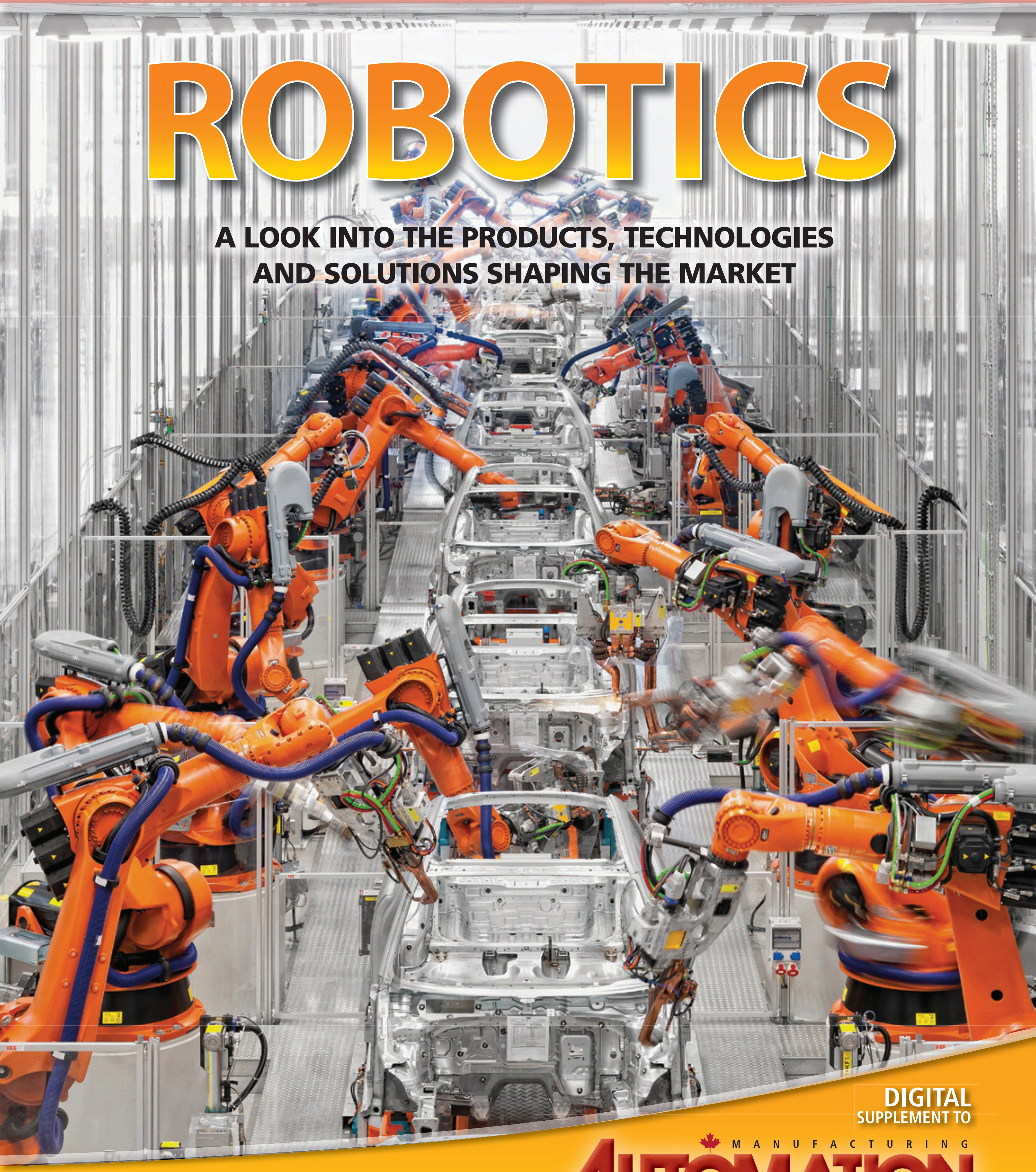
TECHNOLOGY HANDBOOK

ROBOTICS

A LOOK INTO THE PRODUCTS, TECHNOLOGIES AND SOLUTIONS SHAPING THE MARKET



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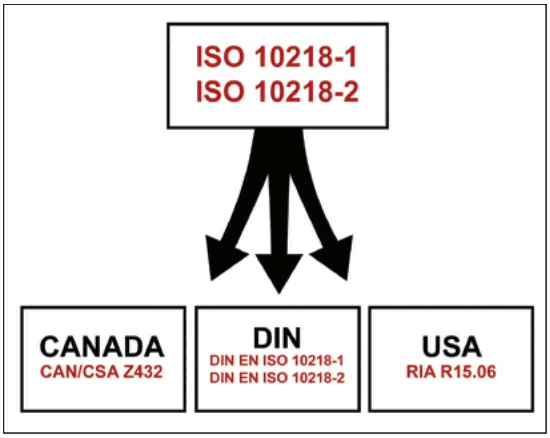
UNIVERSAL ROBOTS

The hazards that people are exposed to from robots and machinery have traditionally been controlled by the use of guarding, interlocking and cordoning off areas. However, a new breed of ‘collaborative robots’ are here that are designed to be used with human and robot working in close physical proximity to each other, sharing the workspace.



The UR5 robotic arm manufactured by Universal Robots has been announced “The world’s most innovative robot” by The International Federation of Robotics and IEEE Robotics and Automation Society. Advanced Motion and Controls has recently been appointed the exclusive distributor for Universal Robots in Canada.

The UR5 and UR10 robotic arms are aimed at companies that thought robots were too expensive, cumbersome and hard to program and integrate in existing production. The lightweight, flexible UR5 and UR10 can work alongside personnel and generally require no safety shielding. The robotic arms are easily moved around the production area and present a plug-and-play solution; a simple user interface lets employees with no previous programming experience quickly set up and operate them.

Instead of expensive sensor technology, the UR5 robotic arm utilizes a unique patented technology to measure electrical current in its joints to determine force and movement. The innovation enables the robot to undercut the price of other automated solutions. This enables even small and medium-sized enterprises to automate production previously unthinkable.

“Small and medium-sized enterprises demand a fast return on investment. Besides the robot’s low initial cost, it operates very cost-efficiently and is profitable in only six to eight months,” says Thomas Visti, Universal Robot’s CCO.

The two ISO 10218 standards define safety requirements for industrial robots. The “-1” part gives guidance for the robot manufacturer and the “-2” part give guidance for the robot integrator. In Canada, the CSA Z434 standard is a combination of ISO 10218-1 and ISO 10218-2. The safety-rated force limiting protection in the UR robots are constructed according to the requirements for collaborative operation in these two standards.

Universal Robots is a result of many years of intensive research in robotics. The six-axis robot arms can easily be implemented in many industries; from a small CNC lathe production to large automobile assembly lines.

Esben Ostergaard, founder and CTO at Universal Robots, explains how the robots were designed to be as user friendly as possible:

“We decided to make programming intuitive by developing a graphical user interface combined with a “teaching function” allowing the user to simply grab the robot arm and show it how a movement should be performed. The robot can be integrated into any production process very quickly. Our experience shows this is generally done in a few hours.”

The robots weigh as little as 40lbs enabling them to be moved around the production area to perform different tasks. The UR5 can handle a load of up to five kilos (11.3 lbs), the UR10, 10 kilos (22.6 lbs) respectively. A significant benefit is the robot’s capability to operate with no safety shielding; As soon as an employee comes into contact with the robot arm and a force of at least 150 Newton is exerted, the robot arm will automatically stop operating.

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Improving robot-human relations

In order for industrial robots to work together with people, the speed at the tool center point must be safely monitored. B&R provides TÜV-certified function blocks for creating the necessary integrated safety applications via openSAFETY. They are a simple way to provide advanced safety features for robotic systems, regardless of the control technology being used.

Places where industrial robots operate are typically off-limits for humans. We're simply too slow to react to dangerous situations on time, every time. And we're too unpredictable for the machine to anticipate and compensate for our next action. That's why robotic systems generally operate within safety enclosures. For the most part, this is a good solution because high operating speeds are only possible when there are no interruptions. There are, however, situations such as setup that require hands-on interaction to put the final touches on robotic sequences. And there are many other processes where it would be useful for humans and machines to work hand-in-hand – or rather, hand-in-gripper.

"One day there could be industrial robots that no longer require protective safety enclosures or cages to protect people from injury," predicted engineer Dr. Gernot Bachler back in mid-2010 when describing the visionary goal of the R&D programs for CNC and robotics which he manages at B&R. One can almost hear the masses crying in protest to "free the robots from their cages!"

Ensuring safety at the TCP with openSAFETY

Traditional methods for ensuring safety, such as an Estop that is triggered when a safety gate is opened, are no longer sufficient. It is important to implement safety concepts specific to robotics, in which safe monitoring of the movement speed accounts not only for the individual axes, but also for the entire robotic system, including the TCP (tool center point). Derived from the requirements specified in the standards EN ISO 10218-1 and EN ISO 10218-2 for safety in industrial robotics and robotic systems operating in collaboration with human operators, B&R set the first stone on the path to advanced robotic safety with the SLS function (safely limited speed) implemented at the TCP.

This new function is an extension of the advanced safety functions for Safe Motion Control integrated directly in the ACOPOSmulti servo drives. Compared to conventional safety relays, these advanced functions, known as SafeMC, lowered error detection and response times from 80 to 7 ms and the stopping distance by a factor of 100. Not only that, but SafeMC also offers a number of alternatives to the abrupt halt of a simple E-stop, including "Smart Safe Reactions" such as STO (Safe Torque Off), SBC (Safe Brake Control), SS1 (Safe Stop 1), SOS (Safe Operating Stop), SS2 (Safe Stop 2), SLS (Safely Limited Speed), SMS (Safe Maximum Speed), SDI (Safe Direction) and SLI (Safely Limited Increment).

Monitored kinematic chain

In order to limit the speed at the tool center point to the 250 mm/s required by the regulations for collaborative operation without using additional sensors, the first step is to determine its actual speed. This is done by combining data describing the status, position and speed of the individual axes in a kinematic transformation.

This data is obtained from the SafeMC modules in the ACOPOSmulti servo drives on the individual axes and transferred to the SafeLOGIC controller via the fieldbus- independent safety protocol, openSAFETY.

This is where the transformation is performed and the resulting speed is compared against the specified safe value. The SafeLOGIC controller provides safe transfer to ensure that requests to execute safety functions reach their destination where they are executed directly on the drive.

Read the full article at http://www.automotion.info/index.php?id=1712

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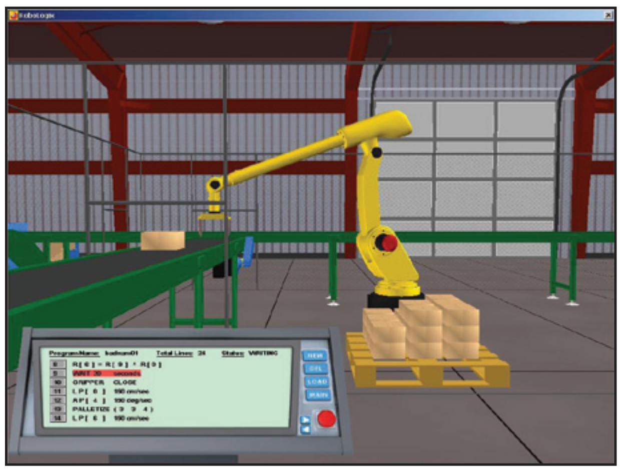
Robotics Technician Training: Flexible, online learning at your own pace

If you are looking for a way to get trained up in industrial robotics, but just can't seem to fit the traditional modes of training into your busy lifestyle, here's an option for you to consider: Flexible, online training from George Brown College that you study in your own home, and at your own pace. And graduates like Patrick Denis, described below, is a great example of just how effective this kind of certificate can be to move you forward in your technical career.



The Robotics Technician Certificate program provides students with a complete introduction to applied robotics, with its main focus being on the role of robots in plants or manufacturing systems. The program prepares students to install, program, maintain, repair, and manage industrial robotics systems by integrating simulated lab experiments within the presentation of theory. Specific areas of study include motion programming, palletizing, conveyor systems, computer networking, automated sorting systems, vision and tactile sensors and computer integration.

Turn your computer into a 3D industrial robot

The Robotics simulator, RoboLogix that is included with the program, is designed as an education tool, but has all the power and functionality of professional engineering-level robotics simulation packages costing thousands of dollars. The ability to preview the behavior of a robotic system in a "virtual" world allows for a variety of mechanisms, devices, configurations and controllers to be tried and tested before being applied to a "real world" system.

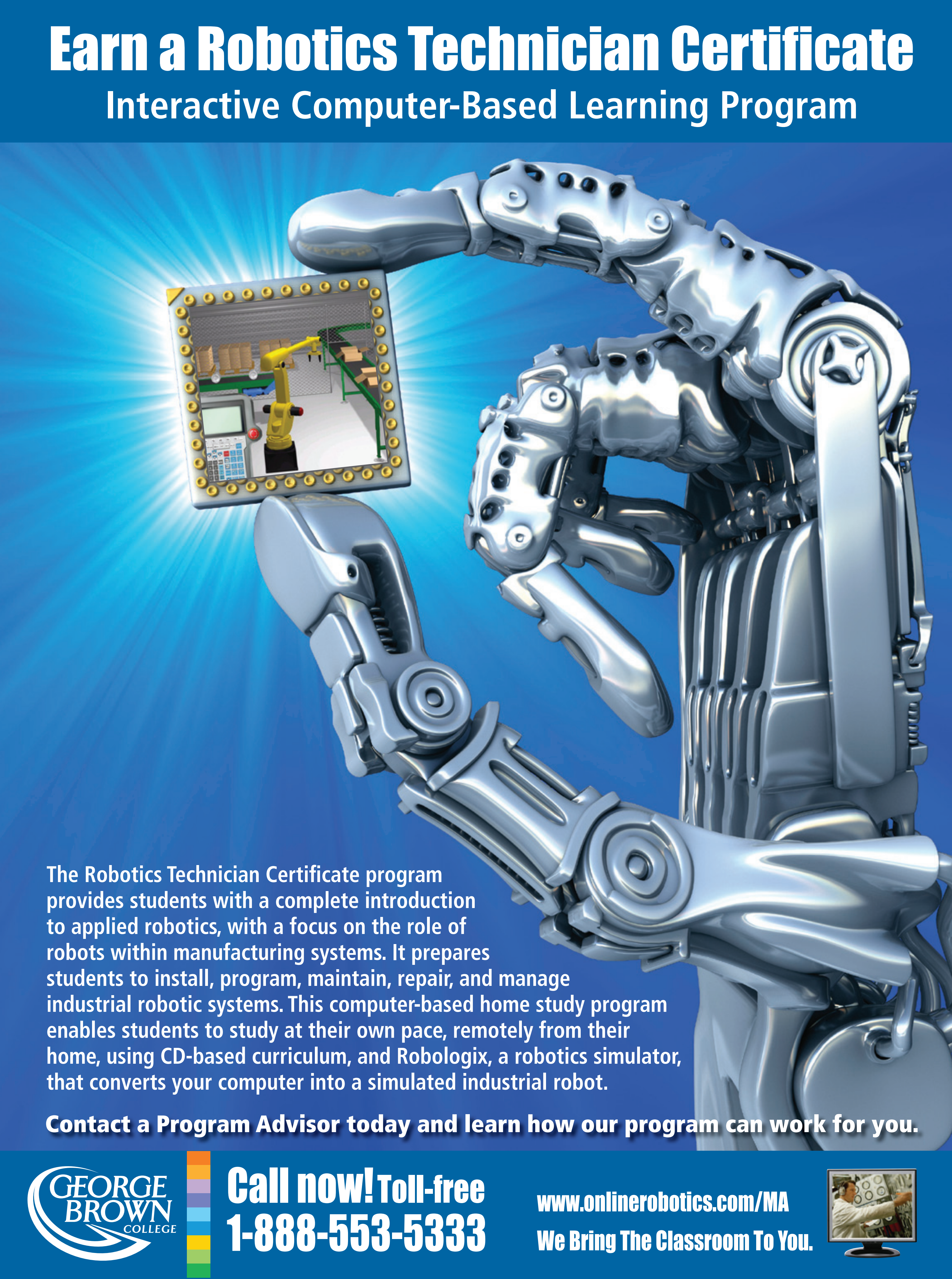
"The job market for Robotics Technicians is continuing to grow as companies automate their manufacturing systems and compete in today's tough business environment. Entering our program, students can get the training they need, on their own terms, and are well prepared and positioned to move into new jobs in this exciting area of technology," says Colin Simpson, Dean of Continuing Education, George Brown College.

Student Success Story

Patrick Denis graduated from the Robotics Technician program and is currently taking the Electronics Technician program. He is a Maintenance and Calibration Technician at Maetta Science, a company that specializes in MIM (metal injection molding).

While Patrick had an Electromechanical Diploma he felt it was important to also understand robotic systems, "Today, all types of companies have robotics systems in place and I want to make sure I keep up to date". "With the Robotics program I am able to understand how a robotic system works, from pick and place, to a palletizing system or even a CMM (Coordinate Measuring Machines). In fact I have been able to fix work problems as they come up; for instance one time our palletizing system failed and I was able to correct the program and restart the production line... something I couldn't have done before taking the Robotics program."

"My biggest challenge was to manage my schedule; I work full time so the distance education programs at George Brown College made it possible for me to continue to learn and upgrade my skills."


Earn a Robotics Technician Certificate
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The Robotics Technician Certificate program provides students with a complete introduction to applied robotics, with a focus on the role of robots within manufacturing systems. It prepares students to install, program, maintain, repair, and manage industrial robotic systems. This computer-based home study program enables students to study at their own pace, remotely from their home, using CD-based curriculum, and Robologix, a robotics simulator, that converts your computer into a simulated industrial robot.
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KUKA

KR AGILUS Series – The Future of Small Robots

The KR AGILUS series is KUKA's comprehensive small robot family. The performance of the KR AGILUS series is unique in its payload category. It sets standards with 5 and 6 axes arms, very high speeds for short cycle times, integrated energy supply system, mounting flexibility (floor, ceiling or wall), and can master even the toughest tasks. All KR AGILUS models are operated with the service-proven KR C4, the universal control technology for all KUKA robot models.

Safe Operation functionality radically simplifies the efficient cooperation of humans and machines, and enables totally new automation concepts. KR AGILUS: Unparalleled functionality and reliability made by KUKA.

KUKA Small Robots – Product Overview.

- **High Speed.** In handling tasks, especially pick-and-place tasks, KUKA small robots demonstrate one of their greatest strengths: extreme speed. This produces impressive results with minimal cycle times.
- **Precision.** Where high repeatability and exactitude are required, KUKA small robots are in their element. They enable manufacturing quality at the highest level. Thanks to their robust design, they work with constant precision throughout the work envelope.
- **Integrated Energy Supply System.** For extremely streamlined contours, KUKA small robots have the energy supply system routed internally, including EtherCAT/EtherNet (bus cable), three 5/2-way valves (compressed air), direct air line, and six inputs and two outputs. This results in simple gripper integration and fast reaction – especially for work in confined spaces.
- **Wide Range of Mounting Positions.** Installation on the floor, wall or ceiling. The KUKA small robots produce impressive results in every position – thanks to the brakes integrated in all axes.
- **Low Maintenance.** The motors and gear units of the KUKA small robots require no change of lubricant. This makes them ideally suited for continuous, uninterrupted productivity.
- **Optimal Work Envelope.** With reaches of up to 1,100 mm and the ability to reach points near to the robot base as well as in the overhead area, the KR AGILUS offers an optimal work envelope. This enables cost-effective, space-saving cell concepts.
- **KUKA KR C4 Controller.** The KUKA small robot family is operated – just like its big brothers – using the same KUKA control technology.

The KR AGILUS small robot family solves automation tasks more flexibly, minimizes cycle times and opens up totally new areas of application. The extensive KUKA small robot series is 100 percent KUKA: reliable quality and durability, combined with maximum functional diversity and flexibility. With the fastest 6-axis robots and the KUKA.SafeOperation function, this small robot family gives you a major competitive advantage.

About KUKA Robotics Canada Ltd.

KUKA Robotics Canada along with KUKA Roboter GmbH, Augsburg Germany (part of the KUKA Aktiengesellschaft group of worldwide companies), ranks among the world's leading suppliers of industrial robots and material handling vehicles. Core competencies include the development, production, and sale of industrial robots, controllers, software, linear units, and omniMove™ omni-directional motion platforms. KUKA robots are utilized in a diverse range of industries including the appliance, automotive, aerospace, consumer goods, logistics, food, pharmaceutical, medical, foundry and plastics industries as well as multiple applications including material handling, machine loading, assembly, packaging, palletizing, welding, bending, joining, and surface finishing. KUKA robots range from 5kg to 1300kg payloads, and 700mm to 3900mm reach, all controlled from a common PC-based controller platform. The company is the market leader in Germany and Europe and the number three in the world. The KUKA Robot Group employs about 2750 people worldwide. In 2012, sales totaled 742.6 million Euro. 25 subsidiaries provide a presence in the major markets of Europe, America and Asia.

SMALL. FAST. ROBUST.
KR AGILUS
The New Master of Speed.
KUKA small robots for 6kg and 10kg payloads.
KUKA Robotics adds a new small robot to its ever growing robot range. Unique in its payload category, the KR AGILUS sets new standards with 5 and 6 axes, very high speeds for short cycle times, integrated energy supply system – whether installed on the floor, ceiling or wall, KR AGILUS masters even the toughest tasks.
KUKA

Final programming of the robot moves to the floor, where lead person and programmer Jamie Bowman takes each pendant in hand to fine-tune robot movement.

More than a FLASH IN THE PAN

Arc welding takes on a new look as a robotic system improves high-volume production

BY CHRIS ANDERSON

Innovation is the norm at Titan Trailers, a supplier to the hauling and earth-moving industries established by Mike Kloepfer in Harley, Ont., in 1973.

Customers know Titan for its patented Thinwall lightweight and strong extruded-aluminum double-walled trailer panels that help optimize load capacity and fuel efficiency. The firm's trailers are used to haul garbage, scrap steel, aggregate gravel and similar loads.

In addition to innovation in design, Kloepfer also stresses innovation in manufacturing techniques, as evidenced by the firm's recent investment in robotic arc welding. "Mike (Kloepfer) continually pushes us to be innovative and inquisitive, and to seek opportunities to apply new technology," says Tom Pursley, Titan Trailer's robot specialist and supervisor of the robotics department. "He's always willing to invest in new equipment to help us do our jobs better."

Among those jobs is fabricating and welding many of the subassemblies that go into the firm's line of trailers and earthmoving equipment—subassemblies such as steel and aluminum fifth-wheel couplers, as well as door, frame and floor sections. Couplers, in particular, prove particularly challenging to welders, charged with assembling 30 to 40 components by depositing as many as four-hundred 3-inch-long stitch welds.

"We have to stagger weld locations to balance heat input to the assemblies and avoid distortion," says Pursley. "This requires our welders to crawl around the weldments quite a bit, a time-consuming and tiring process due to the relatively large size of these weldments. Early in 2011 we began to look for a better way to put these assemblies together."

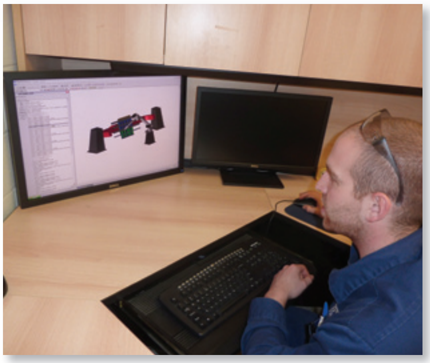
The answer was a robotic arc-welding cell. The cell has reduced the average cycle time to weld a steel coupler to 90 minutes, compared to 2.5 hours manually.

Titan's new cell resides in a new 35,000-square-foot building located a short truck drive from the company's main assembly building. The new facility also houses some of the fabrication equipment used to prepare subassembly components, including a new waterjet-cutting machine slated to take over much of the precision plate-cutting work previously performed by a high-definition plasma-cutting machine.

"With waterjet," says Pursley, "fit up improves and we can achieve tighter weld joints that help to avoid burn through and reduce weld-metal consumption. Our jigs and fixtures are easier to build, and weld cycle times have dropped, since we don't have to spend as much time touch sensing during each weld cycle."

Touch sensing uses energized welding wire set at a predetermined cut length to physically touch the flat sidewalls of a weld joint. The controller uses triangulation to locate the joint and, should joint location differ from what is programmed, initiate a shift in the robot's program to compensate.

Seam tracking occurs via a controller option that directs the weaving of the weld wire back and forth in the weld joint. As the



Programming begins at a desktop computer running offline programming and simulation software, where robot specialist Tom Pursley can perform cycle-time calculations, collision detection and reach analysis.

A long reach and high speed allow the robot to process the large assemblies manufactured at Titan without the need for moving the robot around the large cell on a track or gantry. A servo-driven drop-center positioner provides in-position welding.

wire weaves from side to side, the controller gauges welding current and corrects the robot's path left-right and up-down to maintain the specified amperage.

DROP-CENTER POSITIONER "REALLY MAKES THIS CELL GO"

Titan Trailers' robotic arc-welding cell was designed to reduce weld-cycle times on some of its more labour-intensive and high-volume assembles. As a result, the firm has been able to redeploy welders to other operations within the plant and enjoy overall labour savings, while also improving weld quality.

What really makes the cell ideal for Titan's specific task load, says Pursley, is a servo-driven drop-center tilt/rotate positioner, which provides for as much in-position welding as possible. This proved quite a challenge when manually welding some of the larger assemblies at Titan.

"The positioner really makes this cell go," Pursley says, "because it allows easy access by the robot-manipulated welding gun to some weld joints that were extremely difficult to reach when manually welding. And being able to rotate and position joints to avoid out-of-position welding is critical to ensuring good-quality welds, particularly on aluminum couplers. To deposit a 90-degree fillet weld, for example, we can position the joint at 45 degrees and develop an optimum penetration profile using gravity to equally penetrate both components."

The workhorse positioner accepts weld fixtures as large as 173-inches in diameter, and offers a load capacity of 2640 pounds. Its two axes can move independently or with coordinated motion — with each other and with the robot.

Sharing the cell with the drop-center positioner is a head-tailstock positioner, rated to 13,680-pound load capacity. It proves useful for fixturing and positioning heavy steel weldments for Titan's new line of earthmoving equipment.

Pursley and his robotic cell lead person and programmer Jamie Bowman design and build welding fixtures for the cell, and Bowman says new specialized jigs they have developed have typically reduced assembly fixturing and tack-welding time by half.

"We hold critical dimensional tolerances now in a way that is foolproof," Bowman says, describing the procedure for welding up a coupler assembly, "holding all dimensions off of the center kingpin. We're using pneumatic actuators to pull all of the components nice and tight and flat for the robot. And, instead of using several manually operated clamps to fixture everything, we now design the fixtures to include automation — again, another example of the innovation encouraged by management. To set the clamps, the operator only has to flip two switches. Overall, fixturing and tacking a coupler assembly takes about an hour, compared to more than two hours previously."

REACHING NEW HEIGHTS

The overall robotic-welding cell measures 24.5 by 33 feet, and is safeguarded by an eight-foot-tall woven-wire safety fence, arc-flash protection curtains, light curtains at positioner load/unload stations and an access gate with a positive break safety switch. At the heart of the cell is a six-axis extended-reach (122.3-inch) gas-metal-arc-welding robot with 44-pound payload and positioning accuracy to plus or minus 0.006 inches.

A PC-based robot controller directs the cell action, featuring four levels of password protection for as many as 100 users. Among its features: arc-welding-specific keypad buttons and a 26-foot-long cable connecting the Windows CE programming pendant that Pursley and Bowman use to roam the cell during programming.

To streamline new project programming, Titan opted to invest in programming and simulation software. This software provides cycle-time calculations, collision detection and reach analysis.

"The package was easy to cost-justify," says Pursley, who notes that programming the robot to deposit 300 stitch welds on a coupler can require more than 2000 lines of code. "I can prepare the framework for a new program offline, without having to interrupt production. I can include all of the touch sensing and the welding parameters. Then, all that's needed at the cell during teach-programming is final tweaking of weld locations."

A BAKER'S DOZEN OF PROGRAMS

Titan launched its production-welding operations with 13 jobs programmed, including 12 different coupler designs. Programming the similar coupler models was made quick and simple by taking advantage of the functionality of the controller.

"We developed several subroutines used to weld one coupler, and then were able to reuse many of the routines as we developed programs for the other couplers," Pursley says. "This greatly reduced programming time and also eases program maintenance."

By the end of 2012, Pursley expects to keep the robotic welding cell busy working on some 30 programmed assemblies. And should the cell need to be quickly changed over for welding steel assemblies, Pursley and Bowman say they can switch the cell over from aluminum welding to steel in less than 15 minutes.

Chris Anderson is the product marketing manager, welding, for Yaskawa America Inc.'s Motoman Robotics Division. Reach him at Chris.Anderson@motoman.com.

Two robots work together to pick and assemble thread protectors

A NEW VISION

Vision-guided robots automate oil tool assembly

BY JOHN LEWIS

Installing a thread protector onto exposed threaded pipe on oil tools is a difficult and time-consuming job. Currently, no automation technologies perform this operation in industry because of the complexity of the operation and the many different sizes and styles of thread protectors and pipes. But JMP Engineering, a provider of engineered automation, control and information solutions, found a way around this challenge. The London, Ont.-based company worked with an oil industry manufacturer to develop a flexible automation process that uses two robots guided by machine vision to process a wide range of parts.

"The key to the success of the application is the use of machine vision to locate parts for picking by the first robot and to check the diameter and location of the pipe before it is threaded by the second robot," says Scott Pytel, project manager at JMP Engineering.

THE CHALLENGE

Oil tool manufacturing is characterized by large families of parts whose members are typically produced in relatively low production volumes. Oil industry parts are also not typically produced to the close tolerances required for precision part locating. For these reasons, the hard automation systems that are commonly used in the automotive industry and for other high volume production tasks are not an option for most oil tool production jobs.

More flexible automation systems based on industrial robots offer more potential, but they have also seen relatively little use in the oil tool business because of various difficulties such as the need to pick unfixtured parts and handle many different part numbers. As a result, only a few industrial robots are used in the oil industry.

The family of parts mentioned earlier has all of the characteristics of a typical oil industry part. Thread protectors are installed on oil and gas pipes to prevent them from being damaged during shipping. The family as a whole is assembled at relatively high volumes, but none of the individual part numbers have the volume normally needed to justify automation.

The oil tool manufacturer wanted to assemble thread protectors at a rate of about three per minute. The task of assembling the cap to the pipe is done with pneumatic tools, but the high levels of torque involved make it a demanding physical challenge.

The oil tool manufacturer talked to JMP Engineering to see if the company had any ideas on how to automate the task. JMP designs and builds industrial control, turnkey automation systems, and plant information solutions for the food/beverage, life sciences, environmental, automotive, metal processing and other industries. Since the company pioneered the integration of machine vision and robots to handle applications where parts are not precisely located, not fixtured and not clearly separated from each other, it was up for the challenge.

PICKING PARTS FROM A BIN

In the bin picking operation, thread protectors are packed in bins in layers divided by cardboard sheets. The machine vision system rides on the robot arm. The vision system consists of a Basler Ace camera that interfaces over the GigE Vision interface standard for high-performance industrial cameras with a frame grabber card on a Beckhoff industrial personal computer. A Tectivity light emitting diode (LED) inside the camera enclosure generates red light that helps overcome ambient lighting to capture the image.

JMP programmers wrote a graphical user interface for the workcell in Visual Basic that performs vision operations by calling vision tools from the Cognex VisionPro library. VisionPro provides pre-configured, tightly integrated acquisition support for the complete range of industrial cameras and video formats. Its QuickBuild application development environment makes it possible to configure acquisition tools, define vision tasks and make pass/fail decisions without any programming. The VisionPro library includes tools — such as PatMax, PatInspect, PatFlex, IDMax and OCVMax — that gauge, guide, identify and inspect parts despite variations in part appearance due to the manufacturing process.

Traditional pattern matching technology relies upon a pixel-grid analysis process commonly known as normalized correlation. This method looks for statistical similarity between a gray-level model — or reference image — of an object and portions of the image to determine the object's X/Y position. Though effective in certain situations, this approach limits both the ability to find objects and the accuracy with which they can be found under conditions of varying appearance common to production lines, such as changes in object angle, size and shading.

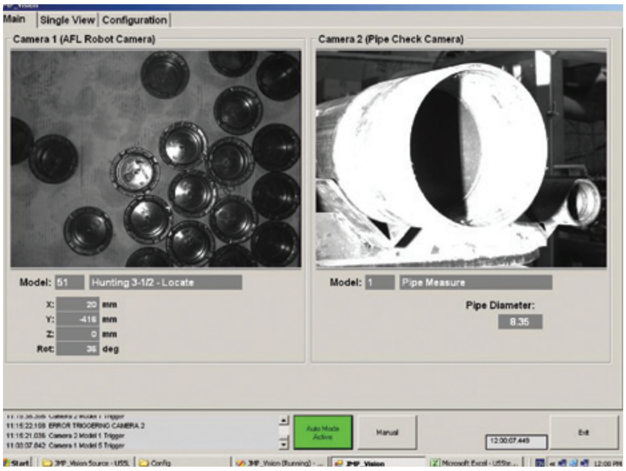
Cognex PatMax geometric pattern matching technology learns an object's geometry using a set of boundary curves that are not tied to a pixel grid and then looks for similar shapes in the image without relying on specific grey levels. The result is a significant improvement in the ability to accurately find objects despite changes in angle, size and shading.

The Motoman HP50 robot moves the camera above the bin and signals that it is in position to take a picture of the bin. The PLC passes a request to the vision system to take a picture. The camera takes the picture and the PatMax vision tool identifies the location of each thread protector in the bin. The vision system then identifies the thread protectors in the image and calculates the location of each one. The Visual Basic interface makes the conversion from pixels in the camera image to millimetres required by the robot control system.

The PLC then directs the robot to pick one of the thread protectors from the bin. The thread protectors come in 11 different sizes ranging from four to eight inches in diameter. The vision system is trained on each different part number. It not only identifies the location of good parts, but also detects the presence of parts of the wrong size that are intermingled with good parts.

ASSEMBLING THREAD PROTECTORS TO PIPE

The robot hands off the part to a second Motoman HP50 robot that performs the task of assembling the thread protector to the pipe. The PLC stores the position of all of the parts in one layer of the bin and commands the robot to pick them up one by one. When the bin is empty, the robot removes the cardboard divider and the camera takes an image to determine the location of the parts in the next layer.



A screen capture from the VisionPro application showing the inside of the bin on the left and the pipe on the right.

The second robot carries the thread protector over to a fixture where the oil tool assembly is located, exposing the sections of pipe where a thread protector is to be installed.

A Basler Ace camera attached to the second robot locates the pipe for thread protector installation. A Smart Vision Brick red light shines on the pipe at an oblique angle to create a shadow that enables accurate measurement of the pipe diameter. Another VisionPro tool, the circle tool, is then used to check the diameter of the pipe to make sure it matches the thread protector and more accurately determines the location of the pipe. The robot arm is equipped with a compliance device that allows the pipe thread to pull the arm and the thread protector as it screws onto the pipe.

The most recent camera image is displayed on the screen along with results, such as the size of the thread protector and the size of the pipe. The part picking robot image and results appear on the left side of the screen, while the thread assembly robot image and results appear on the right. A configuration menu enables the operator to configure the camera.

The automated calibration procedure takes advantage of a fixed, permanent target located near each robot. The camera mounted on each robot acquires four images of the target and between taking each picture moves a known distance. Based on these four images, the calibration routine determines the position of the robot in relation to the target.

The robot was commissioned in JMP's plant and shipped to the customer's plant where it is now running in production.

"It has demonstrated the ability to successfully pick and assemble thread protectors without fixturing or accurate locating in conditions that are common in oil tool manufacturing," says Pytel. "There's a good chance this application will lead to a new generation of vision-enabled robots that will help improve productivity and quality in the oil tool industry."

Another bonus: These robots can easily be configured to handle future variants without programming.

John Lewis is the market development manager for Cognex (www.cognex.com).

AUTONOMOUS MOBILE ROBOTICS gains foothold in manufacturing

WRITTEN BY ARC ADVISORY GROUP

The market for Autonomous Mobile Robotics (AMR) is in a state of transition. The technology is gaining acceptance in industry and in the public eye. As this continues, the market will both grow rapidly and expand globally, according to a new ARC Advisory Group study.

A market that previously relied upon business from government defense budgets is now rapidly commercializing a decade of solid technological developments. AMR companies involved with the defense industry are taking the necessary steps to repurpose this technology for the industrial and consumer market. The market is still very fragmented and few market constituents feel that they compete directly with their peers. There is currently a significant market opportunity for companies interested in entering the market, especially in underserved markets.

"AMR is truly a transformative technology that allows organizations to make a step change in operational efficiencies. Visionaries are driving adoption, leading this market into a rapid growth stage as application domains continue to expand," said analyst Scott Evans, the principal author of ARC's "Autonomous Mobile Robotics Global Market Research Study".

While some solutions have garnered considerable media attention, the use of AMR technology has remained under the media radar in automatic guided vehicles and forklift trucks. Constrained versions of AMR technology have been ongoing in the warehouse, as OEMs of forklift trucks have incorporated navigational capabilities in these vehicles with a restriction on autonomy. Consequently, the total AMR market is highly concentrated in warehousing and distribution. However, the success in warehousing has attracted new entrants to other industries, and the current market for AMR represents only a small fraction of the potential market of this technology.

Many of the well-entrenched material handling companies have begun to offer vehicles featuring navigation technology and decision-making capabilities that self-characterize as AMRs. Seizing on the success of AMRs in material handling, many companies have expanded the industry's horizons by applying AMR technology to intralogistics in other industries, such as hospitals, medical laboratories, semiconductor fabs, and replenishment in manufacturing.

Japan, while a center for robotics research, has focused on "walking" robots for several decades, primarily for application in the human service sector. Developments have been primarily focused on healthcare to address the aging population, however the technology has gained relatively little traction. As a result, the Japanese market has lagged in adoption of the commercially viable solutions that have been gaining traction in the North American and European market.