the pharmaceutical industry manufacturing standard GMP (Good Manufacturing Practice).

To double-check the feasibility of the filament, the company gives each batch a tracking serial number and spools are individually tested before being vacuum sealed in food contact safe bags for protection. According to the company, the plant-based polymer is made from renewable resources and by-products like cornstarch and cassava roots, making it recyclable and non-toxic while producing a low-odor when melted for 3D printing. While the filament itself is food safe, the company warns that 3D printer cleanliness and/or printer component materials can introduce contaminants. In addition, spacing between layer lines can potentially harbor contaminants if not thoroughly cleaned/sanitized.

Available in 18 different colors, True Food Safe PLA is compatible with any system that accepts 1.75mm and/or 2.85mm diameter and comes with a temperature recommendation of 190°C – 230°C. In coming months, the company plans to add a PETG variant to their product lineup.

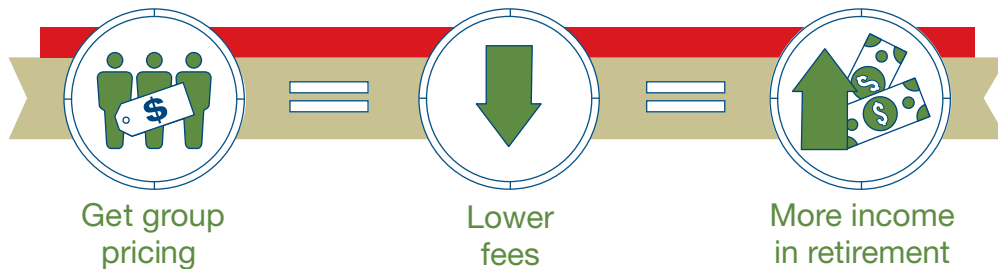
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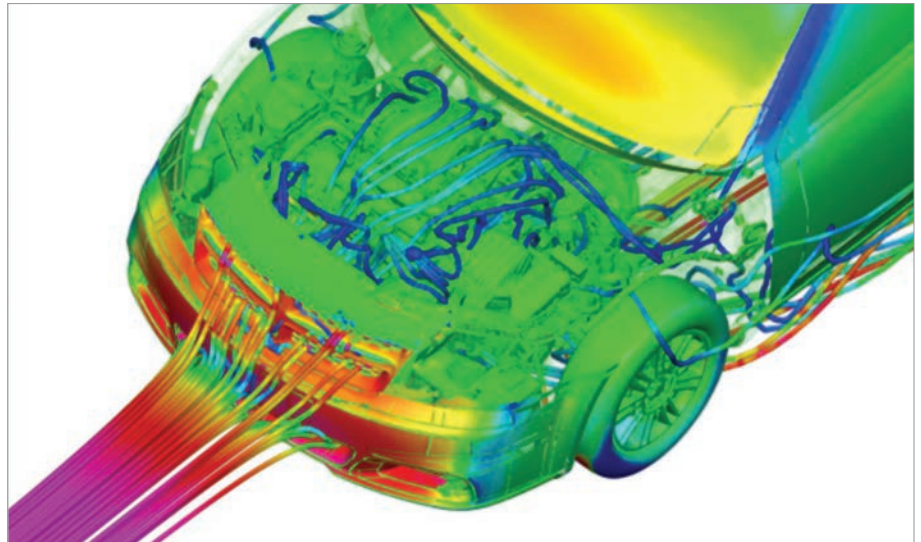
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PTC Creo 5 now includes CFD, provided by Simetrics MP Flow, allowing analysis of fluid motion, heat transfer, radiation, particle movements and cavitation.

PTC IN THE AGE OF CREO 5.0

While its focus may stray from CAD, PTC invests latest design suite with powerful modeling tool upgrades.

By Ralph Grabowski

When PTC launched their brand-new Pro/Engineer CAD software in the late 1980s, it popularized a newish idea: History-based parametric design. The term “history” meant that every single design step was recorded inherently and so could be edited. Parametric meant that a single 3D model could provide dozens of child designs that varied in size and function. The combination proved such a powerful jump forward that the technology still underpins the industry today.

Over the decades, however, PTC meandered in and out of love with CAD. First, they were drawn to PLM for managing drawings and other bits of design data. After a while, the company became infatuated with technical publishing, then application lifecycle management (ALM) for managing software development.

Then, it fixated on service lifecycle management (SLM) for servicing products

designed with CAD. Most recently, PTC has latched onto the Internet of Things (IoT) and augmented reality (AR); more on these two later.

PTC also weaved in and out of other CAD programs, too. The most infamous was the parametric Pro/DESKTOP software that had nothing to do with the desktop.



Figure 1: 3D model of a snowmobile imposed on snow in the real world.

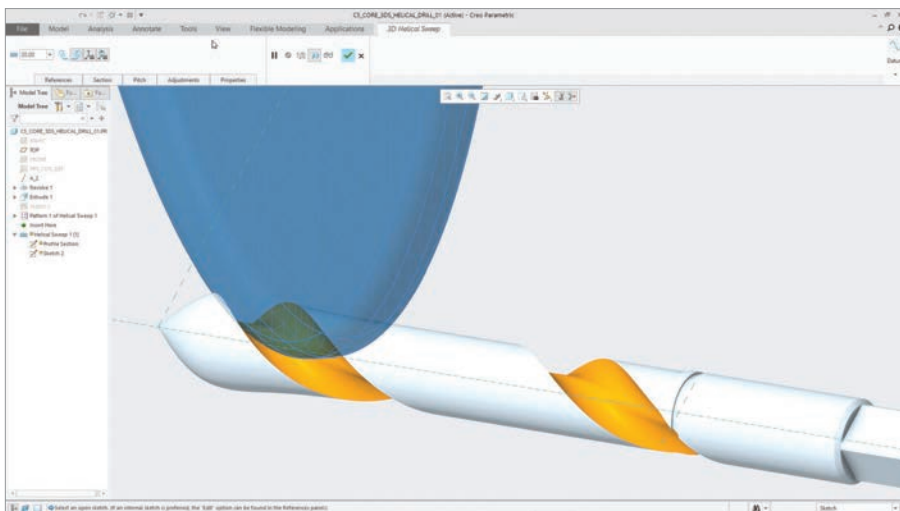


Figure 2: Toolpath being cut along 3D helical sweep.

After PTC acquired it from DesignWave, it gave it away free for home use – for all of three years. PTC also failed to get into architecture on two separate occasions. The first time was when it acquired Reflex, considered the very first BIM program, but held onto it for just one year. Later, PTC lost a rumored bidding war against Autodesk over Revit.

Along the way, PTC acquired historically famous companies like MathCAD, Arbortext, ComputerVision and Prime Computer – loading up on nearly three dozen in all. The most significant acquisition came from HP.

Like other large manufacturers in the 1970s, HP wrote its own CAD programs: ME/10 for 2D designs and ME/30 for 3D modeling. Then, it became vogue to sell off in-house CAD, and so HP divested the ME-series to PTC, who named it CoCreate.

CoCreate languished at PTC, because it was “only” a direct modeler, and history-based modeling was still where the action was. Then SpaceClaim happened. Whether it was the catchy name or some clever marketing, the little start-up startled the industry. Of the big four – Dassault Systems, Siemens, Autodesk, and PTC – only PTC had the technology on-hand through CoCreate; the other three had to write direct modeling from scratch.

PTC co-mingled CoCreate with Pro/Engineer and came up with Creo. It mixes direct modeling with history-based parametric design, but took several releases for direct and history to meld properly.

PTC's Latest Obsession

When you want to know what's most important to a CAD vendor, pay attention to the CEO's opening statements during keynote speeches at conferences or during conference calls with financial analysts. For PTC right now, it's IoT and AR.

IoT consists of tiny, very-low power sensors that collect data from machines and other settings, and then feed that data back to the office (or the cloud) for analysis. PTC sees a link between the data produced by IoT and the ability of CAD and other software to process and react to changes. The master plan is for Creo to edit models based on IoT's feedback from the field.

PTC bought its way into IoT by acquiring ThingWorx, software for writing programs that control IoT devices, and Kepware for its drivers that connect specific IoT devices to the ThingWorx software.

A drawback to producing a lot of data is that you have to analyze it. Thousands of IoT devices continually sending positive data can hide the occasional negative blip. So ThingWorx also provides analytical software that uses machine learning to sift random bits from data foretelling a crisis.

IoT is so important to PTC that it took a \$1-billion investment from Rockwell Automation. In exchange for an 11 percent ownership, Rockwell sells ThingWorx software into markets PTC couldn't otherwise reach. PTC even lists IoT first in its lineup of products. Although CAD sales still dominate, IoT is close to reaping greater revenue than PLM.

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Augmented reality overlays computer-generated data on the real world, like CAD models placed in-situ or illustrated maintenance instructions. (See Figure 1.) PTC purchased Vuforia software for developing AR apps and for publishing data suitable for Microsoft's HoloLens headset.

PTC has a few customers applying AR

to guide maintenance tasks, provide factory operator instructions and give in-situ product demonstrations. Grind Master, for instance, uses Vuforia to turn CAD models of its massive metal finishing machines into AR models. Customers walk around and inspect the apparent full-size model for approval before manufacture.

What's New in Creo 5.0

Creo is as full-functioned as its bigger competitors, Catia from Dassault and NX from Siemens, and can be priced just as high. As of last January, PTC licenses its software only by subscription. While Creo hasn't been used to design entire aircraft and automobiles the way the other two have, it handles significant design tasks like frames of aircraft and automatic transmissions.

Earlier this year, PTC released Creo 5, which would be v33 in the old Pro/Engineer numbering. The company sells Creo in five packages: Design Essentials, Design Advanced, Design Advanced Plus, Design Premium and Design Premium Plus.

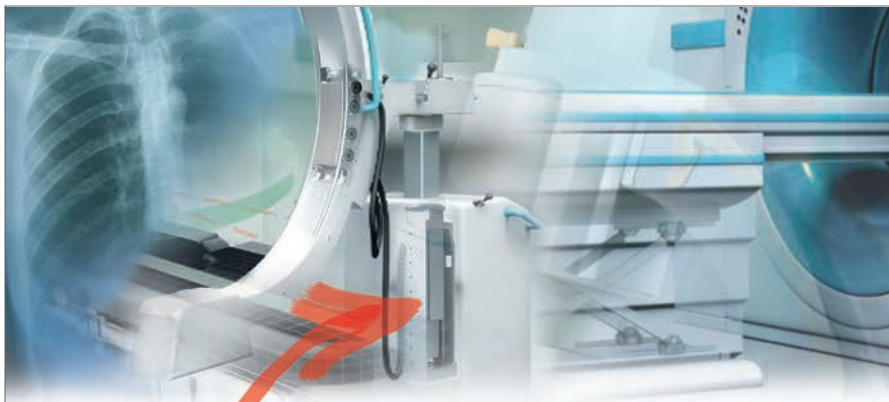
At the top end, you get advanced simulation like CFD, topology optimization (a.k.a. generative modeling) and complete machining facilities. Creo naturally works with PTC's array of other software, such as technical publishing and PLM.

It would be natural to ask, "What could possibly be added to MCAD after 30 years?" After all, basic MCAD software pretty much reached its zenith about a dozen years ago. It turns out, advances in MCAD benefit from technology developed elsewhere, such as computer gaming.

For instance, some MCAD tasks, like loading and regenerating drawings, seem faster because they are executed simultaneously; the software takes advantage of CPUs running more threads on more computational cores. CAD tasks involving predictably parallel operations, such as rendering and analysis, are off-loaded to the thousands of processors (GPUs) housed on graphics boards. Better algorithms in PTC's Granite kernel calculate geometry previously considered too difficult.

New in Creo 5.0 is the 3D helical sweep that cuts true revolved trajectories, instead of approximating them with swept 2D profiles. (See Figure 2.)

Sometimes what's new in one MCAD program is old hat in others. Creo 5 gets the new-old function of extruding (or revolving) multiple overlapping 2D regions. Sheet metal gets two new corner relief styles and the flattened version can coexist with the 3D assembly. New



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curvature constraints align geometry in sub-d (sub-divided surface) models. And you can edit models in perspective view.

Top-end Creo gains topology design, a modeling trend also sweeping the rest of the CAD world. It minimizes the amount of material in 3D printed parts.

PTC also licensed MP Flow from Simerics to add computational fluid dynamics (CFD) inside Creo 5. CFD is associative, so changes made in one environment are reflected in the other. Depending on the level of Creo, you can now analyze fluid motion, heat transfer, radiation, particle movements, cavitation and more.

Promised for next year is real-time FEA analysis, as the company is working with simulation giant ANSYS to add Discovery Live. This is the analysis program that wowed the industry by performing real-time flow analysis: As you change the model, the analysis updates in real time. Even more remarkable is that it runs on desktop computers, not the cloud. For the future, PTC says it hopes to integrate all ANSYS simulation software into Creo, so the future of Simerics is unclear.

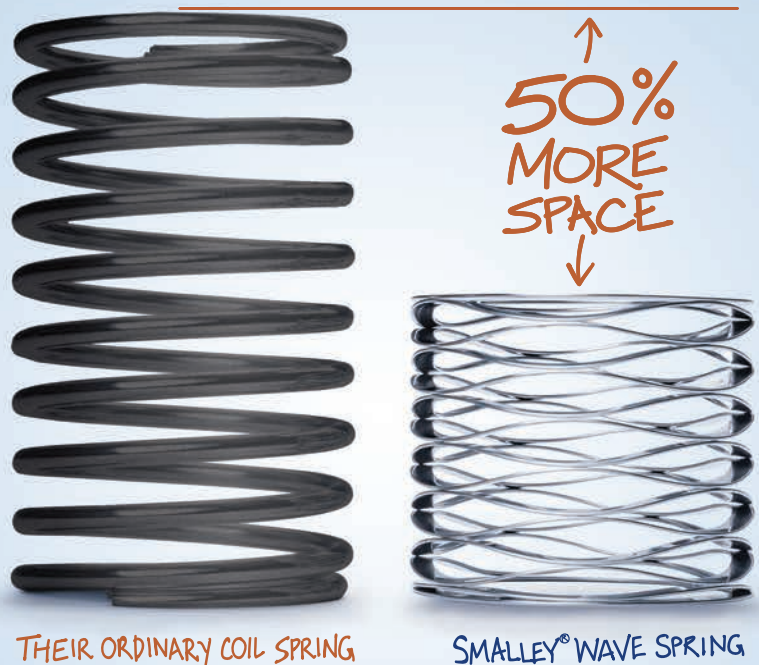
PTC will always have a place in history for popularizing parametric design in CAD, but also for the off-putting aggressive behavior of its sales team, which perhaps explains why sales are a third of its competitors, Dassault and Siemens. To get it out of the flat earnings of recent years, PTC now aggressively co-sells with other, bigger companies.

Even though PTC sometimes forgets it is primarily an MCAD vendor, this software still represents the biggest chunk of its revenue. Parts of the program are aging; it sometimes designed parts in a manner we would consider non-intuitive. Nevertheless, PTC seems to move quickly into new fields, often before competitors; no other CAD vendor has even touched IoT. **DE**
www.ptc.com

Ralph Grabowski writes on the business of CAD on his WorldCAD Access blog (www.worldcadaccess.com) and weekly upFront.eZine newsletter. He has authored many articles and books on AutoCAD, BricsCAD, Visio and other design software.

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SLICK and SMART

McMaster University assistant professor, Dr. Tohid Didar, with PhD candidate, Maryam Badv, and biomedical engineering PhD student and study co-author, Sara Imani. The team's nanocoating promises to decrease rates of implant rejection. (Photo credit: McMaster University)

McMaster researchers hope their selectively slippery nanocoating will slash rates of infection or rejection of medical implants.

As clever as modern medicine has become, surgical implants, like heart valves and hip replacements, still carry a significant risk of rejection and infection. Whenever a foreign object is introduced, the body's natural reaction is destroy or expel it. Failing that, however, the immune system creates a wall of protein that segregates the intruder to prevent it causing further harm. Unfortunately, in the case of beneficial medical implants, that wall can also result in chronic inflammation, scarring, dangerous blood clots and/or infection.

While it is possible to make implants with super slick, or omni-phobic, surfaces that repel all fluid or cell adhesion, the device does need to bind to something or else it won't be anchored where it needs to function. Hence, as in many things engineering, it's a give and take situation: More of one desired quality means less of another.

A team of researchers at McMaster University, however, say they've devised a "smart surface" that repels potentially harmful cells, like bacteria, coagulants and certain proteins, but also allows targeted binding of desired biomolecules that integrate the implant into the surrounding tissue.

"The challenge with biomedical applications is that you want bacteria or things in the blood that could cause clotting to be repelled from the surface," says Dr. Tohid Didar, assistant professor in McMaster's Department of Mechanical Engineering and School of Biomedical Engineering. "But if you're putting an implant into someone, you also want the tissue around it to attach and integrate with the implant."

The process uses nanotechnology called mixed self-assembled monolayers (SAM), a one molecule thick coating, bound to a substrate via chemical vapor disposition and infused with a combination of two lubricants, the organosilanes APTES and TPFS. While an APTES infused coating immobilizes immune cells, it also allows other unwanted calls to attach. Conversely, a TPFS infused coating repels all adhesion, including beneficial targeted cells. Infusing both lubricants, in varying proportions, results in a biofunctional lubricant-infused surface (BLIS) with



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the upside of both, the researchers say.

"The challenge for us was to make the technology a little bit smarter so that not only would it repel everything, but it promotes adhesion of certain targets on the surface," Didar says.

According to McMaster PhD student in Biomedical Engineering and co-author of the study, Sara Imani, a synthetic heart valve with their repellent coating could eliminate the need for blood thinners like warfarin, which is used to prevent blood clots.

"Nobody has tested these on people or even on animals for an extended period of time," says Didar. "We've done these tests on implants for up to five or six days. We're working with cardiovascular surgeons. They think that, if you can prevent clogging and rejection for a couple of days, then the tissue can integrate so the cells could completely cover the surface. You might not even need to add lubricant down the road."

For now, Didar believes these few days are the critical test as to whether or not the body will accept or reject the implant. If rejection hasn't occurred after six days, "things are looking good for the SAM coating."

Outside the body, selectively repellent surfaces could also make diagnostic tests much more accurate. Such a test would only allow particular target cells – a virus, bacterium or cancer cell, for example – to stick to the biosensor that is looking for it, a critical advantage given the challenges of testing in complex fluids such as blood and urine.

The research collaborated with Jeffrey Weitz of the Throm-



A comparison of how blood droplets behave on a control surface at left and the repellent surface at right. The McMaster research team says its omniphobic coating could help prevent blood clots for valve replacement patients. (Photo credit: McMaster University)

bosis & Atherosclerosis Research Institute at Hamilton Health Sciences to understand the challenges related to making successful implants. Their work was published earlier this year in the American Chemical Society's journal *Nano*. Currently, they are working on getting their work into clinical use. The next phase would be animal and human trials. Didar and the team are also looking for industry-specific companies to partner with them on the project.

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A DEADLY CATCH



Ashored Innovations' ropeless trap helps prevent marine animal entanglement.

By Devin Jones

For the endangered North Atlantic Right whale, 2017 was a particularly bleak year. According to the U.S. National Oceanic and Atmospheric Administration (NOAA), 17 North Atlantic Right whales – about 4 percent of their population – died last year, mainly because of either ship strikes or entanglement in fishing gear.

Due to the migratory species tendency to stick close to shore, the large black whales often run afoul of shipping lanes and fishing equipment in the Gulf of St. Lawrence or off the coasts of Newfoundland and Massachusetts. With an estimated one million vertical lines of fishing gear deployed in Right whale habitat in both in the US and Canada, the risk of entanglement is significant.

The situation isn't great for fishermen, either. Canadian crab and lobster fisheries conduct approximately \$3 billion trade with the U.S. annually, but those numbers are in jeopardy due to closures of prime fishing areas following Right whale sightings. In 2018, for example, 14,000 square kilometers of prime fishing waters have been closed resulting in the loss of millions in revenue for Atlantic Canada fishermen.

While it may seem an intractable problem, Ashored Innovations has been quietly working on a solution from its humble office in Halifax. Founded by a trio of friends who all grew up on Canada's east coast, the start-up firm believes its ropeless lobster trap design – developed in conjunction with Halifax-based engineering company Enginuity Inc. – can significantly reduce marine animal entanglement and rein-vigorate one the Maritimes' biggest industries.

Development of their current design is moving along well, with a projected commercial release targeted by the end of 2019, but things weren't always so cohesive. Stevenson recalls

a meeting, early on, with the Mi'kmaq fisheries advisory committee, a community directly affected by the water closures enacted by Fisheries and Oceans Canada during instances of a Right whale sighting.

"I sat down with them and talked briefly about our product and our design and they were skeptical," Stevenson says. "As I was writing all of their concerns down, one of the guys said 'I hate to keep shitting on your idea, but these really are the problems we're having.' I said, 'If we can't solve or address every one of these problems, then we don't have a solution. I would rather know that today, rather than once we get a few hundred thousand dollars down the road.'"

For Ashored, this type of communication, feedback and community engagement has been at the crux of their product development process.

"One of the things that we found out very quickly is that these fishermen all wear these big, heavy blue rubber gloves," Stevenson explains. "Anything we develop has to work with frozen hands, high seas and with these blue gloves on because that's the environment this thing is going to be used in. Now we use the term 'blue glove certified' to mean we've designed and built our system with the end users in mind. We didn't just repurpose some tech to make a quick buck."

That meeting, and many others like it, have resulted in Ashored's latest two products: the Modular Ocean Based Instrument (MOBI) and the Automated Tracking and Location Aggregation System (ATLAS).

Unlike traditional bait traps that employ a buoy connected to a rope extending to the ocean floor, the MOBI system contains the buoy and rope a few feet above the trap. When a fishing vessel approaches an enabled trap, fisherman can signal MOBI to release the spool of rope, allowing the buoy to float to the surface. They can then reel in and empty the trap, spool the rope back into its cylindrical casing and drop the trap back down to the ocean floor.

For testing purposes, the release mechanism is currently timed based. For example, vessel captains can set the system

on a 12-hour release so they can check their traps the following morning. Ashored is currently implementing a system of acoustic transducers and hydrophones to create an on-demand communication link. In the final product, Ashored says the time-based approach will remain as a redundant backup in case of a communication error.

The second product, ATLAS, comes into play when tracking and collecting data on the traps themselves. Using a mix of long range radio-frequency identification systems (RFID) tags and machine learning algorithms, ATLAS helps fishermen track key variables such as trap geolocation, deployment date, weather conditions, tides and water temperature. All data is transmitted to a cloud server for future analysis directly from the vessels after the tags are scanned on board the vessel.

Ashored's chief product officer, Maxwell Poole, says ATLAS removes the onus of data collection or entry from the crew and also helps other vessel operators in the area.

"We use a long-range RFID system with high power readers that have a range of around 30 feet – enough to reach across the stern of the vessel," Poole explains. "The point is to automatically scan information into our database without manual entry. This provides data we can then use to prevent trap overlap, as other fishers will not be able to see surface buoys to check if someone else has already set there."

By July of 2018, the Ashored team say their design started to satisfy many of the concerns users had questions about. Currently, they are in the process of live testing with an industry association and the feedback of which will be iterated into the final product.

To date, Ashored Innovation has relied on grants from Dalhousie University and Saint Mary's University as well as a \$50,000 prize the company won from the Spark Innovation Challenge, a province-wide competition for early stage technology companies in Nova Scotia. The company is also in talks to sell the product on a commercial level by the end of 2019. Recent trips to the U.S. has generated interested as well.

Stevenson says the team has focused on product development first and wanted to get to a point where they could speak intelligently to what it's capable of, which is where he believes they are now.

"Being able to work through that cycle not only helps us from a product design standpoint but it builds confidence within the industry," he says. "From a business perspective, it helps us to be able to discuss it with investors and the department of fisheries and oceans and other regulatory bodies to show how we're going about assessing and proving each step of our technology."

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OUT-OF-ROUND

Machine builder customizes metal-spinning machines for engine lip skins on Boeing aircraft.

For most people, the term “lip skin” conjures thoughts of lip balm or lipstick. For aerospace engineers, however, the term refers to the highly engineered aerodynamic structures that make up the leading edge of jet engine nacelles.

Until recently, manufacture of these lip skin components relied on workers applying heat consistently throughout a process called metal-spinning in which a blank of material is rotated on a spinning machine similar to a lathe. During rotation, a roller on the spinning machine makes contact with a part blank, forcing the heated metal to flow over the spin-forming mandrel surface.

While this method could certainly produce a functional part, the associated variations in part consistency created downstream difficulties and challenges in subsequent fabrication and assembly operations. Even the slightest variation in heating would contribute to undesirable results in the formed part.

For aerospace part suppliers, like UK-based automotive and aerospace components company, GKN Aerospace, part consistency is paramount, especially given the exacting standards set by their clients. For example, the British aerospace supplier manufactures lip skins for high-rate programs such as Boeing’s 737MAX and 777X aircraft from its Camarillo, CA and Orangeburg, SC manufacturing plants.

To reduce variation in the spin-forming process, GKN Camarillo joined forces with California-based machine builder, MJC Engineering, to create an automated CNC solution. MJC’s president, Carl Lorentzen, along with VP and GM, Per Carlson, and electrical engineer, Don Hebert, were up to the task.

The key challenges of the application comprised how to spin-form production run components out-of-round by 8.5 to 9 inches in various aluminum alloy blanks measuring up to 270 inches diameters and a 5/8-inch thickness. Those blanks would also need to be held to tight tolerances, verified by thermo-imaging cameras and fed back by the CNC for accuracy tracking, plus integrate the heating torch for in-process adjustments.

Through a combination of robotics and modern CNC controls, MJC created a state-of-the-art manufacturing process used to produce laminar flow lip skins for Boeing’s newest flagship 737MAX and 777X aircraft.

This careful interplay between the heating and spin-forming operations is made possible by the Siemens Sinumerik

Beyond its cosmetics, the shape of the lip skin on this Boeing jet engine is crucial to air intake so that the engine continues to receive optimal airflow during relative slow take-off speeds as well as higher speed flight maneuvers.

840D sl CNC, which integrates and monitors every movement between the spinning machine controller and the heating robot controller. According to Per Carlson of MJC, part heating difficulties and variations are now a thing of the past.

“CNC spin-formed lip skins with automated robotic heating now exit the process as consistently as a stack of quarters, to draw an analogy,” he says. “The results are no less than phenomenal, yet are derived from straightforward mathematical computations made possible by modern CNC technology from Siemens.”

“There’s real power here,” he adds. Let’s face it, everyone knows variation is the number one contributor to low manufacturing yields and increased operating costs. Study your process, understand where variations occur and then eliminate them with cost-effective solutions. The improvement literally catapults a production floor to new levels of manufacturing excellence. It certainly has at GKN.”

In operation, the machine receives a crane-loaded, 270-inch diameter blank, fixes it to the tailstock of the machine and



MJC Engineering’s machine forms 270-inch diameter aluminum sheets into lip skins for the nacelle on the engines of Boeing 737MAX and 777X aircraft.



Siemens Sinumerik 840D sl CNC, along with Sinamics drives, Simotics motors and Simatic PLC control the seven axes of motion on the MJC machine and the 32 programmable movements of the robot, to which a heating torch is affixed.

rotates it on a 150hp motor-driven spindle. The MJC machine then progressively applies heat via the gas torch on the robot arm. Raytek thermal imaging cameras closely monitor the heat readings

over the entire surface to create multiple control cones.

When inconsistencies are detected, the heat is appropriately adjusted in real time by the controllers. The heated material is then formed over the mandrel into the desired size, with out-of-round conditions ranging from 8.5 to 9 inches, typically. Siemens Simatic S7 PLC technology onboard the machine controls the various mechanisms, while the CNC integrates and feeds back all data.

Solid Edge is the CAD program for the design of the lip skin, while Siemens NX CAM translates the design data into machine execution steps. Each MJC machine involved in this project also incorporates Siemens' Sinamics drives and Simotics motors.

"There are seven axes of motion controlled by the CNC," MJC electrical engineer, Don Hebert, explains. "We created custom screens for teach-in and playback on the machine to facilitate faster commissioning and troubleshooting onsite for the GKN operators. Zone

Pro and Spin CAD were used to create the tool paths. On the robot, there are 32 pre-programmed moves, fully integrated with the heating and thermal imaging processes. The robot runs with an external PLC through G-code on the CNC, which dictates the on/off heating and cooling controls, based upon feedback from the temp zones monitored."

"When we were also able to provide our Green Power technology and, in the process, save the customer substantial energy costs, the advantages of this machine design ratcheted up to a great degree," Lorentzen adds.

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PEPPER PACKER

Automated packing machine provides peak productivity for greenhouse growers.

Peter Piper picked a peck of pickled peppers, but could he pack a polybag of perfectly proportioned peppers as fast as this prodigious pepper bagging machine? Probably not.

As demand for their produce surges, growers in the greenhouse belt in southwestern Ontario around Leamington and Kingsville are embracing automation – like a custom pepper bagger recently completed by Bartel Machine. Leamington is the tomato capital of Canada; greenhouse tomatoes from the region feature prominently in supermarkets, even in the dead of winter. Now, greenhouse growers like NatureFresh Farms are changing consumer habits again with more fresh produce on offer year-round, providing an attractive alternative to imported produce.

That salad staple, bell peppers, can be grown indoors without chemical pesticides, picked near the peak of ripeness and put on grocery shelves the next day, which ticks several boxes for environmentally and nutritionally conscious consumers. Packages of the best specimens – often bearing the grower's brand – are increasingly popular.

"People like the pre-packs," says Steve Bartel, who helps manage Bartel Machine, the small Leamington machine builder his father Ron founded in 1983. "They look nice. When I go to the supermarket, I'm going to choose a bag that has the peppers aligned nicely. So from a packaging perspective, they all need to be the same size and with stems facing the same direction.

This is the second custom pepper bagging machine Bartel Machine has designed and built for local greenhouse operations

Built by Leamington, ON-based Bartel Machine, this custom pepper bagging machine can fill 25-30 poly bags a minute and can pack bags of two, four or six, arranged any way a retailer wants.

and the first for NatureFresh Farms. It can fill 25-30 poly bags a minute and, at full speed, a bag comes off the line every two seconds. It can do bags of two, four or six, arranged any way a retailer wants. There is commercial flow wrapping equipment for filling inline packs of three, so this project focused on wide packaging styles, including polybags with zippers and gusseted bases, for which there were no automated solutions.

The machine has four bagging lanes, or "baggers", with two small robots transferring peppers from trays to loading positions. This modular design is easily expandable by adding more baggers and robots. The biggest challenge, Bartel says, was dealing with the variation in bag sizes and styles. Every grower sells to multiple chains (e.g. Loblaws, Sobeys, Costco, Wegman's). Today, one chain may order 50 cases of 'stoplights' – one green, one yellow, one red pepper – while another may order 100 cases of random colors, tomorrow. The day after, it could be six packs of three reds, two yellows and an orange – any combination or order of colors.

"Also, some bags have zippers on them, some don't," Bartel explains. "And no two peppers are alike. They barely fit in the bag and getting them in without destroying the bag is a huge challenge. It can be maddening."

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Once the robots position the peppers, the machine employs vacuum grippers, and pneumatics technology by Festo, to grab a bag from a vertical magazine and lay it flat. Each bagger has an MPA-L valve terminal and a compressed air preparation unit. A DFM-guided drive lowers another vacuum gripper to lift the top of the bag, while air is injected to puff it open. A servo-driven electric handling system – consisting of Festo's ELGR tooth-belted axis mounted via a sub-plate to the carriage of the company's EGC tooth-belted actuator – then pushes the peppers into the bag.

Festo hardware goes into much of what Bartel builds, a relationship that began when Bartel Machine opened in 1983, which also happens to be the year Steve Bartel was born.

"You could say I've known Steve all of his life," says Paul Kaspardlov, the area Festo rep then and now. "Now, he's helping run the company."

According to Bartel, Festo provides an engineering backstop vitally important for a small machine builder with 10 employees.

"We bring Festo in on the designs early on, and ask 'Here is what we need to do, here's our ideas, what do you think?'" says Bartel, a mechanical engineer himself. "Festo is unique in that way; we get to deal with their people directly. They come alongside us to pick the right product for the application and help us design these machines just like we come alongside our customers to develop the concept."

"There are times when Paul will say, 'I won't sell you that cylinder, it won't work here,'" Bartel adds. "We think that's pretty special."

Bartel built its first paper-packing machine for a different Leamington grower in 2016. It only does six packs. Word got around town about that machine, and late last year, Bartel got a call asking about building this second bagging machine. This was around the time the province announced plans to raise Ontario's minimum wage to \$15 an hour (now frozen at \$14).

Steve Bartel figures the minimum wage hike might have piqued some interest in automation among local growers, but isn't driving it now. The new pepper bagger does replace manual labor; it only takes three workers per shift to load peppers into trays while it takes over a dozen to fill the same number of bags by hand. However, with so much growth, workers displaced by automation are being relocated elsewhere in greenhouse operations. Cost control is always a concern, he says, but automation is being driven by "an appetite for efficiency and for growth – to put more peppers on the shelves faster."

For a small, locally focused custom machine builder, that's a great space to work in.

"A lot of greenhouse automation comes from Holland or wherever in Europe," he adds. "But we believe there are a lot of clever people in this town and this province, and we offer our customers something precious – we're always just down the street supporting them."

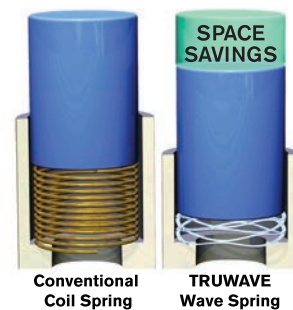
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www.festo.com

This story was contributed by Festo Canada

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Automation

Multi-Axis Controller

Omron Automation Americas added a programmable multi-axis controller to its CK3M family. The multi-axis controller's output speeds reach 50µs/5



axes. Originally developed by Delta Tau Systems (now part of Omron), the CK3M connects to virtually any motor or encoder using EtherCAT and encoder communication protocols. Machine builders can avoid developing their own controller boards as well as specialized control algorithms to integrate a separate controller for each device when just a single controller is needed for high-speed synchronized control. Machine build-

ers can incorporate their own advanced control with its support for ANSI C or an original programming language.

www.omron247.com

Handling Systems



Afa has added its EPS giga YZ and the EPS tera YZ to its portfolio of YZ standard systems. The EPS giga YZ can apply 255 Newton press-in forces, while the slightly larger EPS tera YZ can apply 1024 Newton. The EPS giga YZ moves up to 15 kilograms and the EPS tera YZ up to 20 kilograms. The high payload does not influence the repeat accuracy of up to ± 0.02 millimeters. Standard weight compensation is available for Z-strokes of up to 500 millimeters. Both systems can move a 10kg payload 100 millimeters on the Y axis and 100 millimeters on the Z axis in a 1.5-second pick & place cycle. Like all Afa systems, the two products contain the complete system wiring and parameterization, from the console up to the gripper jaws.

www.agfa.com

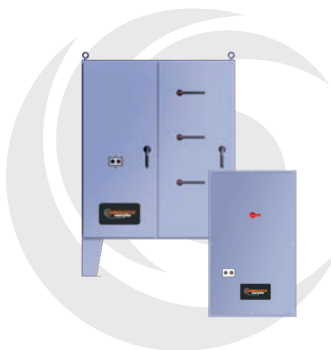
PowerGuard™

by Conductix-Wampfler

PowerGuard™ is easy to install and designed for ease of use and safety. A visual indicator on the front panel identifies when power has been removed from the maintenance zone. Voltage test points are also included that can be used to double-verify that power has been removed from the maintenance zone.

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LCOS Microdisplay

OmniVision Technologies, Inc. announced its OP02220, the industry's first 1080p LCOS microdisplay with integrated driver functions and memory. This microdisplay is especially designed for augmented reality applications such as glasses and head-mounted displays. The OP02220 has a pixel resolution of 1920 x 1080 and is built with the company's 4.5-micron pixel technology, allowing the microdisplay to have a 0.39-inch diagonal display size. With the integrated driver design, power consumption is lower when compared with two-chip solutions. In addition to wearable AR applications, the microdisplay is also suitable for the general-projection and pico-projector markets.



www.ovt.com

Protocol Gateways

Mencom unveiled its Protocol Gateway series which support Modbus RTU, Modbus TCP, Profinet RT/IRT, DNP3.0 Ethernet, DNP3.0 Serial, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, IEC 61850 devices and PLCs. In total, 80 different protocol combinations can be selected in the firmware and integrated with 10 different hardware platforms. The line can withstand temperature ranges between -40°C and +85°C degrees and up to 95 percent humidity. They also have an MTBF exceeding 20 years and they comply with industrial EMC requirements/IEC 61850 chapter 3. All products can be embedded with Security (VPN over IPsec or OpenVPN function). The gateways' Java-based configuration tool helps with data point mapping, polling frequency and configuration upload. The data flow is monitored through the embedded debugging tool.

www.mencom.com



Motors & Drives

Sercos Drives



Rexroth launched its IndraDrive Cs compact drive series that controls up to nine additional axes via a Sercos master interface and features integrated motion logic according to IEC 61131-3. The drives and their communication hardware support standard Ethernet-based communications interfaces, including Sercos, PROFINET IO (RT), EtherNet/IP, and EtherCAT. Users configure the desired communication protocol for the multi-Ethernet interface themselves using the software. In addition, the multi-encoder interface also supports a range of encoder systems, including EnDat, Hiperface, SSI

encoder, simple TTL incremental encoder, sinus- cosinus encoder, resolver, and the encoder system for Rexroth's MSM motors. The drives feature a certified Safe Torque Off (STO) safety function and Safe Break Control (SBC) achieve Kat 4 PL e according to EN ISO 13849-1 and SIL 3

www.boschrexroth.com

Stepper Motors



AutomationDirect has added stepper motors, encoders and inertia dampers to its Sure-Step system. The series includes high-torque, industry-standard NEMA 14, 17, 23, and 34 stepper motors that provide holding torque from 8 to 1288 oz-in. The smaller

frame size NEMA 14 motors are 1.4 inches wide and are available in single and dual shaft versions. The SureStep family has options for open loop control (no encoder), position monitoring (external encoder feedback) and position verification (integrated motor/drives with internal encoder). Fixed resolution encoders are available in

400 pulses per revolution (ppr) and 1000ppr; new configurable encoders allow resolution selection from 48 to 4096ppr (the default is 400ppr). A free downloadable configuration utility autodetects the encoder and allows ppr selection.

www.automationdirect.com

Integrated Servo Motor

JVL unveiled its latest MAC motor that includes an AC servo motor, hall-sensors, encoder, power supply, driver and positioning controller and Nano-PLC. In addition, the motor includes facilities for incorporating various control modules such as Bluetooth, WLAN, ZigBee, EtherCAT, EtherNet/IP, CANopen, DeviceNet, Profibus, Profinet, Nano PLC, RS232/RS485/USB and process control.

Measuring 311.8mm long, the 3000W motor sports a torque of 9.55/28.6Nm at 3000rpm. The motor requires a main voltage of 3x400VAC through the M23 connectors. Control voltage for the encoder and microprocessor circuitry is 24VDC. In an emergency-stop situation, this control voltage maintains encoder position and other values.

www.electromate.com



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IloT Hardware

IloT Gateway

HMS Industrial Networks unveiled its Anybus Communicator IloT gateway and Anybus X-gateway IloT with support for MQTT and OPC-UA. The Anybus Communicator IloT specializes in providing data from devices on serial protocols and CAN, while Anybus X-gateway IloT integrates data from

fieldbuses and industrial Ethernet networks. Typical use cases for the gateways involve data integration from Modbus RTU and TCP, CAN-based protocols, PROFIBUS-DP, EtherNet/IP, PROFINET, EtherCAT, POWERLINK and CC-Link. Using the Anybus Configuration Manager con-



figuration tool, users can configure, convert and tag the industrial data for use in IT-systems or IloT applications. When setting up the IT-connection, the gateways can be presented either as MQTT Client or OPC-UA server.

www.hms-networks.com

IloT HMI

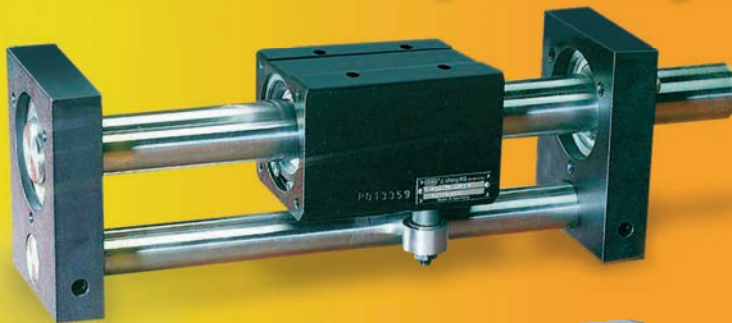
EXOR has released its eX700 series that combines a sunlight-readable display with a controller with networking capability and communication options including client/server OPC-UA. They are designed for IloT edge applications in extreme environments such as marine and process industries. The glass projected capacitive touchscreen is bonded to a 7-inch widescreen display. As with all eX700 Series, the HMIs have been designed to run the JMobile software. The OPC-UA server and client supports Corvina Cloud secure connectivity with full network separation. In addition, the HMI offers the option of a CODESYS V3 runtime with choice of EtherCAT, PROFINET, Ethernet/IP and POWERLINK.

www.electromate.com



Rolling Ring LINEAR DRIVES

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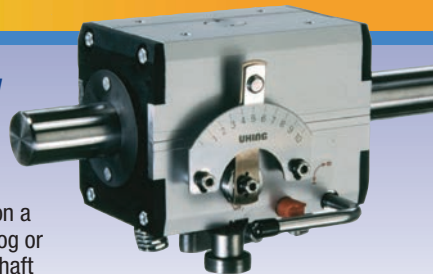


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Uhing® Rolling Ring linear drives run on a smooth, threadless shaft that won't clog or jam. If the system is overloaded, the shaft simply slips instead of churning and grinding. The drive bearings are in constant contact with the shaft, even during reversal, thereby preventing backlash.

Example applications: metrology machines, material handling systems, spooling equipment, packaging & converting equipment.

Many different sizes meet varying requirements for axial thrust & linear speed.



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Fluid Power

Pneumatic Tubing



Festo released its FDA-compliant PTFEN tubing designed for food and other processing applications. Made of polytetrafluoroethylene, the tubing is TSE-free, resistant to cleaning agent and not affected by ambient atmospheric conditions. Microbes and other active agents and contaminants don't stick to polytetrafluoroethylene, making PTFEN tubing easier to clean and ideal not only for food production but also for manufacturing in the chemical, semiconductor, pharmaceutical and cosmetics

industries. PTFEN tubing is rated for up to 6 bar at 130°C for pressure resistance or 150°C for heat resistance. It's offered in seven different outside diameters, ranging from 4 to 16mm. More than 200 nickel-plated brass and stainless steel fittings are available.

<https://www.festo.com>

Pneumatic Gripper

SCHUNK released its entry-level, pneumatically controlled SCHUNK MPC gripper for small components. The gripper is available in six sizes between 16N and 270N, with maximum jaw strokes between 2.5mm and 15mm. The smallest size in the series weighs 50g but can handle components weighing up to 80g. The largest size can handle parts up to 1.3kg. The repeat accuracy amounts to 0.02mm. For applications with more demanding cycle times, precision and service life requirements, SCHUNK also offers its MPG-plus gripper for small components or the mechatronic SCHUNK EGP.

<https://schunk.com>



Cartridge Valve Cover

Moog has launched the latest version of its cartridge cover for its 2-way Slip-in Cartridge Valves (CEE) series. The rated pressure of the covers is up to 420 bar (6,000 psi), depending on cover type and the seal material used. The series now includes two new sizes, 125 and 160, which meet the latest ISO 7368 standard. The cover variants include a DBA cover that uses an integrated pressure relief valve to create simple pilot operated pressure relief functions, and a DBD cover with integrated pilot valve interface. The DBA and DBD covers feature an integrated screw-in pressure relief pilot valve and can be combined with the majority of Moog 2-way Slip-in cartridge valves.

www.moog.com



Sensors

Angle Encoders

HEIDENHAIN introduced its RCN 6000 series, a family of sealed angle encoders with integral bearings and a hollow shaft diameter of 180mm (7.09 inches). The series utilize the company's METALLUR process, in which the graduation is applied directly to the bearing ring, and a reflected light scanning method, which allows larger mounting tolerances. The RCN 6000 encoder provides a through hole of 180mm, overall height of 44mm, a system accuracy of ± 2 inches, and can handle speeds up to 200 rpm. It's also able to interface with EnDat22, Fanuc05 and Mit03-4, and has an IP64 protection rating, reducing the effort required for protective measures.

www.heidenhain.us



Encoder Bracket

Encoder Products Company (EPC) has introduced a bracket that fits all of EPC's Size 25 Shaft Encoders with 2.5-inch flange mounts, including absolute and programmable encoders. Compatible encoders include the Model MA63S absolute encoder with resolution up to 14 bits Single Turn and 39 bits Multi-Turn. The Model 725I features a bearing load of 80 lbs. and uses an internal flexible mount. The bracket also works with the Model 25SP Accu-CoderPro. According to the company, the bracket solves the problem of designing and assembling a bracket, measuring wheel and encoder. EPC also offers a variety of measuring wheels designed specifically to fit the mounting bracket.

<http://encoder.com/>



Proximity Sensors

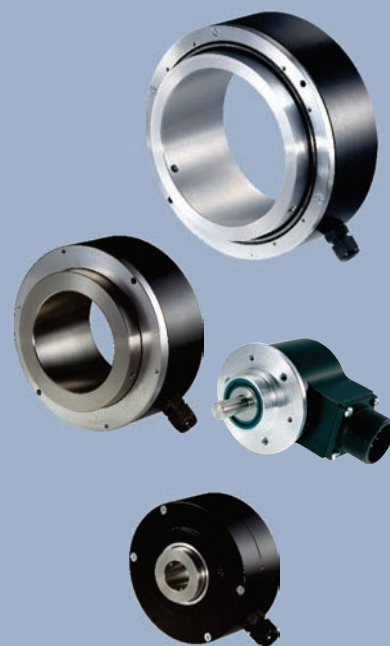
Balluff has expanded its family of steel-faced inductive proximity sensors to include additional models in the M18 tubular form factor. The stainless steel sensors feature Factor 1 technology that detects both fer-

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rous and non-ferrous materials and extends the sensing range to 8mm. The technology also enables the ability to monitor sensor status continuously, even during a welding cycle. All models come with an IP68 protection rating and can be Flush-mounted for impact protection. Other options include improved coating to improve protection against weld-spatter buildup.

www.balluff.com



LVDT Signal Conditioners

Alliance Sensors Group released its S2A and SC-200 DIN-rail-mounted LVDT signal conditioners. The conditioners offer built-in null indication and simple front-panel pushbuttons to set zero and full scale. Calibration time is now reduced from at least 20 minutes per channel to just a minute or two. The conditioners feature power inputs from 15-30VDC or ±15VDC and a choice of 6 voltage and 2 current



loop analog DC outputs. In addition to built-in cyber security and diagnostic features, the series offer a choice of 4 LVDT excitation frequencies. It also comes with auto-mastering and an RS-485 digital communications link with an available GUI and hot swapability.

www.alliancesensors.com

Pressure Sensor

Baumer introduced its PP20R family of pressure sensors, designed for the rail industry, that features high insulation strength and enhanced EMC immunity. The series measures relative pressure from 0–0.25 bar and 0–160 bar. It is available in a variety of models with regard to accuracy, output signal (current 4–20mA and voltage 0–10V, 0–5V and 0–2V), and electronic and process connections. The sensor’s insulation strength is up to 1.5kVAC and its electromagnetic immunity exceeds the EN 50121-3-2 standard requirements. The series also features four pressure equalization ports and meets the newly established GS1 standard for the rail industry.

www.baumer.com



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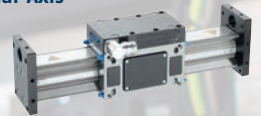
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