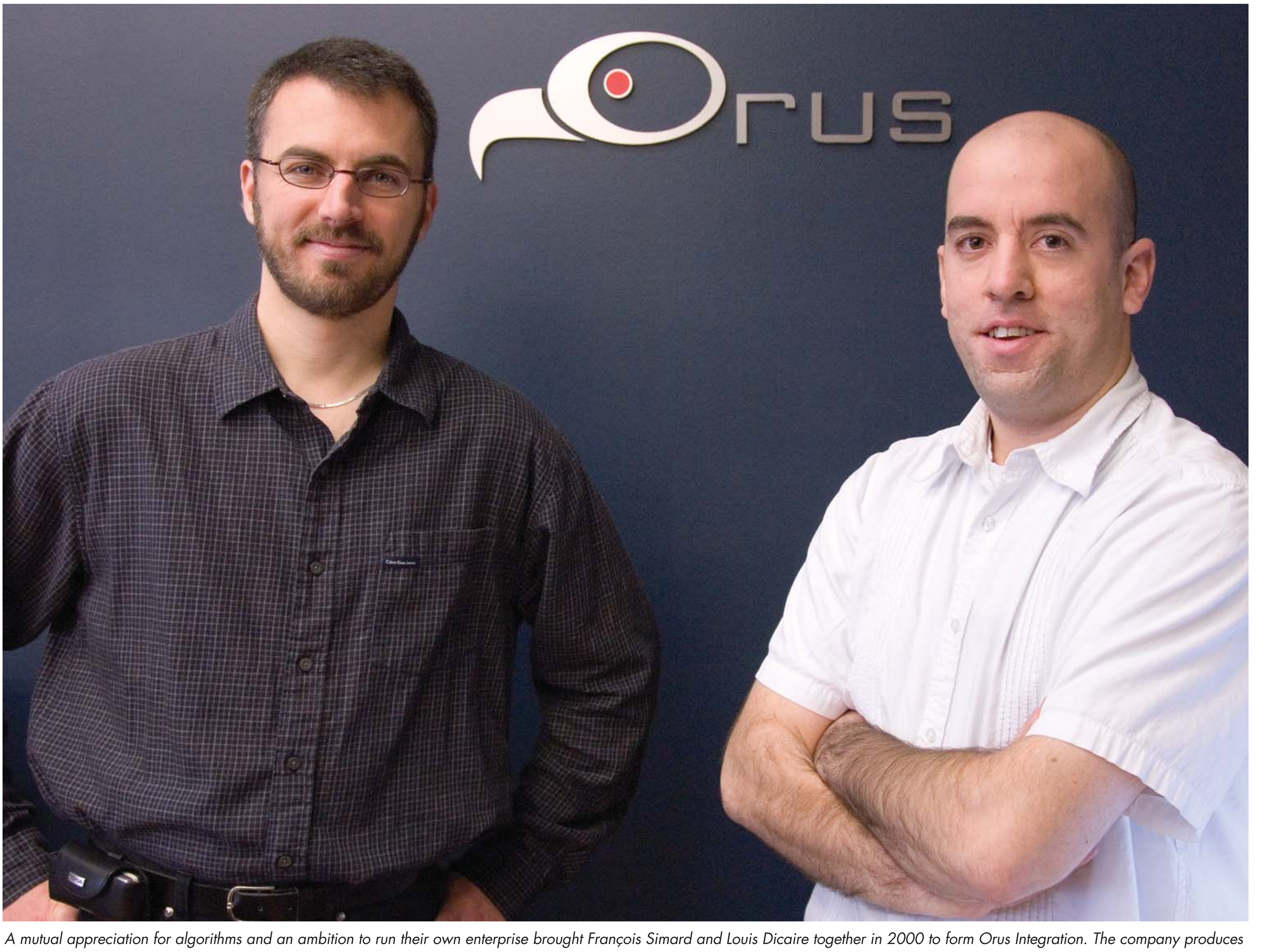
# Orus: all-seeing vision systems




*A mutual appreciation for algorithms and an ambition to run their own enterprise brought François Simard and Louis Dicaire together in 2000 to form Orus Integration. The company produces vision-based inspection systems and is tallying sales of more than $2 million. They are also partners with two others in Orus3D, a manufacturer of 3D scanners used on industrial robots as in-line coordinate measuring machines (CMMs).*

BY RON RICHARDSON

What do blueberries, bullets and buttons have in common? Diverse as they are in substance, form and function, there is actually a common denominator.

At specific North American plants, each of these products get quality inspection checks during processing by extremely accurate, high-speed machine vision systems provided by Quebec-based Orus Integration Inc.

The company chose its name from the Egyptian god Orus, the sky's all-seeing eye. Founded in 2000, Orus set a target of five years to become the Quebec leader as an integrator of machine vision systems for the manufacturing industry, and it has reached its goal.

The original concept for the firm began when Francois Simard and Louis Dicaire were workmates in a Quebec electronics firm. As friends and would-be entrepreneurs, they shared a mutual ambition to run their own enterprise. Their goal was to produce machine vision-based inspection systems, via algorithms, to conduct highly accurate, micro-scale specification checks for quality and other criteria.

The dream–call it a vision–is now a reality. Today the resulting partnership sees 33-year-old Simard serving as president and Louis Dicaire, 30, serving as vice-president.

As is usually the case with many new ventures, it started on a small scale; just three staffers at the outset. With continuing success, a move was made in 2003 to the present and larger quarters in Boisbriand, a community just north of Montreal. The present site houses an expanded staff of more than 15 engineers, technicians and program designers.

As with an increasing staff, sales have also grown rapidly in the past six years. In fact, the firm has been profitable almost from the get-go. Annual sales are now in $2 million-plus range.

The size and scope of work assignments received from the outset were higher than anticipated.

"We were expecting contracts for machines in the $20,000 to $25,000 range," says Simard. "But right off the bat [buyers] wanted complete systems in the $100,000 to $120,0000 range."

The company's aim is to design and install optimized turnkey automated machine vision systems for product inspection in the manufacturing and processing industries. This includes colour line scan cameras, 3D and multi-camera systems.

"Our systems are mainly used for quality control, process control, metrology and data acquisition," says Dicaire.

Typically, turnkey inspection systems include optical equipment, processing units, intelligent reject systems, industrial electrical enclosures (Nema 4x, Nema 12), mechanical design, programming, development, plant integration and optimization, training and other services.

Primary sales come from aerospace, automotive, agriculture, printing, packaging, plastics, rubber, beverages, food and defence.

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# Vision systems reduce production snags

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Dicaire, who directs the firm's marketing efforts, adds, "in the past six years we have completed 40 successful turnkey systems in many different sectors."

A laser-based inspection machine installed by Orus Integration resolved a production problem faced by F&P Mfg. Inc., a leading Tier 1 automotive parts manufacturer located in Tottenham, Ont.

A subsidiary of Ftech Inc., the core business for F&P is automotive stamping and assembly. Each year it turns out more than 58 million component parts for it customers in the assembly of more than 10 different current models.

"Prior to the installation of the laser inspection cell, we were experiencing many mislabels and inaccurate part counts or part types," explains Kevin McNabb, an engineer and senior production manager at F&P.

## Detecting changes

Now F&P packages 28,000 parts per day through the laser inspection cell and wrong part counts or part type problems have "all but disappeared."

The new machine inspects quantitatively, based on surface area and shape. It detects small changes in surface areas while parts flow at a speed of 300 millimetres per second.

"When a nonconforming part is detected," says McNabb, "it directs this abnormal part out of the packaging stream, but at the same time still maintaining an accurate part count for each container. Once the desired container quantity is reached, the integrated label printer provides the required label."

F&P has also reduced abnormal part shipments because the machine detects quality nonconformances. At the same time, it frees up two operators required in the production process.

Orus's present sales are primarily in Quebec, Ontario and Atlantic Canada, but it does handle some work in the US through affiliates.

Machine vision (MV) is a subfield of engineering and encompasses computer science, optics, mechanical engineering and industrial automation.

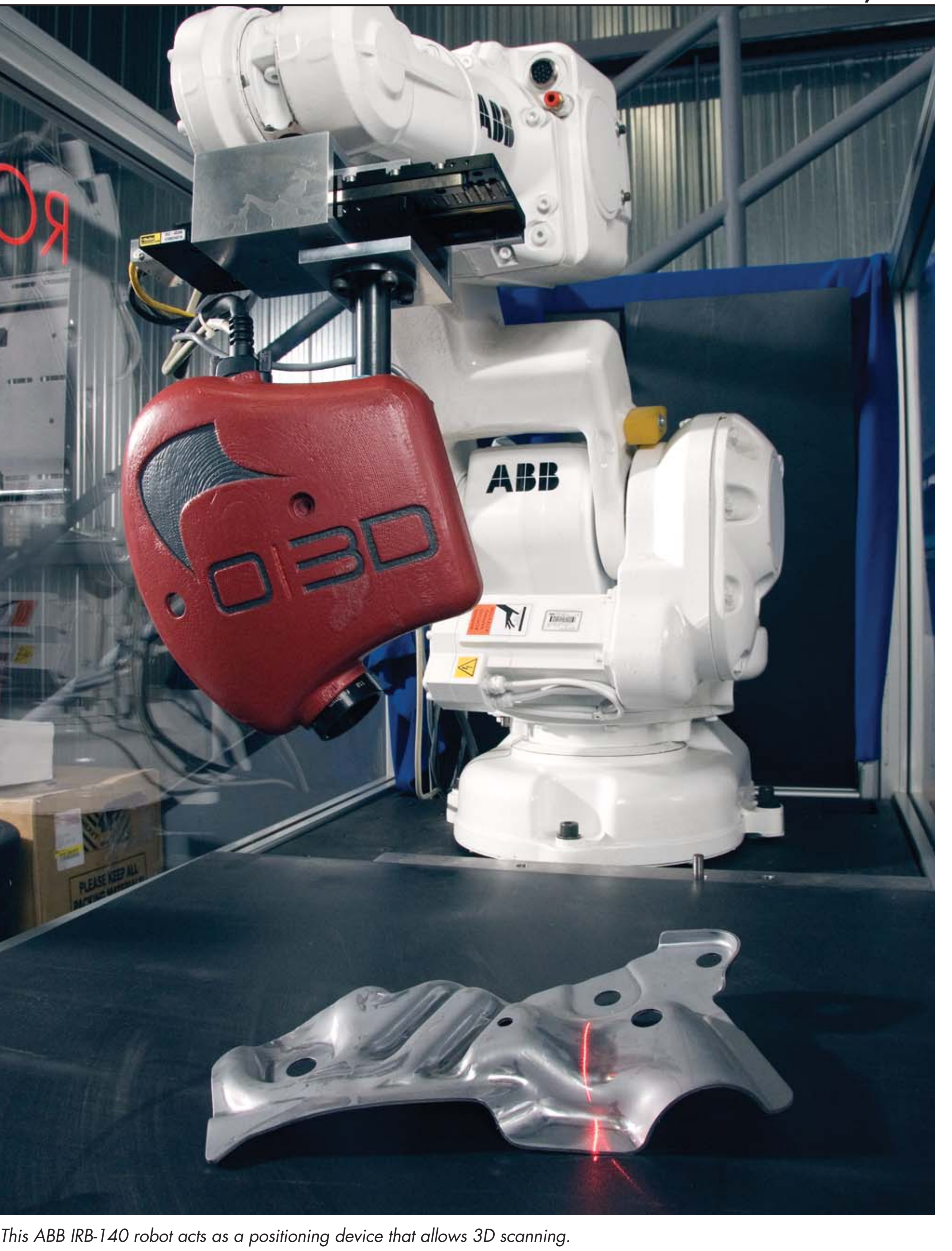
While computer vision is mainly focused on machine-based image processing, machine vision often requires digital input/output devices and computer networks to control other manufacturing equipment, such as robotic arms.

Manufacturers and processors use machine vision systems for visual inspections that require high-speed, high-magnification, 24-hour operation and repeatability of measurements. This includes counting objects on a conveyor, reading serial numbers and searching for surface defects.

In most cases, a machine vision system will use a sequential combination to perform a complete inspection. For instance, a system that reads a barcode may also check a surface for scratches or tampering and measure the length and width of a machined component.

Machine vision, to a large extent, has taken over repetitive tasks that traditionally involved human inspection.

For instance, the extremely fast and accurate Orus online 3D gauging system can be used for 100% online inspection. It's equipped with a 3D scanning head that checks up to 6 million 3D points per second. Typical applications include gauging of aeronautic and automotive

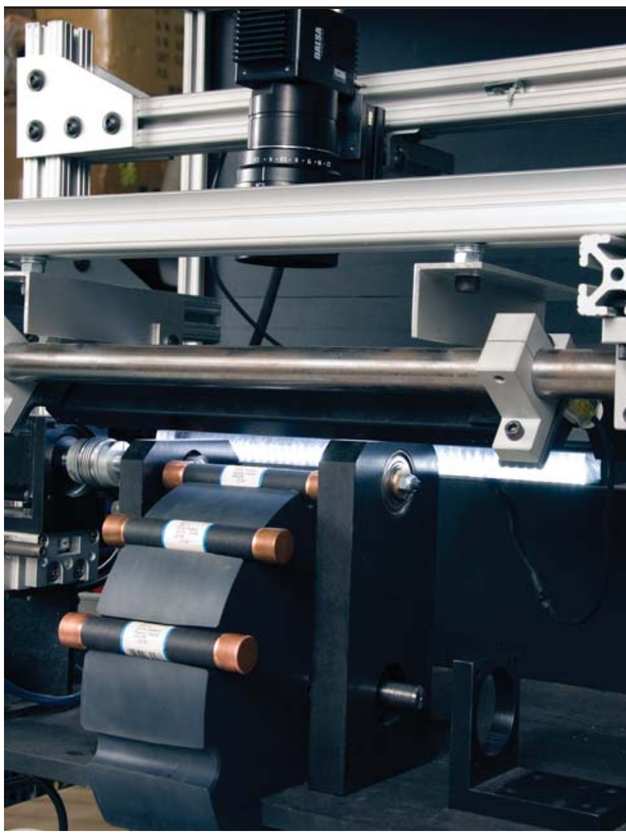



*This ABB IRB-140 robot acts as a positioning device that allows 3D scanning.*

## MV SYSTEM COMPONENTS

A machine vision system will typically consist of these components:

- One or more digital or analogue cameras (black-and-white or colour)
- Lighting
- Camera interface for digitizing images (known as a "framegrabber")
- A processor (often a PC or embedded processor, such as a DSP)
- Computer software to process images and detect relevant features
- A synchronizing sensor for part detection (often an optical or magnetic sensor) to trigger image acquisition and processing
- Input/output hardware (such as digital I/O) or communication links (network or RS-232) to report results.
- Some form of actuator to sort or reject defective parts or objects



This machine performs surface inspection on metal parts such as the fuses pictured here based on three different light set-ups to catch different defects including colour, bumps and scratches.

parts, tire thread identification and metrology, injection-moulded parts, die cast parts, checking fixtures and many other duties.

Orus's role as the manufacturer of MV systems is that of the designer and tester, with actual components acquired for assembly from various equipment suppliers.

"We have a fully equipped lab," says Dicaire," and most of our systems are developed with pre-established criteria. Basically, we can do all the application testing before delivery. We try to run all actual operating conditions in advance of delivery."

Orus had developed strong Quebec-based production partnerships since starting out. These include Matrox, with its highly optimized imaging library, GENIK Automation and CADEC Inc., the largest robotic integrator in the province.

"All of our vision machines are equipped with self-instructions available on computer monitor screens," says Decaire. "This means customers can make their own changes and modifications without having to call on us, as the integrator, for operational assistance."

### Inspection systems

The company's first big contract was for Canadian Buttons, a 121-year-old Montreal firm. It wanted an inspection system for an assembly line that handles up to 900 buttons a minute.

Faced with this challenge, Orus designed a camera and sensor system that catches the buttons in free-fall as they drop off the assembly line. In a millisecond, the system checks all dimensions (including the thread hole diameters) to either accept or reject each button.

The diversified use of the company's product is typified by a machine vision system designed for a fruit processor to scan 20,000 blueberries a second moving along a conveyor belt at about 180 metres a minute, delivering them to plastic packages for shipment.

"A 3D camera imaging system Orus designed checks the blueberries for colour, form and other [pre-programmed] criteria," explains Simard. "The inspection utilizes 218 air jets that examine and then accept or reject each berry."

To test its efficiency, the company tried to trick the system by inserting contaminants such as artificial blueberries, cranberries and even caterpillars in 15-tonne batches, but the system met all challenges with flying colours (*see sidebar*).

At the SNC TEC metal forming plant near Quebec City that turns out a range of ammunition, Orus installed a system for 100% inspection of brass cartridge cases. The system is designed to measure shell casings within 0.00015 of an inch. The production rate is eight casings per second running in a continuous mode with eight measuring points for each product.

A comprehensive user interface provides the operator with full control and status of the production line to adjust tolerances, consult a histogram of measures over time and production reports. A large field-of-view telecentric lens, combined with a high-resolution industrial camera (2 mega pixels), yields repeatable and precise results. A strobed LED light source ensures repeatable results.

Advanced MV systems continue to have strong growth potential–and that's the ongoing focus for Orus. True to its all-seeing namesake, the company has the vision and the skills to take on new challenges as they come into view.

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## BERRY GOOD RESULTS

In a plant that inspects 30,000 pounds of fruit an hour, top quality control is essential. A North American blueberry producer handed the quality guarantee challenge to Orus Integration. The quest was a machine vision-based blueberry inspection system to replace an optical-based system and reduce the need for manual inspection. Orus engineers chose a colour analysis-based machine vision inspection system.

"Initially, we offered a guarantee that our system would catch 94% of the foreign material. Our tests caught 97%," says Louis Dicaire, vice-president and project manager at Orus.

To cover the 60-inch-wide conveyor used in the processing, Orus's FL6500C system uses five colour Marlin 1394 cameras from Advanced Vision Technology Ltd. These are connected to three Matrox Meteor-II /1394 adapter cards.

Three Dual Xeon 3.06 GHz 1U servers and one single P4 1U client machine power the system, acting as a graphical user interface (GUI). Matrox Imaging Library (MIL) analyzes the image data and results are sent to an Omron PLC via ethernet cable to control the reject mechanism. A white strobe LED illuminates the inspection area.

At the start of the process the berries are dumped onto a vibratory conveyor. Its surface is designed with "lanes" to help the fruit sort into single layer, facilitating inspection. Then the berries are transferred to a conveyor with a textured belt that grips and brings them to rest within the first two feet of the 12-foot belt. Positioned over the end of the textured conveyor, the vision system captures the images of the berries as they are "thrown" off the edge.

The textured conveyor on the FL6500C moves at a rate of 600 feet per minute so optimal operation depends on the entire system's timing, which pulses every 1/8 of an inch. The 20th pulse (every 2.5 inches) triggers the cameras for a 120th of a second exposure.

Inspection relies almost solely on MIL's blob analysis module, and each blob is analyzed according to its average hue, brightness in the red layer, size and roundness. Based on these criteria, ice chunks would be rejected based on colour and other foreign particles such as twigs or insects would be rejected based on their lack of roundness and/or colour. Unripe, overripe or other fruit such as cranberries are also caught based on their colour values or size.

An array of air jets directs the particles that fail inspection onto a reject plate. The air jets are positioned over the 14-inch gap between the textured conveyor and a third conveyor. When the processing locates the "bad blobs" their positions are converted to a reject array that corresponds to the air jets, which shoot the matter out of the path of the good berries.

Since the engineers at Orus are experienced MIL users, most of the project's challenges were mechanical: assembling components and handling the speed.

Maintaining the timing for the reject mechanism was vital to the mechanics and image processing, because the engineers only have a 20-millisecond window available for the analysis and creation of reject array. If the air jets are engaged for too long, they'll direct good fruit onto the reject plate. Furthermore, processing each image must take the same amount of time, regardless of the number of berries.

"The number of berries per image is quite random, and we didn't want to limit the number of blobs that could be processed in a given image," explains Dicaire. "And since Matrox optimized the algorithm to separate the hue layer for MMX, the 20-millisecond time requirement could be met."

The FL6500C offers the advantage of speed. The system's reject mechanism inspects 20,000 berries per second and relies on logic to locate and reject the bad blobs. Flexibility is also key since the operator has full control over the tolerances and performance for shape and colour analysis, as well as the timing of the air jets.

Finally, the user can easily find out exactly how many blueberries are inspected and rejected in a given batch.

The FL6500C was developed for a specific customer, explains Dicaire. "But we wanted to ensure the system was product-independent so that we could adapt it for other food products such as coconuts or cranberries."

*Source material was supplied by Sarah Sookman, media relations representative for Matrox Imaging.*