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## Vision-Assisted Robotics, an Enabling Technology for Packaging

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*From sliced meat to late-capitalism, the reasons that vision-assisted robotic packaging applications have been increasing are many. Within this complex picture, though, certain trends seem clear.*



In recent years, vision-aided robots have been showing up on packaging lines with increasing frequency. As our new century began, relatively few robots were employed in packaging when compared to other industries, with the majority of these found in palletizing/depalletizing. A strenuous and repetitive task involving stationary targets, this application has proved comparatively easy to justify for many packagers, and the number of palletizing applications has increased, at a relatively modest rate, over the course of the decade.

By mid-decade, though, this picture began to change, as robots in increasing numbers started moving up the line and into product pick-and-place operations. This trend has continued despite the recession. Though orders for new robots declined by 30 percent in the first three quarters of 2009, sales to the packaging industry remained relatively healthy (precise figures at this point are hard to come by) with continued growth predicted for 2010.

Why this counter-cyclic movement? The explanation can begin with two words: vision and flexibility. Vision has typically been an essential component of high-speed pick-and-place operations. It has also been expensive and difficult to apply, with the complexities of vision technology multiplied by the complexities of integrating vision systems with robots, given their different coordinate and control systems.

Dick Motley, account manager, North American Distribution, for Fanuc Robotics America Inc., Rochester Hills, Mich., puts a personal and dramatic face on these application engineering difficulties when he recalls, "Prior to coming to Fanuc, I've been in meetings on the results of other projects and have seen the vision supplier and the robot supplier literally point fingers at each other."

That began to change dramatically in late 2006 when Fanuc released its first robotic system with pre-engineered, built-in vision capability. With a plug-in port for the camera on the processor board, and vision software for conveyor tracking, error proofing and other vision functions embedded in the

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controller, applications could be brought on line faster and cheaper. It was objected in some quarters that these integrated vision systems weren't suitable for the more complex, high-end applications. Most vision-guided robotic applications in packaging, however, aren't particularly high-end.

"Integrating the camera into the robotic controller has proved to be a tremendous advantage for Fanuc and for its customers," says Steven Prehn, senior product manager of the Material Handling Group at Fanuc Robotics. "Automatically tying the vision into the robotic frame space allowed us to leapfrog the market."

"After the introduction of that concept," notes Motley, "our vision sales effectively tripled."

Competitors took notice. Adept Technology Inc., Pleasanton, Calif., with a long history of both packaging and vision applications, followed suit with an integrated robot/vision platform of its own, augmented with some packaging-specific software. Other robot companies joined in, providing users with additional variety in terms of capability and price, and spurring development efforts within the robot community.

## **Underlying change**

Though the integration of vision with the robotic controller may prove to have been a game changer, the growth of vision-guided or vision-aided robotic applications in packaging stems from more than just this single innovation. Picking an arbitrary but manageable time frame—the last 10 years—it's clear that both robot and vision companies have been stepping up their games in terms of capabilities, reliability and ease of use.

Compare the specs in robot company literature now with the numbers from a decade ago and you'll notice that today's robots are, overall, faster and capable of attaining greater levels of precision and repeatability than their predecessors. The drives tend to be faster and more accurate, and the motors and motion controllers have been improved. Though accurate Mean Time Between Failure information can be difficult to obtain, anecdotal evidence is emphatic on this point: Most of today's robots are highly reliable, low-maintenance machines.

As for vision, that powerful genie that has often been difficult to extract from its bottle, increases in computing power have allowed the use of more powerful software algorithms to enable the systems to cope with greater degrees of variation in lighting, the Achilles heel of many vision applications in the past. In addition, the development of smaller, cheaper cameras and vision sensors has opened

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the door for numerous applications that could not be justified in the past.

A focus on these positive changes should not, however, obscure the difficulties that remain. John G. Schwan, spokesman for robotics integrator QComp Technologies Inc., of Greenville, Wis., says that vision systems, despite their many benefits, “are still costly and not compatible in some applications requiring a higher degree of inspection or data interpretation with a higher speed robot.” That is, greater amounts of data capture and analysis, and higher speeds, both require greater processing power, which translates into greater expense.

Rich Mikulec, project manager for material handling systems integrator Han-Tek Inc., of Victor, N.Y., agrees that the demands posed by high degrees of data analysis still act as a stumbling block to many potential packaging applications. Han-Tek, he says, “first experimented with vision roughly 10 years ago, and we were frustrated by the quality of technology. However, the technology has come a long way since then, and we have used a variety of vision solutions for bar-code reading, package-marking evaluation and part orientation.

“Vision linked to robots today is gaining ground,” he continues, one of the main reasons—paradoxically enough—being cost. He cites the integrated robot-vision systems with their ability to reduce overall cost by decreasing engineering time as well as reducing equipment and software needs. Also, “the ability to visually check products without human intervention will allow for more accurate product deliverables and therefore lower production costs due to minimizing human error.”

Companies such as Han-Tek and QComp are playing a significant role in the realization of those benefits. “Integrators have played a key role in the growth of our vision product,” declares Fanuc’s Motley. “More and more integrators are comfortable with the setting up of the applications and are getting more expert at lighting and optics. The application expertise needed to take those vision tools and turn them into something valuable for the customer is essential and it is growing.”

## **The flexibility imperative**

Up to this point, one of the key advantages of robotic technology, particularly robots linked with vision, has remained in the background. It’s flexibility. We are all accustomed to hearing that consumer demand is the main engine driving the American economy. In the years following World War II, that engine was fed by hard automation churning out the goods that the men and women who endured the war wanted and could now afford—washing machines, refrigerators, cars, televisions, lawnmowers, cake mix, peanut butter and a thousand and one other things with which to stock their new homes.

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At a certain point, however, the market gets saturated with these primary goods. In this stage, generally characterized as late-capitalism, the market is driven largely by advertising and the continuing diversification of essentially similar products, particularly as far as consumer packaged goods are concerned. Hence, Rush LaSelle's astute observation: "The simple fact is that with a lot of products, especially within the food context, packaging is as much a part of the value of the product that is sold to the end-user as the contents within it."

LaSelle, who is director of worldwide sales and marketing for Adept, notes that "vision and robotics working hand-in-hand have enabled manufacturers to rapidly retool or redeploy so that they can accommodate the packaging changes in today's reduced product lifecycle. I think that's probably one of the largest overall trends, and certainly one of the largest drivers behind the adoption of these technologies."

Schwan of QComp cites an example that illustrates LaSelle's contention. It involves the high-speed handling and inspection of shrink-wrapped trays of sliced meat and sausages. "This system utilizes a two-robot system where the first robot creates an array of product and then the second robot picks the array and places the product into shipping cases. We use vision to locate the product and inspect the product labels on a moving conveyor at 150 parts per minute. These rates exceeded the current hard-automation solutions for the product. The frequently changing product configurations create difficult handling situations for hard automation."

The trays have two labels, one on the top and one on the bottom of the tray. They are inspected for label presence and for accuracy of placement. "There are multiple varieties of products in the same style of package," notes Schwan. "Some product types are simply the result of variations in the flavor of the seasoning."

"The trend is definitely for more variety and more frequent changeovers," he continues, "and the older styles of packaging equipment—robust, hard automation—are not flexible enough for the new requirements. The only real solution, as we see it, lies in robotics with incorporated vision systems. A robotic system can change product orientation, provide different array set-ups to a wrapper, and the like, all at the push of a button." He adds that 80 percent of the systems that QComp now builds have a vision system working in combination with a robot.

Leo Petrokonis, business development manager, packaging industry, for automation supplier Rockwell Automation Inc., Milwaukee, weighs in with another impressive percentage. "Recently, I was looking over some surveys of manufacturers, and one from 2008 particularly struck me. It

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reported that over 40 percent of the packaging OEMs (original equipment manufacturers) surveyed are either offering robots today or are going to offer them in the next several years.”

In line with those figures, and in expectation that vision will play an increasingly important part in this growing list of applications, Rockwell has launched initiatives that both mirror and help expand the trends discussed above. These include an “add-on profile” with its vision partner Cognex Corp., Natick, Mass. The idea is to allow easy, quickly implemented communication between Rockwell systems and Cognex vision systems. “It allows a Cognex system to appear to our system as if it is just another device on Ethernet, so we don’t have to write special software to communicate with it. This, coupled with the fact that the vision software has gotten easier to configure, allows vision-aided robotics to be much easier to use in packaging, with quicker installation, start-up and troubleshooting.”

Another area the company is focusing on is expanding line controller capabilities. “One of the recent advances has been the integration of robot control directly into the line controller rather than having a separate dedicated-purpose robot controller,” notes Bob Hirschinger, product manager for Logix Motion at Rockwell Automation. This higher level of integration, he says, helps reduce the cost and improve the productivity of a packaging operation, and makes it significantly easier to maintain and support the robot.

The trends, then, would seem to be clear: greater use of vision-aided robots in packaging, increased integration among the various components of the system, and a continuing emphasis on making the systems easier to implement and easier to use. And the high level of product differentiation that provides such fertile ground for the growth of vision-assisted robotic applications shows no signs of abating in the near future.