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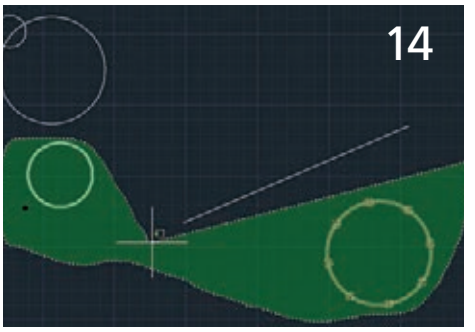

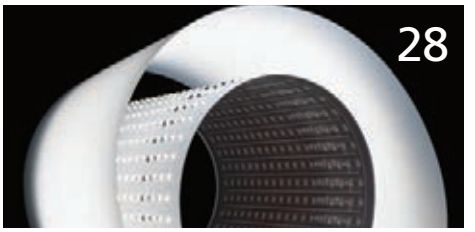

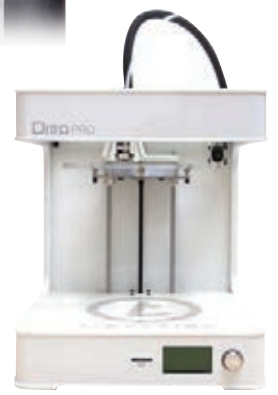

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Windsor Hum

For years, residents of Windsor have been plagued by a pulsating noise that, until recently, remained a mysterious but aggravating fact of life in Canada's automotive capital. But a report, released in May, confirmed the source, if not the exact cause, of what has come to be known as the Windsor Hum. Far from a mass hallucination, the vibrations, it turns out, have been seeping across the Detroit River from a manufacturing plant located on a heavily industrialized patch of land aptly named Zug Island.

Unfortunately, solving the mystery has provided little comfort for sleepless Windsorites; the bad news is that there may be little they can do to stop the noise; the iron-making plant occupies most of what is a separate municipality from Detroit and the company has refused to let scientists pin-point the cause or respond to the Canadian government's efforts to resolve the issue.

In a larger sense, the Windsor hum isn't the only relentless source of sleeplessness emanating from the Motor City into Southern Ontario. A separate report released in May by RBC economist Josh Nye paints a bleak picture for Canada's auto sector. In it, he says that, although motor vehicles sales in Canada last year hit a record high of 1.8 million units and a solid 15.9 units in the U.S., little of that resurgence in the sector is benefiting the Canadian automotive industry.

Specifically, the report states that shipments are still 15 percent shy of where they were before the recession. Worse still, only 8,300 of the 43,400 jobs lost since 2007 have returned, making automotive one of the worst performing manufacturing industries. Similarly, 2013 saw weak investment in Canadian motor vehicle and parts manufacturing. In total, capital investment was down to a third of what it was in 2007.

The automotive sector's failure to ride the upswing in sales, the report concludes, is due to a "shift in the North American production landscape" as assembly work has increasingly moved to Mexico and the southern U.S. Since the NAFTA era, Mexico's market share has risen from 7 percent in 1994 to a high of 20 percent in 2011. Conversely, Canada's production has eroded to 14 percent in recent years, largely to southern U.S. states. Future investments planned in those locations will only further the trend.

In the end, the report doesn't single out one cause (free trade, strong Canadian dollar, comparative labor costs, government subsidies, etc.) for the shift in the landscape. Instead, it simply suggests that it will continue and there may be little Canada can do to stop it.

To be sure, the report holds few bright spots but this shifting landscape may take years to fully come into focus. In the meantime, it serves as the latest of many sirens warning that the struggle to retain or land new automotive manufacturing investment, facilities and jobs will become increasingly cut-throat.

The question is whether Canada will let the industry fade or try to match the labor deals, tax incentives and other inducements offered by the likes of Mexico and Alabama. My guess is that, like the Windsor hum, Ontario and the federal government will continue to whisper comfort to voters in the automotive capital of Canada, but ultimately it lacks the political will to make itself heard above the relentless hum emanating from manufacturing plants south of the border.

Mike McLeod

@ I enjoy hearing from you so please contact me at MMcLeod@design-engineering.com and your letter could be published in an upcoming issue.

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UP FRONT

Canadian additive manufacturing ISO standards committee formed

The Standards Council of Canada (SCC) announced that it has tasked Bureau de normalisation du Québec (BNQ) with managing the SCC mirror committee SMC/ISO/TC 261 on additive manufacturing.

Canada is one of 18 countries involved with the ISO/TC 261 international standardization committee on additive manufacturing set up in 2011 by the International Organization for Standardization (ISO).

"With BNQ having harmonized the Canadian and international ISO/TC 261 committees, Canada now has wide-ranging industry influence in setting these important international standards," said John Walter, Standards Council of Canada's CEO.

BNQ is currently completing the formation of the Canada mirror committee that will enable Canadian stakeholders to follow and influence the international committee's work. The committee will be chaired by François Richard, project engineer for additive manufacturing at Pratt & Whitney Canada.

www.bnq.qc.ca

ATS sales, profits rise for 2014

Cambridge, ON-based ATS Automation Tooling Systems Inc. announced that its books have significantly improved over the past quarter and since this time last year.

According to its recent fiscal 2014 financial results, ended March 31, 2014, the system integration company saw its revenues from continuing operations grow to $200.7 million, 31 percent higher than last year and up 13 percent from the third quarter. Similarly, the company's earnings were $17.2 million, compared to $16.7 million in the their quarter and $14 million in the fourth quarter of 2013.

A major factor in company's improved balance sheet has been the acquisition last year of IWK Verpackungstechnik GmbH, a German-based automation company that specializes in packaging machinery for the pharmaceutical and personal-care industries.

IWK added revenues of $29.6 million plus bookings that pushed the total order backlog to a record $474 million. In addition, the company said revenue from customers in the consumer products and electronics sectors climbed 216 percent in the fourth quarter compared to a year earlier, while revenue from the energy sector increased 94 percent.

www.atsautomation.com

Engineering salary survey details compensation across Canada

Engineering staffing firm, Randstad Engineering, recently published its 2014 National Compensation Survey, which details salary information for most engineering positions in Canada. Based on salary data from the Economic Research Institute, the guide provides a snapshot of typical salaries in 58 cities across the country. In addition, the survey also factors in levels of experience by showing average compensation for hundreds of engineering and related roles at five, seven and 10 years of experience.

A quick comparison from Randstad Engineering's salary guide shows that location can make quite a difference. For example, according to the survey, manufacturing mechanical engineers in Calgary pull down between $91,030 (five years) and $109,811 (10 years) while "next door" in Regina, they average $76,675 to $89,390.

Comparatively, in concentrated engineering markets like Toronto and Montreal, manufacturing mechanical engineers' salaries are near equal (Montreal: $78,369.38 to $91,535; Toronto: $83,140 to $96,882). The big money, however, is found in more remote but high demand markets like Fort McMurray, where manufacturing mechanical engineers make between $117,302 and $137,641, depending on years of experience, the report says. The complete salary guide is freely available on Randstad Engineering's website.

www.randstad.ca

Novel Canadian device precisely dampens load from collision impact

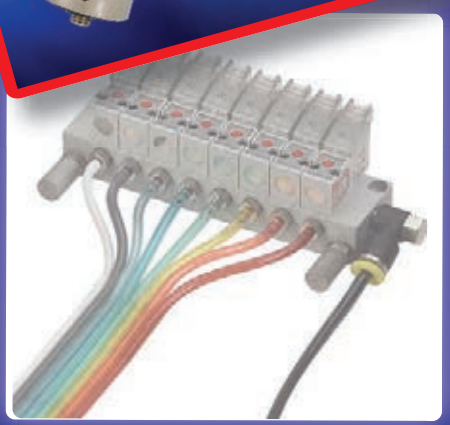
Since Mercedes-Benz patented the idea of crumple zones in the early 1950s, the energy absorbing systems have become a standard safety design feature. But while they have saved countless car occupants from suffering the full force of impact energy over the past 60 years, they do have limitations.

According to Dr. Bill Altenhof, associate professor in the University of Windsor's Mechanical, Automotive and Materials Engineering





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University of Windsor engineering professor Bill Altenhof holds a piece of aluminum tubular frame split by his energy-dissipating, axial cutting device. (Photo credit: University of Windsor)

Department, crumple zones don't always deform in predictable ways, which leaves some uncertainty in pre-determining how effective the measures will be.

"The current systems typically depend on a collapsing, accordion-type deformation, which depends a lot on some very small imperfections or geometric incontinuities," he says. "But if a small variation is introduced, because of the manufacturing or welding, they can lead to some pretty big differences."

To remove chaos from these measures, Altenhof says he and his colleagues at the University of Windsor have created a simple device that provides a more predictable way to absorb impact energy. Shaped like a steel wheel with four spoke-like blades, the device could be built in to the end of a tubular aluminum frame. Upon impact, it cuts down into the frame tube, like a kitchen tool, causing the metal to spread rather than crumple unevenly.

"One of the first technicians that saw it said it was the world's most expensive banana peeler," he says. "While it does slice through materials, there is a lot of engineering behind it. When someone says that they need the load to be a specific value, we can engineer it so that the load is very close to that value. We can also 'program' into the device how its load deflection behaves."

While vehicular applications for the device are evident, Altenhof says the device could be used in any situation where energy needs to be absorbed evenly and predictably, such as in buildings designed to withstand earthquakes.

"Give me any application where you need a way to optimize energy dissipation and load transfer resulting from impact or other traumatic events, and we can probably find a way to make this work," he says.

www.uwindsor.ca/mame

Université Laval retains Shell Eco-Marathon Americas title

For the sixth time in the competition's eight-year history, Universite Laval's Alérion Supermileage team of engineering undergrads has won the Shell Eco-Marathon Americas title with a run of 2,824 miles per gallon (1200 km/l). The fuel efficiency competition, which took place in Houston in April, brought together 120 teams across North America to vie for the $2,000 prize for the most fuel-efficient vehicle.

The Laval team has historically run away with the first place prize in years past, but Alérion faced stiff competition from their rivals at the University of Toronto's Supermileage team, which lagged due to friction problems.

Six-time winners Universite Laval's Alérion Supermileage team took first place in the prototype gasoline category at the 2014 Shell Eco-marathon Americas. (photo credit Jack Thompson/AP Images for Shell)

"Our team is very excited with the results of the weekend," said team captain Audrey Lainé. "Initially we had issues with our engine, but we came together as a team to fix it and are extremely satisfied. The University of Toronto and Mater Dei High School had very close scores to our team, which made the weekend even more exciting."

After five years in Houston, the competition is scheduled to move to Detroit on April 10-12, 2015.

www.shell.com/ecomarathon

UP FRONT

Magellan, University of Manitoba partner on satellite integration facility

Magellan Aerospace announced it will partner with the University of Manitoba to create an advanced satellite integration facility (ASIF) in Winnipeg. Located at Megellan Aerospace, Winnipeg, the facility will research, develop, construct and test satellite buses and components. The company says it will invest more than CAD$2 million in the project and establish an Industrial Research Chair in the area of satellite development within the Faculty of Engineering at the University of Manitoba. Construction of the 6,000 square foot facility is scheduled for completion in June 2014.

www.magellan.aero

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Sporting a new look, Creaform's redesigned HandySCAN scanner line is 40 percent more accurate yet 25 percent faster than the original.

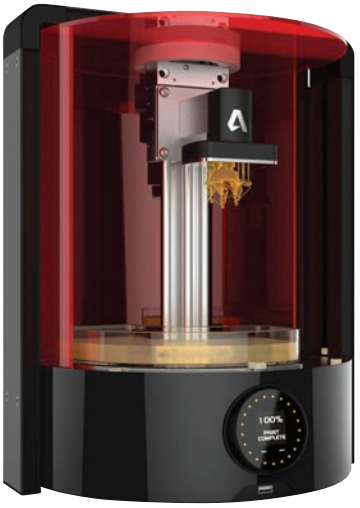
Creaform overhauls 3D portable scanner lines

Quebec-based Creaform announced that it has re-engineered all its hand-held 3D scanners, including the HandySCAN and GO!Scan lines. For example, the new HandySCAN 300 and HandySCAN 700 sport a significant redesign from the company's original 3D scanners. Beneath the surface, though, the company says its latest HandySCANs are 40 percent more accurate (volumetric accuracy of 60µm/m) and 25 times faster than the former generation.

Creaform has also boosted the capabilities of its entry-level Go!SCAN line. The Go!SCAN 50, designed for measuring larger parts, and the Go!SCAN 20, for smaller objects with intricate details, now feature accuracy up to 0.1 mm (0.004 in.) and resolution of up to 0.2 mm (0.008 in.). According to the company, both models produce meshes, with captured color maps, in under five minutes typically, with little to no prep time.

www.creaform3d.com

Autodesk to release open source 3D printer, software platform



Autodesk CEO Carl Bass announced that the company will release an open source 3D printer platform (i.e. operating system) and its own reference 3D printer later this year in the hopes of spurring the technology beyond its present infancy.

According to Bass, the software platform, called Spark, will "make it more reliable yet simpler to print 3D models, and easier to control how that model is actually printed." In addition, he says it will be open and freely available to anyone including 3D printer manufacturers. Presumably, the intent is to create a standard operating environment for 3D printers similar to Linux for PCs or the Android OS for smart phones.

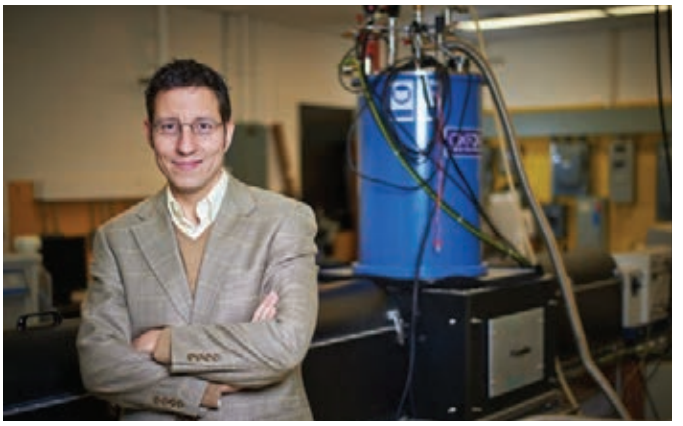
As a reference system for Spark, the company has developed an SLA 3D printer that uses a resin build material but will accommodate multiple materials. Like Spark, Bass says, "the design of the printer will be made publicly available to allow for further development and experimentation."

www.autodesk.com/spark

Waterloo-developed nanotech promises to revolutionize LED light bulbs

As time runs out for incandescent light bulbs and compact fluorescent lights (CFLs) have failed to gain much consumer affection, many are looking to LED light bulbs to become the new standard in lighting. While efficient, LEDs are also currently expensive to produce, due to rare earth components required to make naturally blue LEDs emit white light.

However, a research team at the University of Waterloo, headed by chemistry professor Pavle Radovanovic, say they have developed a nanotechnology that can perform the same function for a fraction of the price. The result could start a revolution in energy-efficient lighting, they say.



Pavle Radovanovic, Canada Research Chair in Physical Chemistry and Spectroscopy of Nanoscale Materials at the University of Waterloo. (Photo credit: Light Imaging)

According to Radovanovic, who is also part of the university's Institute for Nanotechnology, the breakthrough combines energy-absorbing nanocrystals with organic dye molecules. The two layers allow the light emitted to be tuned to a brighter white without the need for expensive, and sometimes difficult to get, rare earth elements.

In addition, he says the nanoparticles exist in liquid form, allowing for a spray-on application method that could significantly cut the engineering and production complexity inherent in the manufacture of standard LED light bulbs.

At present, the University of Waterloo team is in talks with VC firms in the hopes of launching a start-up company to develop and market the technology in the near future.

www.uwaterloo.ca

What's New in AUTOCAD

Autodesk tweaks latest version of venerable CAD application including a new dark and "sexy" UI.

by Ralph Grabowski

AutoCAD 2015 is a "fine tuning" release. There are no big changes; instead, Autodesk programmers applied tweaks to several areas of the venerable CAD program, many of which users will love, others they might not. For instance, this year the area receiving the most attention is point cloud processing — not a priority for most users. (Last year, it was mapping.)

By my speculation, there are a couple reasons why this is a tweak-release. One is that many customers are on subscription, and so Autodesk no longer needs to "sell" the new release to juice annual upgrade sales. Another reason is that AutoCAD maintains the same DWG file format for three releases in a row. AutoCAD 2015 still uses the DWG 2013 format. But AutoCAD 2016 will have a new DWG format, allowing Autodesk to remove the leash and bring about major changes.

Changes to Internal Commands

One of the most powerful ways to speed up drafting efficiency is for the CAD program to preview editing actions. In AutoCAD 2015, Autodesk adds previews to the Break, Extend, Lengthen, MatchProp and Trim commands. For example, when we move the cursor during the Trim command over entities, we see which one(s) will be removed — no need to say "Oops," press U, and Spacebar to retry the command.

In a similar vein, complex linetypes are now displayed when we change their positions through commands like Move and Rotate. This is controlled through the ComplexLtPreview system variable. Color, lineweight and linetype are shown on entities as we draw them, which is cool to see in action. AutoCAD lacks an editor to edit those linetypes, however.

To select an irregular area, AutoCAD had provided the polygonal Fence mode, but now there is a Lasso mode: We hold

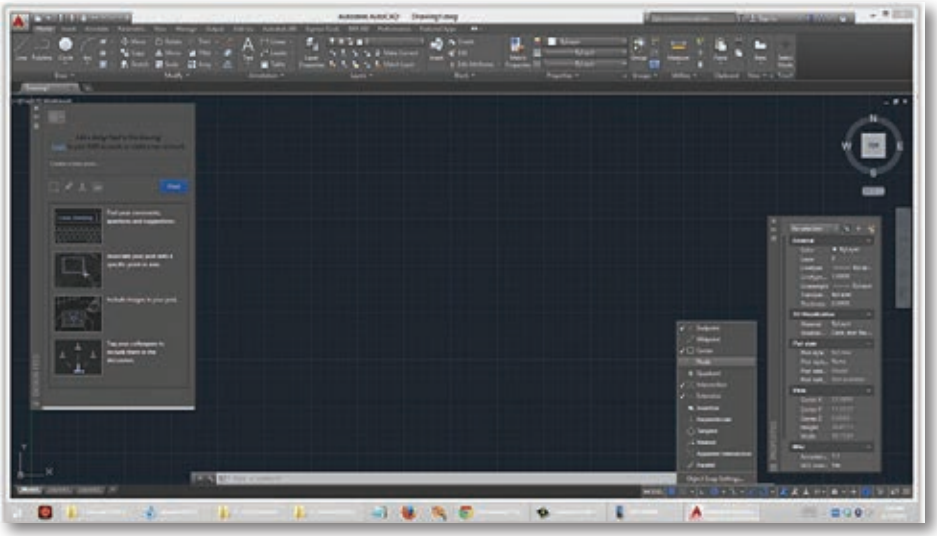


Figure 1: The user interface of AutoCAD 2015 goes dark.

2015

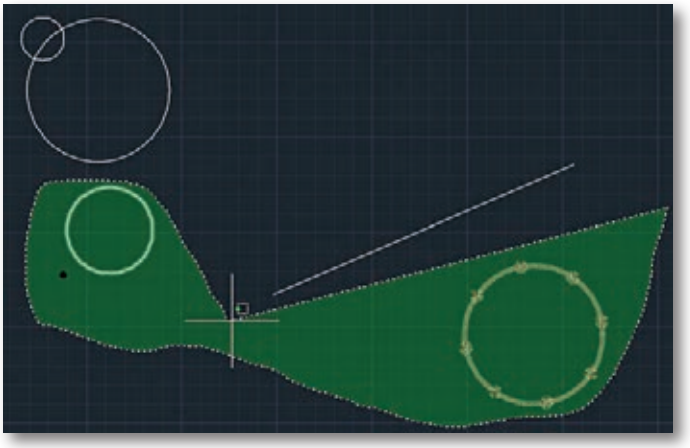


Figure 2: AutoCAD 2015 now allows sketching an arbitrary selection path using the new Lasso mode.

down the left mouse button in an empty part of the drawing, then start dragging the cursor around entities. (See Figure 2.) Pressing the spacebar switches sub-modes between crossing, windowed and open.

For the nth time, Autodesk 2015 changes how we access blocks. Earlier attempts included the icon menu (too difficult to customize), Tools Palette (still around), Dashboard (a personal favorite surviving just two releases), Content Explorer (painfully slow in my experience), and then last release's method of typing the first few letters of a block's name at the command prompt. In AutoCAD 2015, blocks are accessed in one more way: Visually, from the Insert section of the ribbon, in the same manner as hatch patterns.

And then there are changes to other commands: MText gets plumped up with property-matching between text selections, automatic bulleting, alignment of independent paragraphs and reversing of all-caps with the Shift key. AutoCAD 2014 introduced background maps (sourced from Microsoft's Bing) but they couldn't be plotted. In AutoCAD 2015, they can.

In addition, natural sort order (1, 9, 10, 11...) now appears in all commands that list layer names, such as QSelect; we determine sort order through the new SortOrder system variable. We can switch between isometric viewing modes with a new button on the status bar (in addition to the old keyboard shortcuts), but Autodesk doesn't provide isometric text and dimension styles.

Changes to External Utilities

Recap (short for "reality capture") is a program introduced with the last release that processes point clouds externally to AutoCAD. I think Autodesk may confuse some users by splitting point cloud tasks between two programs, externally in Recap and in AutoCAD. The split widens in AutoCAD 2015 with the move of the Create Point Cloud command to Recap.

The number of points that AutoCAD can display has increased from 10 million to 25 million. Point clouds now orient themselves to geographically-correct positions in drawings with geographic positioning turned on. We have more ways to colorize and size point clouds, based on the points' elevation, normals, intensity, and classification, and the colors of objects scanned. (See Figure 3.)

On the down side, AutoCAD 2015 works only with its proprietary RCS scan and RCP project formats, and no longer supports PCG and ISD files. The workaround is to attach them to drawings in AutoCAD 2014. ReCap now requires OpenGL driver v3.3. The not-free ReCap Pro version was supposed to get the ability to convert point clouds into 3D CAD objects, but it is not clear to me if this has happened.

Design Feed was added last year and acts like a chat window exclusively for AutoCAD users. To work, it requires all participants to log in with their Autodesk 360 account. This year, it shares our comments on specific aspects of drawings like a communal markup system. The drawback is that Autodesk stores our chatter on servers it leases from Amazon; security-aware

users are unhappy that these proprietary conversations cannot be stored on private, on-site servers.

Application Manager replaces the former update mechanism, and keeps AutoCAD and any plug-ins up to date.

Changes to the UI

Users are always keen to learn about new CAD functions, but changes to the user interface are not as warmly embraced. Autodesk broke with tradition by making a change we cannot undo: Buttons on the status bar are moved to the right (no biggie) and are displayed only as icons (a biggie). I suspect Autodesk went non-text to reduce the cost of internationalizing its software but, on blogs and forums, some users expressed their outrage. There is no system variable for displaying buttons as text. In contrast, the text-based screen menu from AutoCAD v1.0 is still available, as is the text-based menu bar from AutoCAD Release 9.

Buttons—which I find useful, like coordinate display and lineweight toggle—are turned off by default. We need to click the new pancake button to choose icons for the status bar, which now total 27.

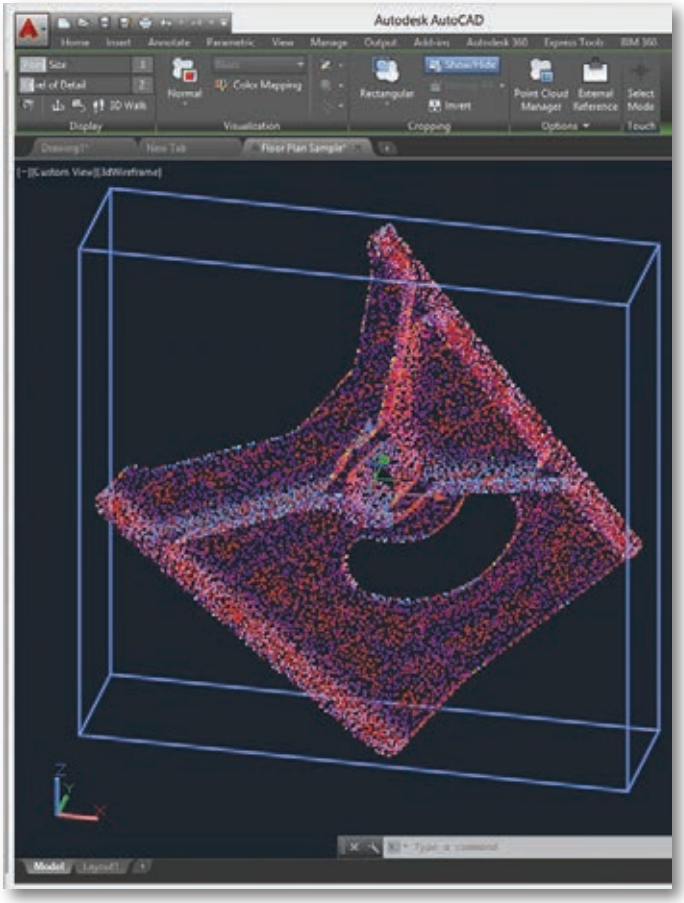


Figure 3: AutoCAD 2015 adds the ability to colorize point cloud data by normals, as well as set a minimal Level of Detail and make point size larger.

Speaking of the menu bar, Autodesk removed the Classic workspace, making it harder to switch the interface to toolbars and menu bar, which I prefer. The workaround is to recreate the lost workspace with the CUI command.

The other big change to the user interface is non-destructive: The default color scheme is dark gray, like the Mac version of AutoCAD. (See Figure 1.) Autodesk claims the near-black UI is easier on the eyes, with one blogger even calling it "sexy." But then the effect is ruined the first time we open a dialog box, which appears blindingly white. This doesn't match the design goal. The workaround is to revert the color scheme to light through Options > Display > Color Scheme.

Back in the 1980s, AutoCAD began with a screen that listed options, such as starting a new drawing, opening or plotting an existing one. Last year, AutoCAD got back the start screen, but this year it appears every single time you click the '+' new tab button. I suppose the idea is to make AutoCAD friendlier to new users, but power users will want to turn it off immediately (with the new NewTab system variable), because it gets in the way.

The cursor gets additional icons (called "badges") to report what's going on. I like these as confirmation of which command is operating. There's an '?' badge for inquiry commands like Id and List, and others for editing commands like Erase, Move and Scale.

Other changes to the user interface: Curves and diagonal lines "look" smoother in 2D wireframe displays (but not in 3D or on plots) through additional anti-aliasing, which can be toggled with the new LineSmoothing system variable. We can resize model space viewports interactively by dragging their boundaries, and create new ones with the new '+' marker. Selected objects are displayed more prominently in preview mode. There is, however, nothing new that's specific to Windows 8.x or touchscreen-equipped computers.

AutoCAD 2015 is a curious beast. I count just 13 new commands (one is just a renaming, with PType replacing DdPType). This represents the smallest number of new commands in the last eight releases I've tracked. It mixes worthwhile productivity enhancements with some changes that might be considered drawbacks.

So, is it worth it? When you pay for the annual subscription, you'll get this new release "free" automatically. If not, then the 13 commands will cost you an arm and a leg. I expect subscribers will embrace the productivity enhancements in AutoCAD 2015, while upgraders should wait until next year April to see what Autodesk has in store for us with AutoCAD 2016. **DE**

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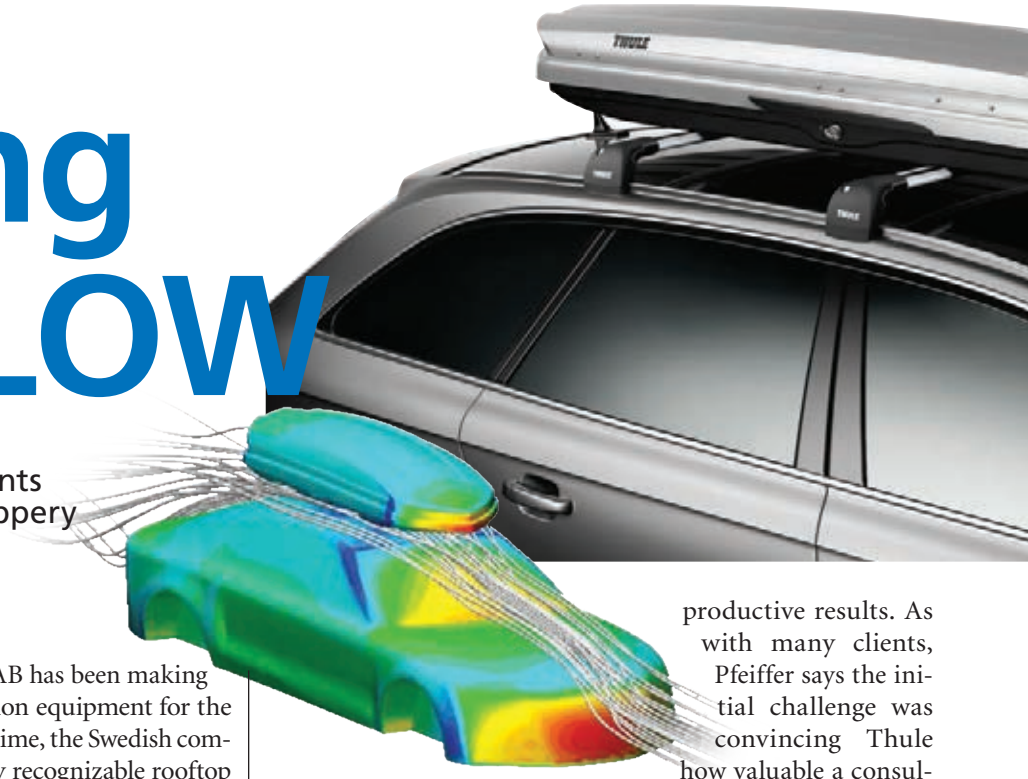
Ralph Grabowski is a CAD journalist and blogger at worldaccess.typepad.com

Finding the FLOW



Engineering analysis consultants bring expertise to bare on slippery design challenges.

By Mike McLeod

For more than 60 years, Thule Group AB has been making cargo carriers and other transportation equipment for the automotive accessories market. Over that time, the Swedish company's products have become an instantly recognizable rooftop fixture for anyone who has transported bikes, sporting equipment or the family's luggage during an extended cross-country vacation.

Obviously, carrying capacity is a central design target for its products, but other considerations, such as aesthetics, noise and aerodynamics, have become increasingly important. Due to their placement, cargo carriers can impact car handling and fuel economy.

As a result, when Thule decided to push the top end of the cargo box market with its new "Sonic" line, the company needed a compelling justification for what would become the most expensive model on the market. It decided to streamline the cargo carrier's aerodynamics through CFD analysis and thereby derive a quantifiable advantage for the high-end accessory.

Possessed with more than half a century of product development and approximately CAD$980 million in revenues last year, Thule had the personnel and financial resources to perform the work itself. However, it turned to CFD consultants at Autodesk reseller IMAGINiT Technologies instead. The result was a design that reduced the container's drag coefficient by 35 percent and ultimately lead to the company's trademark Thule AeroNose.

"Ours is a very collaborative model," says Jason Pfeiffer, director of CFD analysis at IMAGINiT Technologies. "A lot of people think, 'you're a consultant, so go off in a black hole and come back when you've solved my problem.' We are strongly against that. I tell people that we can definitely fix your problem but we may come back with a design that is cost prohibitive, difficult to manufacture or not aesthetically what the market is looking for. So, it's really important that we combine our core competencies so that all the recommendations we give fit within the product's constraints."

In Thule's case, Pfeiffer says his team was brought in early to the design process but the relationship wasn't love at first sight. The Swedish company had worked with analysis software internally and other CFD consultants in the past with less than productive results. As with many clients, Pfeiffer says the initial challenge was convincing Thule how valuable a consultant like IMAGINiT could be.

"There is no shortage of software tools and consultants," he says. "A big part of what we have to do is continue to build credibility in our own expertise because of perceptions that have been created by others. Some of those perceptions were created by consultants who said they were the greatest thing since sliced bread but then really fell short. For others, they have bought into the idea that the software can be driven by anyone but then eventually it becomes shelf-ware. So what we do is show that this really is what we do for a living and, if it is the right application fit, then we are the right consultant for them."

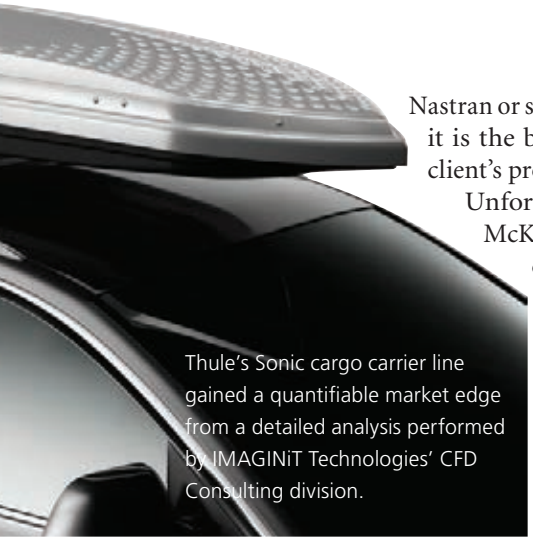
Finding that right fit is critical, agrees Creaform's FEA/CFD manager, Pier-Olivier Duval. Best known for it's handheld 3D scanners, the Québec City-based firm has also offered engineering services since its founding in 2002, including a dedicated team of analysis experts.

According to Duval, although simplified FEA and CFD modules bundled with popular CAD software can provide workable answers in the early design stage, in-depth analysis requires an expert who knows how to pose the right questions.

"When it comes time to make complex analysis like dynamics, CFD, vibration or fatigue analysis, you need someone who has a better understanding of how the physics work," he says. "If you aren't aware of the tools you are using to apply loads, boundary conditions and these kinds of things, you aren't correctly fixing your part in the space and this will generate bad results."

In addition, he says it's important to choose the right tool for the job. In truth, FEA and CFD software isn't a commodity. Each application has strengths in particular applications, but relative weaknesses when applied to others.

"We don't rely on only one software package; we use many in fact," he says. "A particular application may be able to perform very complex simulations in one instance, but it may not be the best for all kinds of design. So, we may choose LS-DYNA, Ansys,



Thule's Sonic cargo carrier line gained a quantifiable market edge from a detailed analysis performed by IMAGINiT Technologies' CFD Consulting division.

Nastran or something else because it is the best suited to solve a client's problem."

Unfortunately, says Alan McKim, P.Eng, vice president for customer service with SimuTech Canada—North America's largest Ansys reseller and a full service CFD and FEA analysis consulting firm — many companies don't realize they have a problem that needs solving, often with costly results.

"We get involved with a lot of companies who discover after-the-fact issues with their products," he says. "Those are huge expenses. These days, you often don't get a second chance. If you put something out to market that doesn't work properly, people will just go to your competitors. So it's often the cost of not doing the analysis that people don't recognize."

On the upside, McKim says engineering analysis can uncover positive product qualities a manufacturer may not be aware of initially. As an example, he says SimuTech was recently contracted to test a Toyota Prius body kit (spoiler, fender flairs, etc.) for an Ontario-based automotive after-market manufacturer. After a CFD analysis, the kit —which was initially intended for aesthetic purposes—was actually found to improve the aerodynamics of the already fuel-efficient vehicle.

"You can gain so much more of an understanding of your product on a computer than you can from a physical test," he says. "With a computer, you can see everything, all at once, and do it a lot quicker than anything that can be done physically."

Ultimately, he says engineering analysis pays its biggest dividends when it's used not only to validate a finished model but also leads engineers to an optimized solution.

"Because simulations are so much easier to do and computers are so much more powerful, we can set up a full parametric study, run a few hundred simulations and come back with a full statistical sensitivity study," he says. "This way, you're not doing a one-off analysis of an ideal part you're never going to manufacturer. Instead, you'll get an understanding of the factors that really impact the performance of your design and use that to focus on how you want to do your manufacturing and get your costs down." DE

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Generation ENG

Ontario Society of Professional Engineers survey reveals potential issues in the coming generational shift in the engineering workforce.

By Chrisy Wilson,
Mercer (Canada) Limited

Over the next five to ten years, approximately 17% of today's Ontario engineers will have reached the age of retirement. These employees are primarily part of the Baby Boomer generation and have an average of 18 years of service with their current employer.

These observations are from a recent survey conducted by Mercer (Canada) Limited for the Ontario Society of Professional Engineers (OSPE). Compensation and workforce metrics data for more than 15,000 engineers across six engineering responsibility levels and 14 job types were collected from 212 organizations in both the private and public sector. The 2013 survey reflects data for engineers working in organizations of all sizes, across a broad array of industries, located in 17 metropolitan areas in Ontario.

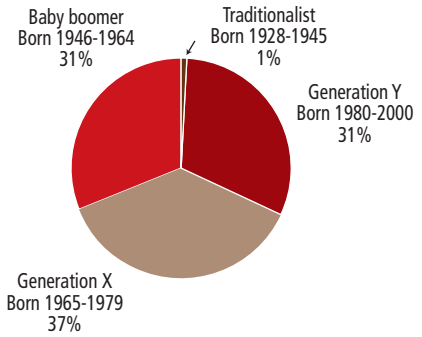

Figure 1: Distribution of the OSPE Employer Compensation Survey database by generation

The need for a workforce plan

Canada has an aging population and with a significant number of Baby Boomers expected to retire in the coming years. Many organizations will experience a loss of intellectual capital, causing critical skills gaps. In fact, many organizations are already experiencing a shortage of highly-skilled workers and, although employers are hiring, they are having difficulty finding the "right" skills to meet their needs. Employers are also having difficulty finding employees with enough experience to fill their roles, with many employers looking for engineers with five or more years of experience.

This is a "catch-22" situation as, on the flip side, new graduates often struggle to find work in their chosen profession and are not able to obtain the valuable experience that employers are looking for. With Baby Boomers exiting the workforce and Generation X employees beginning to fill their shoes, it will be increasingly important that Generation Y (also referred to as Millennial) employees are provided with opportunities to gain the right experience and help to fill the resulting gaps in the workforce.

Of all incumbents reported in the 2013 OSPE Employer Compensation Survey database, Generation X represents the largest proportion (37%), followed closely by Baby Boomers and Generation Y (at 31% each). Traditionalists represent only 1% of survey incumbents, as shown in Figure 1. These proportions may not seem alarming or create cause for concern; they may even make sense for many organizations as their employees gain skills and experience and move up through their organizational structure.

However, this distribution varies by industry, as shown in Figure 2. With approximately half of the Baby Boomer generation set to retire within the next five to ten years (depending on the age of retirement), this could have a tremendous impact on industries that are currently dominated by Baby Boomers.

Based on data from the 2013 OSPE Employer Compensation Survey, there are at least two industries that may need to address workforce planning issues sooner rather than later. The Public Sector and Not-for-Profit industry is currently dominated by Baby Boomers, with 46% of engineers falling into that generation, as shown in Figure 2. Even if this industry is able to transition a large portion of their Generation X employees into the roles of the Baby Boomers, with only 13% of their current workforce comprised of Generation Y, they may struggle to fill the gaps left by Generation X.

The High-Tech/Electrical Products/Telecom industry may also find itself in a similar situation due to the lower proportion of Generation Y engineers (19%); however, this industry is already dominated by Generation X, so the impact may not be as great.

In terms of differences by industry for each generation, industries that have higher or lower compensation within the OSPE

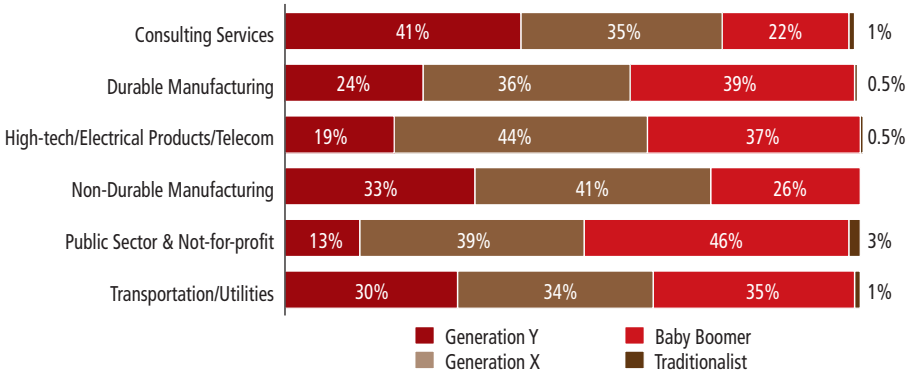

Figure 2: Generation distribution by industry

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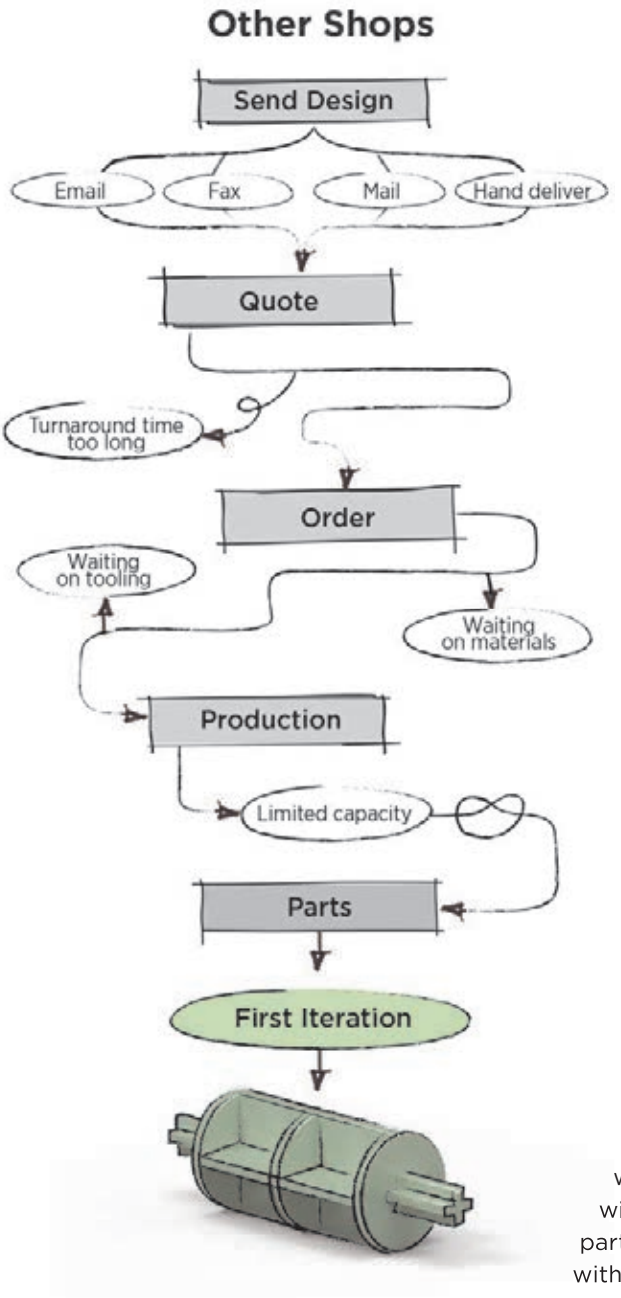

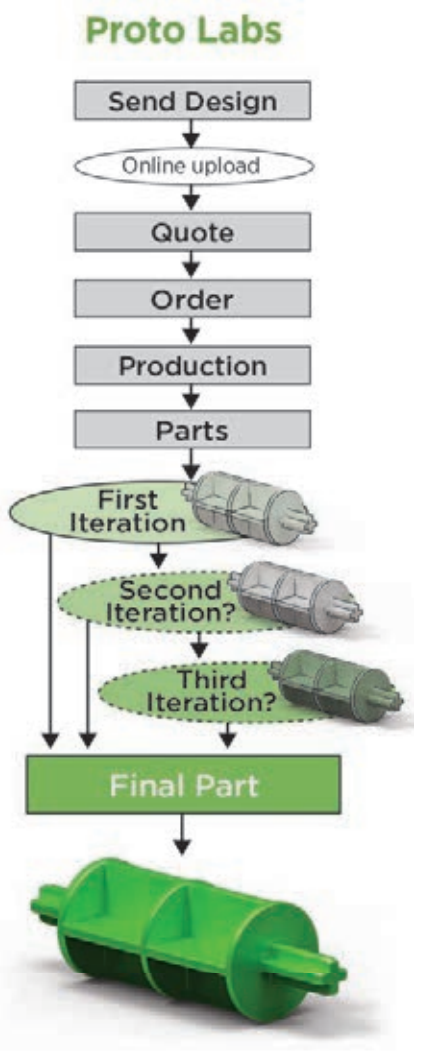

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Generation	Consulting Services	Durable Manufacturing	High-tech/Electrical Products/Telecom	Non-Durable Manufacturing	Public Sector & Not-for-profit	Transportation/ Utilities
Traditionalist	$132,252	$104,121	$109,538	--	$105,172	$115,188
Baby Boomer	$121,725	$93,912	$109,382	$131,582	$105,853	$117,082
Generation X	$98,432	$87,040	$95,155	$120,138	$98,469	$109,033
Generation Y	$67,602	$66,528	$70,480	$97,728	$80,612	$85,321

-- Indicates insufficient data to report the statistic

Figure 3: Average base pay by generation and industry

Employer Compensation Survey also represent the high and low end of the scale within each of the generations. The Non-Durable Manufacturing industry has higher base salaries for each generation, while the Durable Manufacturing industry is at the low end of the spectrum for each generation, as shown in Figure 3.

Not only will there be a potential loss of knowledge and experience with the exit of the Baby Boomers, the workforce dynamic will also change. The needs of a Generation Y employee are different than the needs of Generation X, and even more different than the needs of a Baby Boomer. For example, employees are significantly less likely to remain with the same employer for the majority of their working life — Generations X and Y do not appear to have the same sense of loyalty as Baby Boomers, with Generation Y often showing little hesitation in moving on when they are dissatisfied.

This may mean that retention will be a primary area of focus for many organizations in the coming years. However, the traditional mechanisms for retaining employees may not be successful in retaining Generation Y, so it will be important to understand the factors that drive and engage this generation. Organizations will need to review the current and future state of their workforce to prepare for the generational shift before it is too late. Organizations that have not addressed these inevitable changes and implemented a succession plan will likely suffer the most from the loss of intellectual capital and loyalty of the Baby Boomers.

Now in its 60th year, the employer compensation survey of engineers in Ontario helps establish meaningful criteria for levels of engineering responsibility for the benefit of both engineers and employers of engineers and provides current data with respect to actual compensation levels for engineering work. The survey results are available in PDF format for both employers and OSPE members.

As in previous years, the design and implementation of the survey was overseen by an OSPE advisory committee comprised of representatives from industry, as well as the engineering and human resources communities. The committee ensures that the survey remains a current and reliable resource on compensation for engineers. A list of committee members is provided in the published report. DE

www.ospe.on.ca

The OSPE Employer Compensation Survey is open to organizations that employ engineers in Ontario and provides total cash compensation data for the full spectrum of engineering responsibility levels (Levels A through F). To participate in the 2014 survey, visit www.imercer.ca/ospe, call 1 800 333 3070 or email info.services@mercer.com.

In addition, employers and OSPE members can order the 2013 OSPE Employer Compensation Survey via the Mercer contact info above. OSPE members can also access a complimentary copy of the Member Market Compensation Summary online at www.ospe.on.ca.

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READY for Anything

Toronto's INKAS Armored Vehicle Manufacturing designs security vehicles that cruise through the world's hot spots.

By Treena Hein

You know those countries you hear security travel advisories about – the ones that cause you concern when someone you know is about to travel there? Those are the places where you're very likely to find an INKAS armored vehicle.

You may not realize you've seen one, though. While the company modifies luxury sedans with armor and many other security features, the vehicles are designed not to call attention to themselves, in that both their appearance and performance are kept as close to the original as possible.

Established in Toronto in 1996, the company has become the world leader in the design and production of specialized armored vehicles. It has manufacturing facilities in Toronto and Dubai, and sales offices in dozens of countries. "About five years ago, we were putting out about ten vehicles a month, and now some months we are over 50," says INKAS sales director, Philip Daskal.

Luxury sedans are just one of the many vehicles INKAS works with. And just like the vehicles themselves – from armored personnel carriers and cash-in-transit trucks to SUV's and even taxis – the people riding around in an INKAS custom-made vehicle also run the gamut.

About three quarters of their current sales are made to government agencies, such as Departments of Defense, law enforcement, foreign trade commissions and embassies. The U.S. military is a big customer. Western Africa is also a huge market for the firm, as is the Middle East, Eastern Europe and South America.

"Stretching vehicles into a longer version is big business for us," explains Daskal. "This includes hearse manufacture, which is a whole business section in itself, and a lot of stretched SUV's with executive interiors and luxury options."

The modification process always starts with speaking to the client about their needs. Armoring and other options are selected in accordance with the desired level of protection, as well as national and international ballistic standards. "We assess where they live and what ballistics are usually used in that location," Daskal explains. "We have a pretty good idea of the threats that are out there."

Materials that might be used include ballistic glass, INKAS overlap system (a unique trough system built into an armored vehicle's doors to protect passengers from bullets which may penetrate where door meets frame), heavy-duty wheels, run-flat tires, protected fuel systems, reinforced bumpers and protection systems for a vehicle's electronic controls.

"If it's a vehicle that might be used in riot situations, there are the options of sirens, bomb-jamming devices, automatic fire suppression in the gas tank and engine, and water cannons to deal with Molotov cocktails," Daskal says. "We can provide tanks that hold tear gas, foam, dye and up to 10,000 liters of water."

If kidnapping is a concern, options include dual door locks and escape hatches. Military-style rescue mission options include pop-up gun turrets, platforms for SWAT team snipers, gun ports, spotlights and night mode, where no light is visible.

INKAS' bullet-proof Armored Toyota Land Cruiser can be fitted with gun ports, a smoke screen and run-flat tires.

Released in May, INKAS' Huron Armored Personnel Carrier features a gun turret, under-carriage blast protection and lightweight armor.

"People watch James Bond movies and want the same things, but some of these are just visual effects," Daskal says. "You see tire re-inflation happening in the movies, but the real-life device is run-flat tires and they work well. It's all about quick response and actually being able to get away from the threat."

Whenever possible, INKAS encourages private clients to select defensive and not offensive options. "There are oil and tack-dispensing systems, smoke screens, steel shearing; we can do it all, but we encourage securing safety first," Daskal explains. "Electric door shocking handles have been requested, but we don't promote this. We screen who we sell to and everything must be within legal guidelines. We don't want a child going up to a vehicle on the street and getting shocked or hurt in any way."

The actual modification process starts with stripping a vehicle down to its frame. Teams of engineers and technicians then install the various vehicle options. At each stage, quality control checks and certifications ensure functionality while maintaining the vehicles' low-profile and high performance.

"We are usually always adding about 20 to 25 percent of the original weight, so suspension and braking must always be upgraded, and door hinges reinforced," Daskal says. "There are lighter steel composites available now, which helps. As technology advances, we keep up." In terms of total cost, an INKAS private vehicle product is usually double the sticker price.

When a new option or design is given the green light, a prototype is often built first, depending on the client budget and whether the

design is likely to be used again. That will likely be the case with a new design just sent to a policing agency in Colombia called the 'Huron.' It's a 16-passenger armored personnel carrier (APC) which the company describes as a tactical attack and defense vehicle equipped for police and military tactical missions, convoy protection and border control.

Light relative to its size, the Huron's exterior and engine compartment are encased in lightweight armor designed to provide protection up to NIJ-STD-0108.01 Level III / CEN Level B6 ballistic standards. It also features under-carriage blast protection to defend against fragmentation hand grenades or light anti-personnel mines. Sporting an 8.3L Paccar Engine and a ten-speed manual Allison Transmission, the off-road APC also incorporates heat and noise insulation materials and a customizable gun turret.

INKAS' Armored Riot Control Vehicle includes a water cannon, surveillance equipment and an adjustable-height "ram bumper."

"Most APC's hold four to six people, so we needed something altogether different," Daskal explains. "We ended up using a tractor trailer with a four wheel-drive capacity. It was three months of design, trial and error. We think there will be some demand for similar vehicles going forward."

When asked to name a few unusual client requests, Daskal thinks for a moment and then laughs. "We were once asked to armor a convertible and that was pretty funny. There have also been some funky requests for turrets with rocket launchers, and people wanting flames to shoot out the back of the car. We talked them out of all that."

What does the future have in store for INKAS ? Daskal thinks more 'smart' vehicle functions are coming eventually, and the depth and breadth of sensors is also sure to increase. "We are in a lot of talks for various things," Daskal says. "More remote operation of vehicles may come, and things like launching unmanned aerial vehicles from the trunk are probably likely." DE

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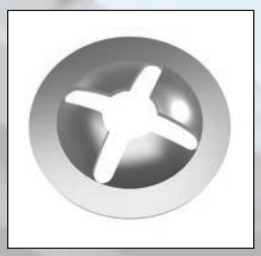

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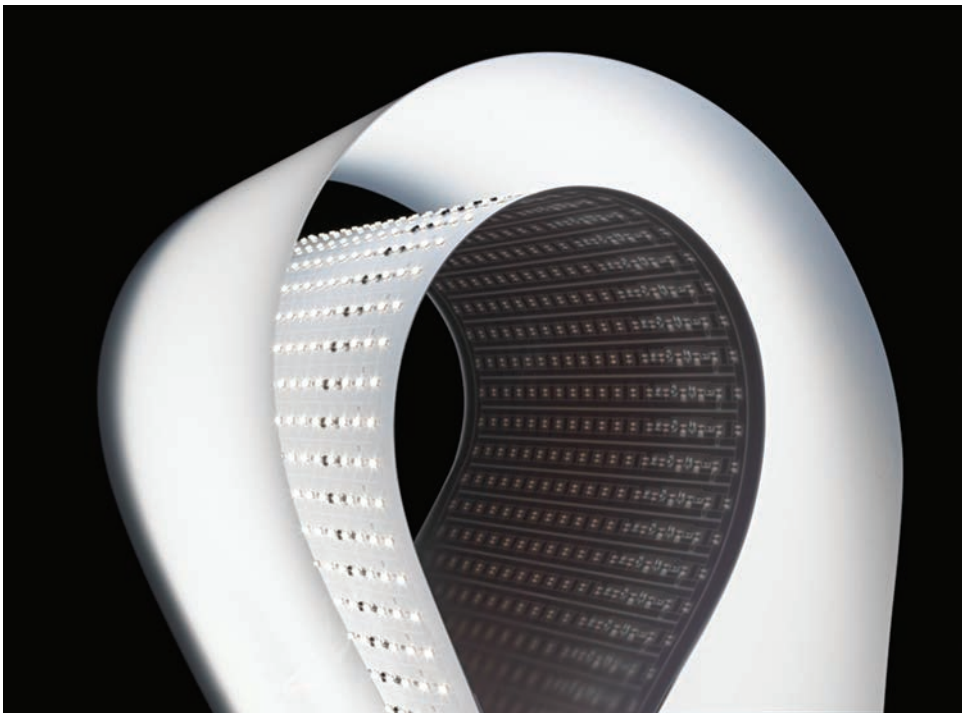
LIGHTING the WAY

Companies can tap into Canada's storehouse of engineering research capability — if they know where to find it.



This flexible LED light sheet, created by by B.C.'s Cooledge Lighting, was made possible via a partnership with Simon Fraser University's material science 4D LABS.

Three years ago, the founders of Burnaby, B.C.'s Cooledge Lighting were in the early stages of research and development for their product and needed a way to test many ideas in a short period of time. They searched the globe and ultimately found what they needed in their own city: Simon Fraser University's 4D LABS. The facility houses some of Canada's most advanced research infrastructure for materials science and engineering.

The facility provided Cooledge with a ready suite of tools, facilities and expertise to accelerate the development of their flexible light sheet, an energy-efficient film of LED lights for use in unique lighting designs. The company, which launched its premier product last spring, was able to find the right combination of materials and processes faster and at a lower cost than it could have on its own.

The collaboration between 4D LABS and Cooledge is one example of the kind of mutually beneficial partnership that is happening across Canada. According to a recent report by the Association of Universities and Colleges of Canada, Canadian universities conduct almost $1 billion worth of research in collaboration with the private sector annually, which provides "the intellectual raw material that drives innovation and builds prosperity."

But it can be challenging for companies to tap into the research resources at post-secondary institutions. They are either not aware of what resources they can access or they don't know what kind of labs or expertise are available.

Clarifying this is the driver behind a new online tool, called the CFI Research Facilities Navigator, launched by the Canada Foundation for Innovation (CFI) last November. The online tool is a searchable directory of participating research labs and facilities in universities, colleges and research hospitals across Canada that are open to working with business. Almost 350 labs — 127 of which are in engineering disciplines — have submitted entries for the Navigator, and the number is growing.

For research facilities, the Navigator is a way to promote their research capabilities to the private and public sectors. For companies, it's a venue to find the research facilities that can help their business grow, stay competitive, design new or better products or processes, and foster relationships with highly skilled people.

Tapping into Canada's storehouse of research capability to open up a company's potential is a notion that comes naturally to companies like Cooledge and one that has repeatedly been proven in institutions across Canada. Cooledge is one example of what can happen when business and research come together. And this is innovation — when a company can gain an edge by finding an inventive way to develop and move their product to market faster, which is exactly the kind of boost a venture capital-backed firm needs. DE

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METAL or PLASTIC?

In many applications, self lubricating plastic bearings show lower rates of wear than traditional metal bearings.

Misconceptions keep engineers from taking advantage of plastic bearings.

Plastic bearings can often be an ideal replacement for traditional metal bearings. They have been around for many years, but still face somewhat of an uphill battle for the respect and trust of the engineering community.

A major reason for this mindset is the belief that plastics are inferior to metals, and all plastics are cheap, flimsy or disposable. The fact is, low cost plastic materials are available with excellent strength and thermal properties, allowing for the production of inexpensive plastic bearings that are able to outperform their metal counterparts in many rotary, oscillating and linear applications.

Engineers that are inexperienced with plastic bearings may be reluctant to put an expensive machine at risk with low-cost components they know nothing about, and many users have only turned to plastic bearings out of desperation when all else has failed.

However, with the growing recognition that plastic bearings have gained, engineers are starting to realize the true potential of plastics for a wide variety of applications, with a range of benefits.

Advantages of plastics

Plastic bearings typically consist of a thermoplastic alloy and solid lubricants, with a fiber matrix often added for additional strength and creep resistance. The most common low-cost materials are nylon, ultrahigh molecular weight (UHMW) polyethylene and Teflon. High performance engineered plastics, like Vespel, Torlon and PEEK, are sometimes used for extremely high temperatures and high loads, but can be cost prohibitive.

Self-lubricating plastic bearings contain solid lubricants embedded in millions of tiny chambers throughout the reinforced plastic material. During operation, the bearing transfers lubricant onto the shaft to help lower the coefficient of friction.

All the bearing constituents – the thermoplastic, the fiber

matrix and the lubricants – have excellent antifriction and low-wear characteristics that produce a self-lubricating effect, which is especially critical at initial start-up, when a lubricant film has not yet been formed, and the bearing begins its operation dry. With metal bearings, this can accelerate wear, but the self-lubricating plastic bearings are able to run lubricated from the start.

As soon as the plastic bearing moves, microscopic amounts of solid lubricant and thermoplastic abrade, smoothing the surface of that shaft by filling in imperfections and providing an optimum surface for continuous lubrication. This minimizes 'stiction', or stick-slip. The dimensional changes to the bearings are essentially immeasurable, and abrasion rates decrease rapidly following startup, becoming negligible in continuous operation.

Metal isn't always better

While plastic bearings are able to self-lubricate and have lower wear rates, most metal bearings are oil-impregnated sintered bronze, which require regular oiling. Sintered bronze bearings rely on capillary action to create a lubricated film over the shaft, and high-speed rotational motion is required to maintain the optimum lubrication.

This can be inhibited by shaft oscillation, low speeds and intermittent use. If movement of the bearing stops, oil on the bearings surface can dry up, leading to high friction and squeaking/squealing noises. High temperature applications can also degrade the oil/lubricant film.

Plastic bearings are effective solution for applications requiring chemical compatibility.

A lubricated shaft can create additional maintenance, as the bearing will push the oil up and down the shaft as it moves, depleting the oil layer. Oil film on a shaft is also a magnet for dirt, dust, and other debris. This can clog the bearing, or contaminate a system, particularly in the food and medical industries.

Plastic bearings offer solutions to these problems – first by requiring zero external lubrication or maintenance. Even under the dirtiest conditions, particles that could seize a metal bearing are simply embedded into the walls of the plastic material with little to no effect on performance. Faced with the same application, a metal-backed PTFE bearing's lining would likely scratch off, leaving metal to metal contact, and an increased coefficient of friction, along with increased noise.

Plastics are also a surprisingly effective solution for applications requiring

chemical compatibility. Plastic bearings are available that stand up to corrosives like hydrocarbons, alcohols, alkalines. Teflon bearings are available to stand up to most chemical corrosives, even etching acids.

Plastics are also widely underestimated at high temperatures. While many engineers expect a plastic bearing to soften and lose its shape and strength in heat, some plastic bearings operate continuously in temperatures approaching 500°F, withstanding peaks of 600°F, and running still in temperatures as low as -40°F.

Plastic bearing walls are much thinner than metal, typically between 0.04 and 0.06 inches thick, compared to metals' 0.06 – 0.1 inches, for a greater ability to dissipate heat, equaling higher PV values, and allowing for higher loads and faster speeds.

Plastic misconceptions

Despite the advantages plastic bearings have shown over metal, there are still several misconceptions that may make engineers reluctant to fully embrace plastic. The first is component durability. Some engineers tend to stick to the school of thought that plastics can never have the same strength and lasting power as metals. It is important to remember that bearing wall thickness does not correlate to the strength of the bearing – metal or plastic.

It seems reasonable to think that a plastic bearing with thin walls would not have as long a lifetime as its thick-walled bronze counterparts, but this is actually untrue in many cases. The heat-dissipating abilities of the thin plastic help to reduce wear, as mentioned above. Additionally, bronze bearings are given thicker walls to account for some amount of wear, which occurs throughout its service life.

In applications where the bearing experiences uneven or inordinate wear, such as low speed rotation, or back and forth oscillation, causing problems like a loss of accuracy, higher friction, excessive noise and premature failure.

Another mistake engineers make is they assume that the thin wall of a press-fit plastic bushing will have an effect on the surface pressure. In reality, the surface pressure of a press-fit bushing is determined by the load divided by the surface area it acts upon: $Ps = L/(D \times l)$ where Ps = surface pressure (psi); L = load (lbs); D = the inner diameter (inches); and l = bushing length (inches). Whether using a thin-walled plastic bearing or thick-walled bronze, wall thickness will have no effect on surface pressure.

Plastic bearing have already replaced sintered bronze or other metal in thousands of applications in a wide range of industries, including agricultural machinery, lawn mowers, medical equipment, and more. Decreased maintenance, cost, and weight with increased performance, cleanliness, and reliability should give them the respect from engineers that they deserve. DE

www.igus.com

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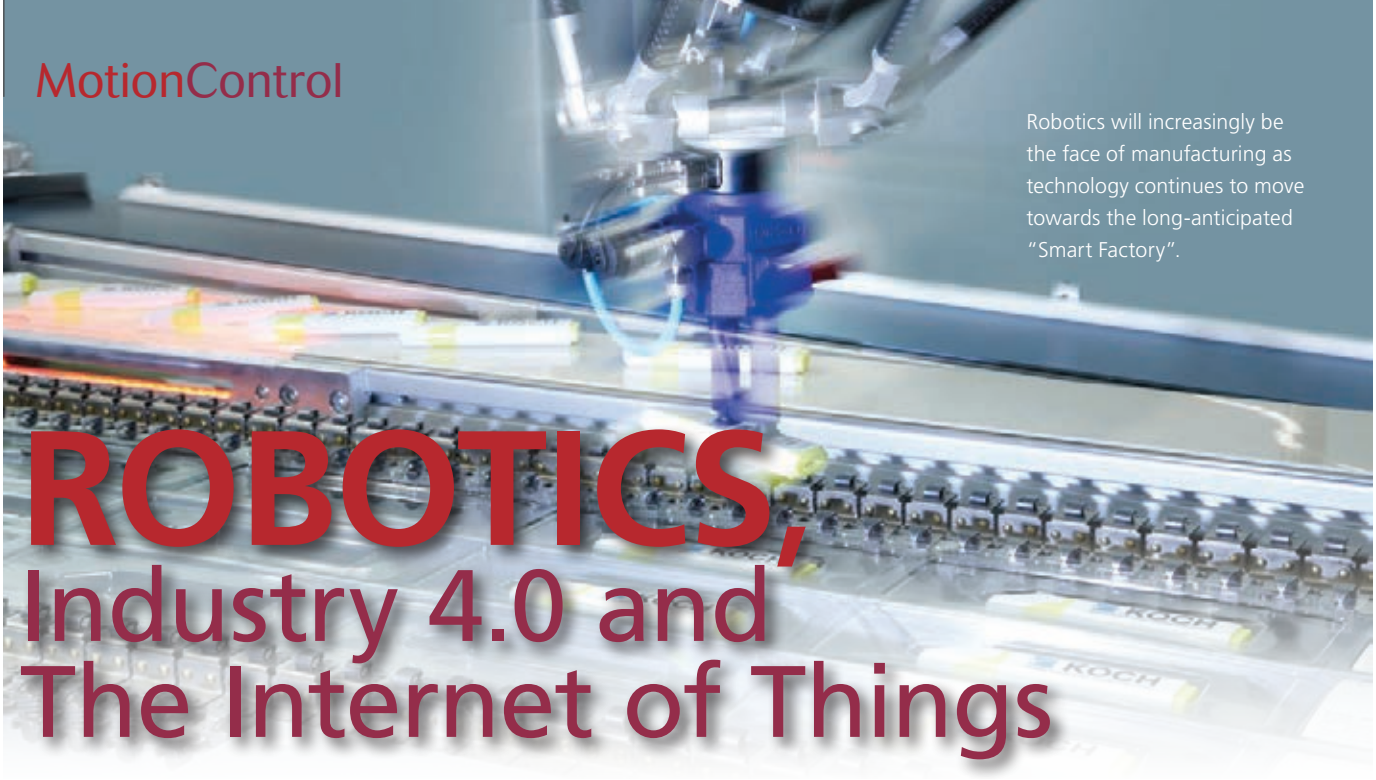

Robotics will increasingly be the face of manufacturing as technology continues to move towards the long-anticipated "Smart Factory".

ROBOTICS, Industry 4.0 and The Internet of Things

Are these industrial "instruments" ready to play in the same manufacturing symphony?

By Joe Ottenhof

In manufacturing today, robots are literally everywhere. There are very few products for sale today that didn't involve a robot at some point in its production. So with an area of technology that is so pervasive and so well-covered, I'd like to take a look at the history of robotics and how some of today's very large technology movements could change the dynamics of the industry forever.

In the interest of being… well… interesting, let's consider the derivation of the word "robot". In actuality, the word comes from a theatrical play, "R.U.R." (Rossum's Universal Robots) written by the Czech writer, Karel Capek in 1920. The play begins in a factory that manufactures artificial people called "roboti", or robots (today we would call them "androids").

The word "robot" itself means "worker" or "labourer" and was the name given to these manufactured "people" in the play. That definition provides the necessary segue to allow us to talk about industrial robots, since that is exactly the primary role today's multi-axis manipulators play. Robots perform the hardest, most repetitive labour that would otherwise be done by humans.

The Internet of Things and Industry 4.0

Whether the configuration (kinematics) takes the form of a 5 or 6-axis articulated, 3-axis Delta or multi-axis SCARA, the industrial robot is, of course, an indispensable component of the manufacturing process today. By all accounts, robots will only increase in technological importance as manufacturing moves towards and through the next industrial revolution. This "next revolution" has taken on a couple monikers including "Industry 4.0" and "The Internet of Things" (IoT).

Some think of those two ideas as the same, but there are significant differences, particularly when considering the state of their supporting technologies. IoT is tremendously broad in scope and has as its core concept, the streaming of endless amounts of data from billions of devices through and via some media (the "Cloud") to vast arrays of data servers that are programmed to meet any number of end applications. IoT has many ramifications for industry, but also for the increasingly connected lives of consumers. The foundational technologies for IoT are largely existing IT technologies and, thus, making the IoT a reality; it's really just a matter of time and organization.

Industry 4.0, by contrast, is much more focused on manufacturing. This is considered the 4th industrial revolution because it describes how the Internet will change how manufacturing itself works. The technologies that support Industry 4.0 are much newer and are still in the process of becoming mainstream.

The reason is that manufacturing has added "responsibilities" that have always differentiated, and to a degree separated, the IT world from the controls and automation technology (AT) world. These differences include security, reliability, interoperability, safety, and real-time performance. While some of those are, of course, important in the IT world, they are vital to the manufacturing and AT world.

Refocusing on the aspect of robots again, with robotics and Industry 4.0 we can see a natural connection. The robot is largely the "end effector" in the manufacturing process. It is the robot that is and will increasingly be the "roboti", the labourer, as Karel Capek might say (actually his brother Josef Capek, an artist, coined the word). However, the robot is no "island of automation", but rather part of a tightly integrated manufacturing "ensemble". The ensemble consists of electro-mechanical players as well as biological (human) players such as operators and maintenance personnel. Each naturally has an individual "part to play," a job to do.

What tools can we envisage today that will provide the proper infrastructure for control and communication among all these team members while providing data to the enterprise as a whole?

Smart factories

Let's consider an example of an advanced manufacturing facility that consists of robots, transport systems and humans, as well as a myriad of ancillary operations including packaging, warehousing and shipping. The plant floor is just one part of a competitive, interwoven business enterprise. The so-called "smart factory" will better integrate the manufacturing and business sides of the enterprise. That enterprise must produce products with the highest quality within budgeted cost targets. Production rates must be maximized with minimized waste and an optimized use of resources, especially energy and raw materials. Orders must be processed, scheduled, prioritized and shipped on time. Parts and process materials must be available, but not aged or languishing in inventory. The entire smart factory is, in essence, a symphony of manufacturing excellence.

As with all symphonies, there needs to be a "conductor" in the factory to ensure this excellence. This conductor must oversee the performance, maintain the timing and coordinate every instrument to produce a flawless product. The conductor on the plant floor is clearly the automation control system. The control system must have the power, flexibility, and connectivity to allow all the disparate technologies to act as one completely synchronized system acting in harmony. Bringing the symphony analogy into the world of technology leaves us considering what computing platform would be up to the task.

It's not hard to see that the PC-based controller is the only solution with the innate ability to accomplish the task. The industrial version of the PC (the "IPC") is the ideal computing platform for the symphony of manufacturing that is the smart factory. Equipped with a Windows Operating System (OS) and multi-core processors, the IPC is the defacto open platform necessary to satisfy both the AT and IT disciplines within the enterprise. By implementing functionality in software rather than in hardware, the IPC acts not only as the PLC and data acquisition system, but also as the motion controller, and most relevant to this discussion, the robot controller. That is, the same processor implements in software all functional devices on the plant floor.

The communication protocol used among the various devices and up to the enterprise needs to exhibit certain performance characteristics as well. The protocol is the "sheet music," or the script, if you will, that ensures all the players in the enterprise are in sync and moving towards a common objective. Communication must be robust, secure, fast and completely open. In today's world of process and manufacturing automation, the technology that stands out most is OPC UA.

OPC UA is the next generation communication technology used in numerous industries to establish secure communications among devices and higher enterprise level servers. It addresses today's communication infrastructure needs such as Internet security, safe access across firewalls and support for legacy OPC

devices. In addition, OPC UA provides platform independence (PC, Mac, smartphone, tablet) and OS independence (Windows, Mac, Linux VX Works). Only OPC UA has the momentum, history and wide adoption rate necessary in the smart factory to enable and maintain a seamless integration of all the technologies necessary to make "music" on the plant floor.

What will the next generation operator interface look like between the robotics, the machine or process and operator? Of course, we could have expected that the world of commercial electronics would impact this important area of machine and process design. It shouldn't be surprising that multi-touch functionality is becoming a standard characteristic of the industrial HMI. The capacitive or resistive single point touch screen is augmented with multi-touch gestures such as "swipes", "flicks", and "pinches".

Now we can see an entirely new approach to the HMI with the advent of "augmented reality glasses". Introduced and typified by Google Glass, this wireless interface to the control system provides the opportunity for dramatically increased efficiency from the operator level in the future. Equipped with a camera, heads up display, microphone and touch feedback (think "wireless mouse"), operators equipped with Google Glass will make a quantum leap in terms of the human-machine interface as we currently understand it. This will also provide unprecedented mobile access to information about the robot-enabled machine, its programs, and specifications.

Robots and Industry 4.0 offer North American manufacturing the opportunity to regain some lost ground. This is no better seen than with Tesla Motors and its new manufacturing facility in California. Tesla took an abandoned automotive factory of the past and created a modern manufacturing marvel. Robots seemingly do everything in the plant, but even there they are just the face of an impressive plan to change the way we manufacture products in this part of the world.

Robotics will increasingly be the face of manufacturing as technology continues to move towards the long-anticipated "Smart Factory". However, the realization of that near future depends on an understanding that robotics are only one part of a bigger, often technologically disparate whole. The ability and willingness of all elements to "play nice" together is inevitably linked to the wide adoption of broadly based standards for hardware, software and communications. Those standards exist today. The question for North American manufacturing is, will we become part of a great symphony of manufacturing or continue to merely settle for a thousand "one man bands"? **DE**

www.beckhoff.ca

Joe Ottenhof is General Manager of Beckhoff Automation Canada Ltd. and has more than 30 years experience in industrial automation and controls.

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Automation

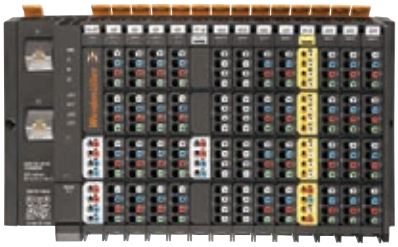
Servo Terminal I/O

Beckhoff Automation released its EL7201-0010 servo terminal that supports One Cable Technology (OCT), which combine power and feedback signals in one standard motor cable. The terminals integrate a complete servo amplifier for motors up to 200W in a High Density (HD) terminal housing measuring 12mm wide. OCT is also available as an option on the Beckhoff AM8000 servomotor series instead of the traditional resolver interface. The EL7201-0010 servo terminal supports the direct connection of new Beckhoff servomotors: AM8121 (0.5 Nm), AM8122 (0.8 Nm) and AM8131 (1.13 Nm).

www.beckhoff.com

Distributed I/O Platform

Weidmuller launched its u-remote distributed IP20 I/O platform. The platform's design features 11.5mm-wide I/O slices and Push-In wire technology. The card slices are hot-swappable and can be installed, updated and removed without the need for tools. The unit also features an integrated web server to provide real time network access to the 64



I/O slices/cards connected to a single field bus coupler. The field bus couplers include ProfiNet, EtherCat, Modbus TCP, Ethernet TCP/IP and other protocols for integration into existing plant/machine networks. The high-speed system bus provides impressive electronic performance and works with up to 256 DI/DOs in 20 µs.

www.weidmuller.com

Mechatronic Gripper

SCHUNK expanded its EGP gripper series with a size 25, electrically-driven gripper that weighs 110g and has a stroke of 3mm per finger. The gripping force can be adjusted on 2 stages and its maximum gripping force amounts to 40 N. The gripper can handle workpieces of up to 200g and has a closing time of approximately 0.09 seconds. It features brushless servo motors with cross roller guidance. The mechatronic gripper is based on the company's pneumatic MPG-plus small part gripper. In many cases, users can transfer the sensor system of the MPG-plus onto the EGP, allowing for a quick change from pneumatics to electronics.

www.schunk.com

Modular Industrial Connectors

HARTING expanded its Han-Yellock line of modular industrial connectors with the introduction of its smallest size yet: the Han-Yellock 10. The compact connector can fit both rectangular and circular panel cut outs, allowing direct replacement of circular connectors with a panel cut out diameter between 28 – 30mm. It joins the Han-Yellock sizes 30 and 60 and comes with either cable glands M20 or M25, top or angled entry.

The Han-Yellock10 can be used for power only, or for combinations of power, signal and/or data, accommodating any of the company's 25 Han 3A inserts. It can carry up to 40A / 690V of power, data for Ethernet applications, and optical data transmission. In addition, multi-pole inserts with up to 21 contacts also are available. Termination options include crimp, screw and HARTING proprietary Han-Quick Lock. Like the larger Han-Yellock sizes, the zinc die-cast Han-Yellock 10 features EMC properties and as well as IP 65/67 protection when locked.

www.harting.com

Air Nozzle

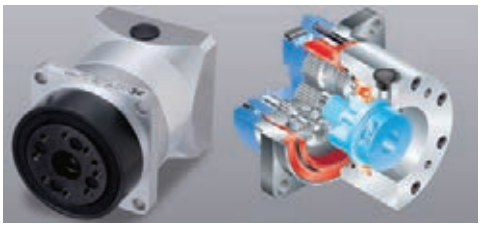
EXAIR introduced its PEEK 3/8 NPT Super Air Nozzle. Constructed from PEEK plastic, the blowoff nozzle operates in temperatures up to 320°F (160°C). The Model 1104-PEEK 3/8 NPT Super Air Nozzle provides a blowing force of 1.9 pounds (850 grams), with air consumption of 35 SCFM at 80 PSIG. Airflow of the company's CE-compliant Super Air Nozzle cannot be blocked, which meets OSHA dead-end pressure standard 29 CFR 1910.242(b). Sound level is 82 dBA and meets OSHA noise requirement 29 CFR 1910.95(a).

www.exair.com

Power Transmission

Planetary Gearhead

Harmonic Drive released its HPGP high-torque planetary gearhead series that the company says achieves 33 percent higher torque than the original HPG Series with the same precision. The gearhead features reduction ratios between 4:1 and 45:1 and standard backlash of less than 3 arc-min. In addition, the HPGP series also features a cross roller bearing for high load capacity and moment stiffness as well as a Quick-Couple input shaft and motor flange for mounting to a servo motor.



www.electromate.com

Rigid Couplings

Ruland introduced rigid couplings with precision honed bores, anti-vibration hardware, and opposing hardware on two-piece styles. Ruland couplings use high grade forged screws and feature proprietary Nypatch coating to resist vibration. The company's rigid couplings are offered in one- and two-piece clamp styles with or without keyways in bore sizes ranging from 1/8-inch (3mm) to 2-inch (50mm). Materials used include 1215 lead-free steel, 2024 lightweight aluminum and 303 stainless steel. Custom dimensions, inch to metric step bore combinations and 316 stainless steel are available by request.

www.ruland.com

Square Bore Mounting Collar

Stafford Manufacturing introduced a line of machined square bore two-piece shaft collars machined from steel, stainless steel, aluminum, and plastics to fit square shafts and structural tubing from ½-to 2-inch square. Featuring one or two flats on the O.D. with dual-purpose threaded mounting holes, they can include a variety of mounting options. Standard and large footprint designs of Stafford Square Bore Mounting Collars are offered to accommodate different size components and can be machined and modified to customer requirements. Round bore designs are also offered along with a plastic hinge mounting collar.

www.staffordmfg.com

DESIGN GENERATOR

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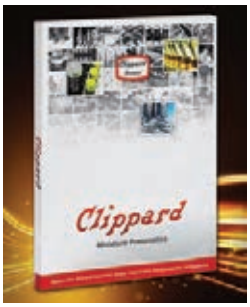

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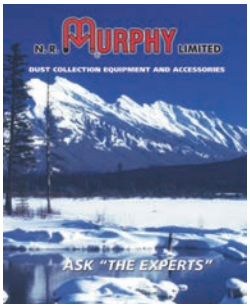

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Motors & Drives

Disc Magnet Motor

Portescap launched its P760 series disc magnet motor that delivers high torque and acceleration up to 5,000 rpm, via a combination of Disc Magnet technology and an optimization of the number of pole pairs. According to the company, the high-speed stepper motor can deliver a boosted torque of 0.7 Nm with inertia as low as 17E-7 Kgm2. The closed loop RoHS-compliant step motors are suitable for textile, life science, medical, fluid handling and industrial automation equipment.

www.portescap.com

Servo Drive

B&R has expanded the functionality of its ACOPOS line of servo drives, via a firmware update, to include repetitive control, which improves accuracy by using predictive following-error compensation. Embedded in the standard speed control loop for the ACOPOS drive family, repetitive control adjusts the torque setpoint of the drive in a way that reduces the periodic portions in the speed or following-error. The algorithm undergoes a constant learning process so that changes to the load profile – caused by wear, for example – have no effect on the drive due to predictive compensation for disturbances.

www.br-automation.com

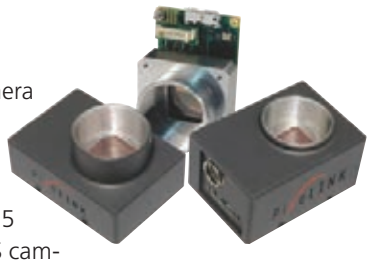
Machine Vision

Color Line Scan Camera

Chromasens released its all-PIXA pro, what the company says is the fastest color line scan CCD camera available. The camera provides line rates up to 87kHz in standard models and up to 148kHz in special OEM configurations, approximately 300 percent faster compared to conventional CCD line scan cameras when used in CameraLink Full mode, the company says. The camera features improved responsivity due to upgraded tri-linear CCD sensors. The camera line comes in resolutions from 2048 x 3 to 7300 x 3 pixels. Continuous white balancing compensates for minute color differences in different types of light, while internal keystone correction allows the camera to be mounted in multiple angles.

www.chromasens.com

USB 3.0 camera



OTTAWA-based industrial camera maker, PixeLINK, released its Titan USB 3.0 CMOS camera line. With a resolution of 15 megapixels, the Titan PL-D7715 USB 3.0 Global Shutter CMOS camera combines high resolution CMOS technology with the high-speed data throughput of USB 3.0. As with all PixeLINK cameras, Titan cameras can be combined with the PixeLINK Software Developer's Kit (SDK) to integrate the camera into machine vision applications.

www.pixelink.com

CMOS X-Ray Detector

Teledyne DALSA introduced the first in its Rad-icon series of CMOS X-Ray cameras. The Rad-icon 1520 detector features 1548 x 2064 pixel resolution, an active area of 15.3 x 20.4cm, and 99 micron pixel size. The detectors also deliver frame rates of up to 30 fps at a 5 lp/mm resolution via Gigabit Ethernet or Camera Link interface. The 1520 detector captures 14-bit images at an energy range from 10 to 225kV. The detectors are suitable for industrial x-ray inspection, scientific imaging and non-destructive testing, including weld inspection, wire bond and printed circuit board (PCB) inspection and other industrial imaging applications.

www.teledynedalsa.com

Sensors

Encoder

Leine & Linde introduced its High Current TTL (HC-TTL) encoder capable of driving long cables and meeting high and low level voltage requirements. In the 700 or 800 series encoders, the HCHTL outputs can drive a 0-30V square-wave signal with frequency of 100kHz. Signal quality exceeds industry standards for voltage amplitude and signal rise-time while driving up to 350 meters (~1150 ft) of cable when terminated into a 40mA resistive load. Signal integrity is maintained with temperatures ranging from -40 to 85°C.

www.leinelinde.com

Rotary Encoders

POSITAL announced that its IXARC optical rotary encoders are now available with EtherCAT communications interfaces. The encoder line features resolution of up to 65,536 steps per turn (16 bits). Multi-turn models with measuring ranges up to 16,384 revolutions are also available. The EtherCAT interface, which was implemented using fast field programmable gate array (FPGA) circuits, provides cycle times of less than 125 microseconds. The encoders are available with shaft and connector seals rated at up to IP67 level and with explosion-proof (ATEX certified) stainless steel housings. Other industrial Ethernet systems supported include EtherNet/IP, Profinet IO and MODBUS+ Ethernet TCP.

www.posital.com

AC Current Transducer/Switch

NK Technologies released its ATS Series AC Current Sensors that combine a current operated switch and transducer in a single package. It's design features a built-in digital display that indicates where the contact changes. The sensors provide a solid-state contact that changes state when the current exceeds an adjustable level or falls below the normal running current. ATS transducer/switch models provide a N.O. or N.C. solid-state switch to control circuits up to 240VAC. Compatible with most automation systems, ATS models are available with a choice of 4-20mA, 0-5VDC or 0-10VDC output. Each output offers a range that is proportional to either 0-50A or 0-200A.

www.nktechnologies.com

Linear Inductive Sensors

Pepperl+Fuchs introduced two PMI40 models to its family of PMI linear inductive sensors. PMI40-F90-U-V15 and PMI40-F90-I-V15 sensors offer a 40mm distance measurement intended for vertical valve measurements. With the added models, PMI linear inductive sensors are now available with linear ranges of 14mm, 40mm, 80mm, 104mm and 120mm. The optimal distance from PMI40 to the standard sensor target (BT-F90-W) is 2mm, but an available sensing range of 0.5 to 3mm delivers accurate linear position regardless of the sensing range. The 40mm linear distance delivers 33um resolution.

www.pepperl-fuchs.us

Portable Oscilloscope

Fluke Corp. introduced its 190-504 Series II 500 MHz ScopeMeter Portable Oscilloscope, the first to achieve 500 MHz at 5 GS/s real time sample rate in a 4-channel handheld, without compromising on safety rating, ruggedness or battery operating time, the company says. Like other units in the line, the 504 ScopeMeter features 2 or 4 independently insulated input channels and an IP51 dust and dripping water ingress protection with models available in 500 MHz, 200 MHz, 100 MHz or 60 MHz bandwidths. The series features memory up to 10,000 samples-per-channel. The 190 Series II safety rating, according to CSA C22.2 No 61010 (IEC 61010) standard, is 1000V CAT III/ 600V CAT IV making it possible to safely measure from mV to 1000V.

www.fluke.com

Pressure Transducer

Marsh Bellofram released its Type 3110 single-loop electro-pneumatic analog circuit-card servo pressure transducer, designed for air pressure monitoring. Measuring 2 x 2.8 inches (50.8 x 71.12 mm), the transducer features available analog monitor output ranges from 29-inch Hg to 600 psig and configurable (zero and span) 0-10VDC or 4-20mA control signals. The product's onboard pressure transducer within the manifold block permits ±0.5 percent full scale accuracy.

www.marshbellofram.com

Temperature Data Logger

TandD Corporation unveiled its Multichannel Recorder MCR-4TC, a 4-channel, battery operated temperature data logger. It runs on two AA alkaline batteries and supports thermocouple types K, J, T, S and R. Up to 4 units can be coupled together, making it possible to simultaneously measure and record up to 16 channels. Besides using a USB connection to access recorded data via PC, it is possible to save the data into an SD card. Data can also be viewed on the unit's LCD display. The data logger supports a -270°C to 1760°C measurement range and electrical isolation between channels.

www.tandd.com

TINKER'S Dream

Canadian-made DittoPro looks to go head-to-head with competitors in the prosumer 3D printer market.

By David Godkin

Who knew the 80/20 rule applies as much to 3D printer technology as it does to diet and exercise? Because that's the precise ratio of aesthetic to performance enhancements Tinkerine Studios in Vancouver is offering in its latest 3D printer, the DittoPro – arguably giving a break from the relentless search for speed and power in return for an elegant, lower cost box in which to put it.

"[Our] previous models are [made from] laser cut wood and look like they'd [be suited for] a garage or a workshop," says Tinkerine VP, Todd Blatt. "This machine, you'd be proud to have it on your desk."

Blatt insists, however, that DittoPro is not just another pretty face. In development for just over a year, the new printer's machined aluminum construction, over a 350 x 370 x 480mm footprint, also uses 43 percent less desktop than its competitors. The unit will have broad appeal says Tinkerine CEO Eugene Suyu, from prototype engineers and teachers to small business professionals.

"It really allows entrepreneurs to explore their ideas into real life and have access to something they didn't have before: toys for the kids or to explore the robotics of industry that's exploding in education; all those applications are now opening up," he says.

In fact, Tinkerine came into being as a result of Suyu's own education. A graduate of Simon Fraser University in 2012, Suyu says he built his own 3D printing skills by tinkering with the "rods and bolts" of an open source RepRap printer. Suyu quickly decided that this technology wasn't up to snuff. As prosumer models had yet to be introduced, he set out to rectify that by designing his own 3D printer.

"We found working on an open source platform was more tuning, tweaking, hacking and making as opposed to utilizing the tools of the machine for creating the actual product," he says. "That was what I wanted to achieve."

Scroll forward two years and Suyu's newest 3D printer has increased speed over its predecessors, the Ditto+ and Litto, by 20 percent and doubled the resolution from 100 to 50 microns. Equally important, says Blatt, is Tinkerine's open C frame design providing DittoPro with a build volume of 225mm x 165mm x 205mm for printing larger sizes—

in other words, a little bit wider, deeper and taller than competitors' 3D printers.

"As a designer, I would find the height of those machines crippling," says Blatt. "Using DittoPro, you get more detail when you're printing on the Z axis. You're able to print taller things because the machine is taller."

Suyu agrees. "We just wanted to make one that you could utilize around what you want to build. So you're not limited. You can open yourself up to long objects as well as small objects."

The aluminum construction and stable glass print bed allows precision printing of very small parts as well. In addition, DittoPro relies on an open spool filament system to avoid lock-in to a cartridge system, says Blatt. It's a complaint aimed at CubePro and other cartridge-based 3D printer manufacturers. Blatt says that, far from being grateful that they can send back their empty cartridges in return for a discount on new cartridges, some customers view it as a money grab.

"They're offering a discount on a very expensive product, so it's deceptive," he says. "You get much, much less plastic, like one third of the amount, and they charge more for the cartridge." By contrast, he says, DittoPro's filament system accommodates other manufacturers' filament. "Not only do we manufacture high quality filament at an affordable cost, we're not requiring you to use it."

Beyond the printer's larger build space, Tinkerine's other objective is one-click operation and ease-of-use functionality with all settings available at the software level and automatic file generation. Available on Windows or Mac, Blatt says the printer's software guides users through the printing process.

"You just push the import button," he says, "[The software] brings in your model and puts it on the platform for you. There's nothing imposing about it; the settings are preset and you're ready to go."

Suyu says Tinkerine prides itself on building high performance units at an affordable price. The price tag for its DittoPro seems to bear this out. At a retail price of US$1,899, it's lower than MakerBot's previous Replicator 2X (US$2,499), though that model's build volume is comparable (246 x 152 x 155mm). By contrast, 3D Systems offers a single jet CubePro with comparable speed but a lower resolution of 100 microns and higher price tag of US$2,799.

Has Tinkerine truly entered the big leagues in 3D printing? Perhaps not. MakerBot's US$6,490 Replicator Z18 and 3D System's US$5,000 CubePro, also unveiled this spring, justify their heftier price tags by providing higher build volumes (305mm x 305mm x 457mm; 275mm x 265mm x 240mm respectively) and connectivity that includes mobile and Wi-Fi. Neither is currently available with DittoPro. **DE**

www.tinkerine.com

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