Motion Gets Smarter with Integrated Actuators

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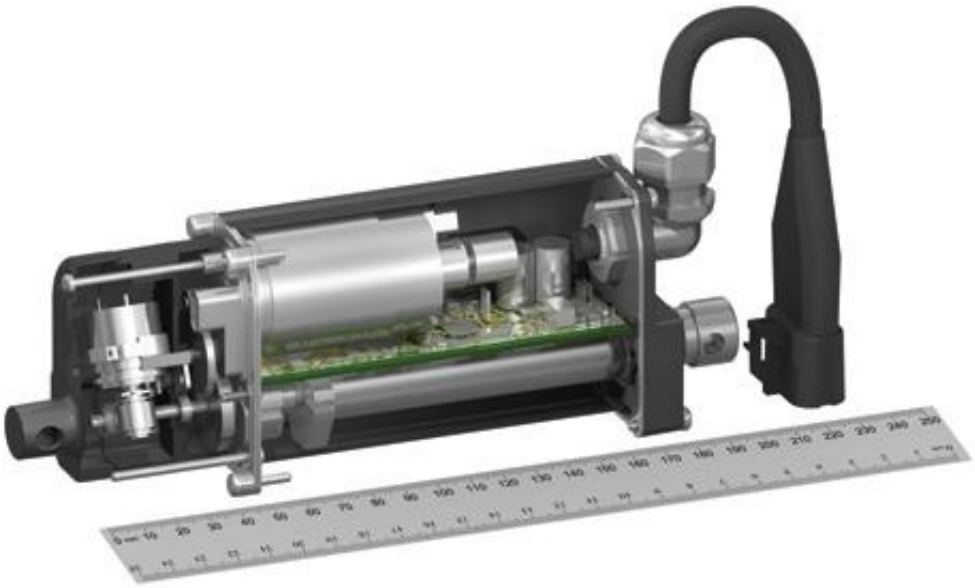
Integrated actuators incorporating more advanced controls and broader network connectivity options are finding their niche in applications where the simplicity of an all-in-one, actuator-motor-control package fits cleanly into new machine designs. The key is a single mechanical actuator-motor with onboard electronics that can provide both a broader set of controls and the simplicity of an integrated solution.

"The sweet spot for integrated solutions is where distributed power and control offers a significant advantage," says John Walker, vice president for Exlar Corp. "Mobile equipment is an example of applications where typically there are no traditional control panels to house the drives and controls for electric actuation on a vehicle. Actuators on mobile equipment are often powered from the vehicle's batteries, and having a compact controller and power device right on the motor and actuator is a big benefit."

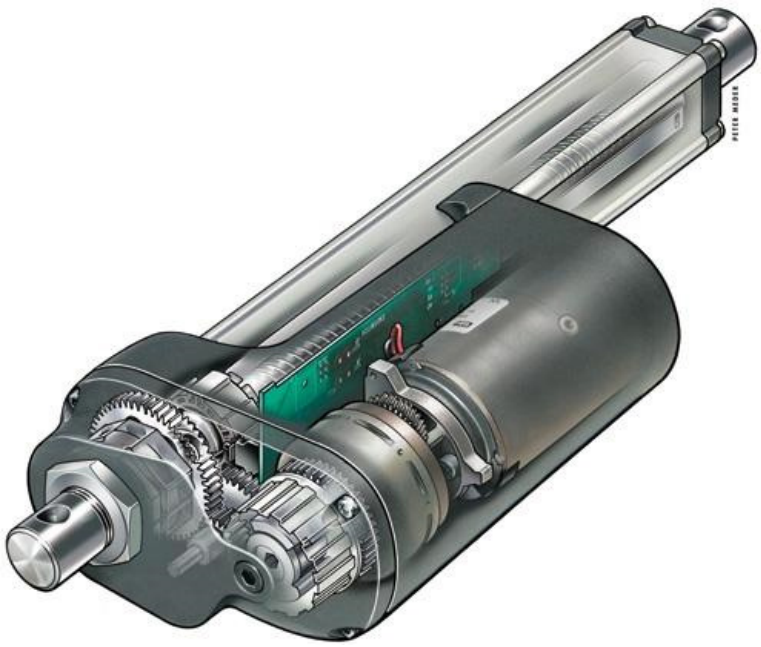


The new Thomson Electrak smart actuator is a single actuator with onboard electronics that can provide speed, current, and position sensing, as well as temperature and voltage compensation.

A typical packaging machine isn't always the best fit for the integrated actuators. Packaging machines often use a traditional control panel with PLCs and drives and don't have long distances from the drives and controls to the actuators. Integrated technology provides a larger benefit when there are longer travel distances between the central controller and the actuator or in applications that don't traditionally have control panels at all.

Control of independent, single-axis machine functions is an ideal candidate for distributed motion. Traditional hydraulic and pneumatic cylinder applications are inherently standalone, single axis, and provide point-to-point motion. In replacing fluid power solutions with electric linear actuators, coordinated motion is typically less common. These types of standalone, point-to-point applications are well suited for, and often solved with, integrated actuators.

Walker says that developing additional network communication solutions is an important factor for distributed motion products. One of the big advantages of the integrated solutions, compared to traditional servo systems with separate amplifiers, is the elimination of the expensive motor power and feedback cables. Traditional AC or DC power is still required for the distributed solution, and some applications require a multi-conductor I/O cable, which is far less expensive.



Additionally, many applications can be controlled solely via network communications and can use simple communication cables. This network is often already distributed throughout the plant, and the user just runs a drop to the integrated motion product. Because the networks are bidirectional, users can send commands to the unit and receive monitoring, status, and diagnostic information over the same connection.

"The application of integrated power and control electronics on motors and actuators is slightly different than traditional plant-based industrial automation," says Walker. "Distributed control and power becomes a bigger advantage for large scale production facilities with more expansive production lines compared to applications on discrete machines."

Automotive production is one example where integrated solutions are effectively applied for functions such as gripping parts and clamping fixtures throughout the assembly process. These axes of motion are widely distributed throughout the plant and often not conveniently located near an electrical panel containing motion controllers and servo amplifiers. Examples in automotive assembly are clamping for sheet metal welding and frame fixturing. Electric clamps and fixturing throughout an automotive assembly facility are often done using distributed motion products. These solutions do not require discrete panels for servo drives and controls that would consume valuable space in an automotive assembly facility.

The LA36 family of smart actuator products from Linak is used in agricultural equipment like combine harvesters, solar tracking, and building ventilation systems. Customized PCB modules in the actuators make it possible to implement specialized features required in specific industries.

Off-highway vehicles, such as agriculture, turf, and construction, are a growing market for smart electric actuation. As these pieces of equipment are becoming more sophisticated, using satellite navigation for example, more sophisticated and smarter operation is required throughout the vehicle, even down to the mechanical actuators and cylinders.

"Being able to use bus communications creates an advantage for these mobile vehicle manufacturers because they can implement a single ECU [engine control unit] instead of multiple single function controllers," says Håkan Persson, product line manager for Thompson Linear Actuators. "Commands can be sent to the actuators for execution and the actuator can provide status information in return, such as position and speed. It can also report on potential safety problems such as an overloaded unit or high temperature conditions."

Persson says that this approach also makes it possible for the vehicle manufacturer to optimize the vehicle cable harness. Larger gauge wires connect directly to the power source and a smaller gauge control cable connects the actuator to the vehicle bus. This reduces the number (and costs) of wires and cables.

Using smart actuators simplifies the control in some ways, but more importantly, it can standardize controls, so that the same control could be used for headlights, fans, or the valves and actuators used on the vehicle. Persson says customers are also standardizing their control systems and using a standard ECU between different types of off-road vehicles, including excavators, loaders, and tractors, reducing costs across different platforms.

"The biggest advantage smart actuators offer mobile off-highway equipment is the ability to piggyback off what the automotive market has already perfected," says Anthony Smith, an electrical engineer for Thomson. "CANbus, LINbus, and those types of communication technologies were originally designed for the automotive market. These technologies facilitate reduced assembly times using simplified connection interfaces while improving the ability for all pieces of the vehicle to run in unison. Mobile off-highway vehicle manufacturers are starting to follow that trend because they can achieve the same benefits."

The Tritex IITM Series actuators from Exlar now include a DC linear unit that incorporates a servo drive, digital position controller, brushless motor, and linear actuator in one compact, sealed package.

"Other smart technology used in these vehicles, such as GPS steering and speed automation, requires everything to be more synchronized. With centralized communication, vehicle motion can be driven at the same time measurements are being taken, ensuring that safe and precise commanded movements are made," he adds.

If you look at the past and how mechanical actuators have been used, standard industrial linear actuators offered just a motor and no controls. As time went on and the technology improved, customers started to add position feedback, limit switches to stop at the ends of stroke, and an H-bridge to control the speed or measure the current.

Persson says that with intelligent actuators, all of those pieces are handled inside the actuator itself. So instead of the customer needing to design a separate control to handle each one

of these add-on features, a single actuator with onboard electronics can provide speed, current, and position sensing, as well as temperature and voltage compensation.

"With integrated actuators, because you are often not replacing an existing motion solution, there may not be an existing electrical cabinet for the drive and the desire to add a cabinet or junction box," says Aaron Dietrich, marketing manager for Tolomatic. "An integrated solution alleviates these problems, and eliminates wiring and cables because you don't need a motor power and an encoder cable from the drive to the motor."

He says that integrated products are also starting to incorporate more networking options from RS-485 to Ethernet protocols, which also helps eliminate cabling and wiring and makes solutions a lot cleaner.

"The two big trends are replacing pneumatics and automating manual processes," says Dietrich. "But the price-cost pressures and expectations in these applications are typically very aggressive, so any electric actuator solution has to be very cost effective."

In replacing the pneumatic actuator, valve, flow control, and other functions in a pneumatic system, Dietrich says those axes are typically in the $100 to $200 range. And while engineers are willing to pay more, cost is still a major concern. The types of manual processes being automated include hand cranks, slides with locks, or simple hand operations.

One challenge for integrated product application solutions is harsh environments, such as the food and beverage industry, where equipment may be sprayed with water or caustic wash-down. Other specialty or general automation applications have requirements for outdoor operation or other non-factory environments where there are special requirements that make it challenging for onboard designs.

"Integrated product solutions are a growth area for us, and our ERD [product line] is a very low-cost, electric rod style actuator family," says Dietrich. "It looks like a throwaway pneumatic cylinder except that a motor is mounted to the unit."

Tolomatic has launched a drive and stepper motor solution to provide higher levels of motion performance. The focus with its new configurable drive has been on how to make it easy to use with "canned" modes, such as an index-move mode where the drive is commanded via digital I/O and an analog position, allowing the user to provide an analog signal from a PLC. Ethernet connectivity options include Ethernet/IP and Modbus TCP, along with immediate plans to offer a pneumatic mode that allows the drive to replace a pneumatic valve without the need to rewire the system.

"While there will always be demand for electric actuators with simple in and out movements, in applications with more advanced control systems we definitely see a trend towards motion solutions with additional positioning feedback and communication capabilities built directly into the actuator," says Randy Bowman, Techline market manager at Linak US. "Our latest smart actuators are built with a printed circuit board [PCB] inside the actuators and these PCBs can be customized to meet specific customer requirements."

In advanced control systems, like larger off-highway equipment and solar trackers, it is becoming more and more common to use actuators that offer different types of bus communication. Modbus, for example, is typically used in the solar industry, and CANbus and LINbus are both commonplace in the larger mobile vehicle markets. The HVAC and marine industries are also developing standard communication protocols for devices that could include smart actuators.

"Positioning feedback and communication options are really separate items," says Bowman. "With the newer trends towards more advanced communication options, like the various bus languages, smart actuators can allow positioning feedback and other information to flow even more effectively between the actuator to the controller."

Smart actuators enable control system designers to have information available, such as counting how many times the actuator has cycled in and out, the temperature of the microprocessor at any point in time, or even a signal to confirm that a command from the controller was executed. Another potential area of interest is preventative maintenance. If the amperage, for example, is starting to rise over historical values, it may indicate that the application needs to be maintained, which can be important for remote installations.

"Communication of various types of information via bus is a key benefit with other drivers, including lower materials and labor costs," says Bowman. "When you can run one wire that transmits communications over multiple nodes and actuators and there is no point-to-point connection required for each actuator, the amount of wiring and labor that is needed to install that wiring is reduced."