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MAKERS IN MOTION

Article

The force awakens

A new generation of electromechanical actuators is replacing hydraulic cylinders in a host of demanding applications. Increasingly, that choice is being driven as much by cost advantages as by performance.

For generations, when engineers wanted to produce large forces or move heavy loads their first choice would be hydraulic actuation. Today, however, hydraulic systems have a powerful rival in the linear motion world: the electromechanical actuator.

Electromechanical actuators replace hydraulic systems with a precision ball or roller screw, driven by a locally mounted electric motor and gearbox. In many applications, electromechanical systems provide a host of advantages over their hydraulic counterparts. They are smaller and lighter, and since the motor powering the actuator is connected directly, electromechanical systems do away with bulky pumps, accumulators, oil tanks and pipework. The absence of pressurised oil has safety and environmental benefits too, eliminating the risk of fire, pollution or injury associated with leaks and spills. Electrical actuation is also quieter than hydraulics.

Electromechanical systems also offer significant performance advantages. They can operate at a wider range of speed and power than hydraulic equipment and offer a higher level of positional accuracy. They also work more consistently. The viscosity of hydraulic oils can change with time and temperature, affecting machine performance. Electromechanical systems go on working to precise tolerances, and because their moving parts are based on well-understood rolling element bearing technology, it is possible to predict their operating lifetimes under a given set of operating conditions.

Then there is control. With no need for separate control valves and associated hardware, electromechanical actuators are easier to integrate into a machine’s electronic control system. Together with their fast response, accuracy and repeatability, that makes it easier to program complex movements, or to build machines that adapt quickly to different process requirements.

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Where's the catch?

Against this compelling list of advantages, electromechanical devices have one apparent flaw: cost. On a per-actuator basis, the initial purchase price of electric machines is certainly higher than their hydraulic counterparts. Historically that has been enough to discourage their use in certain applications.

When viewed from a total cost perspective, however, this argument rarely holds sway. Over the full lifecycle of a machine, electromechanical actuators offer sources of savings that far outweigh their higher initial cost. Those savings arise from six principal factors.

Energy efficiency. Hydraulic systems suffer multiple sources of energy loss from the initial conversion of electrical power into motion to drive the hydraulic pump, losses within the pump itself, fluid friction in transmission pipes and further losses within the actuator. Overall, a hydraulic system is likely to deliver only around 44 percent of its input power to the load. Electromechanical systems, by contrast, lose energy only due to the limits of motor efficiency and via friction in the gearbox and actuator components. An electromechanical actuator will typically transfer 80 percent of its input power to the load. Moreover, while hydraulic pumps must run continually in most applications to ensure adequate response from the machine, the power consumption of electromechanical actuators is zero when they are not being used. In many applications, an electromechanical actuator may only consume its peak power for a tiny fraction of the machine's operating time. Overall, this means that electric actuators can pay back their initial costs in energy savings alone in just a few months.

Reduced heat. The energy lost in hydraulic machines is converted to heat. In precision applications, such as plastic moulding machines, this heat must be removed using chillers, further increasing overall energy demand. Thanks to their higher efficiency, electrically actuated machines require only around 35 percent of the cooling energy of a hydraulic equivalent.

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Shorter cycle times. The higher speed and improved controllability of electromechanical actuators can allow machines to run faster, increasing output. Take robotic spot welding in the automotive industry for example. Between welds, the tongs mounted on a robot arm must be opened to allow the arm to access the next weld location. Fluid power systems typically require the tongs to be fully opened after every weld. Electromechanical systems, on the other hand, can be programmed to open just enough to allow the tong to be repositioned. When a Japanese car manufacturer switched to electromechanical welding tongs, this change, along with the higher speed of the new actuators, permitted an increase in throughput of 10 percent, equivalent to more than 100 vehicle body shells every day.

Improved material utilisation. Enhanced accuracy and consistency means electrically driven machines are typically offering twice the repeatability of hydraulic alternatives. That drives up quality and reduces scrap. Furthermore, since the electric machines deliver consistent performance from the moment they start up, losses after changeovers are reduced and production teams spend less time adjusting machine variables to get processes under control. Even in applications producing low precision components, savings from scrap reduction and quality improvements can outweigh the additional actuator cost in two years or less.

Increased uptime. Electric machines have fewer wearing parts, and those are all located within the ball or roller screw mechanism and gearbox. Hydraulic devices rely on a network of valves, hoses, filters and seals. And as hydraulic power is distributed, a failure in one part of the system is likely to bring the entire machine to a stop until the problem can be identified and repaired. A problem with an electrical actuator can usually be addressed by quickly swapping out the affected device. As a result, uptime and machine availability is typically two percent higher with electromechanical actuators, improving output and reducing per-unit production costs.

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Simplified maintenance. Finally, electric machines have few reoccurring expenses. Operators don't have to buy oil, filters or seals. They don't have to stop machines to replace these parts and they don't have to spend money protecting against, or clearing up, leaks and spills. Electromechanical systems can also be equipped with fully integrated condition monitoring technology, alerting operations and maintenance staff to potential problems before they result in an unscheduled stoppage.

Together, these benefits will add up to savings of several tens of thousands of pounds per year for a typical production machine. Just under half of those savings come from areas other than energy use.

New generations

The latest generation of electromechanical actuators have been engineered to build on the advantages inherent in the design, and to extend those advantages with products that are more powerful, even longer lasting and easier to integrate into machines.

Ewellix's CASM range, for example, has been designed for demanding duty cycles in high speed, high volume automated production. CASM electric cylinders use a modular design, available in a wide variety of standard sizes that allow the units to be used as a drop in replacement for pneumatic cylinders on existing production equipment. They can be operated by a wide range of different motor types, allowing machine owners to simplify procurement and spare parts management by selecting motors from their preferred supplier. A large selection of options and accessories makes them easy to integrate in numerous applications.

Inside, the CASM actuators have been engineered for extremely high performance and a long life. High quality bearings and ball- and lead- screws offer low friction for energy efficiency and low axial play for increased precision. The units are lubricated for life, with integrated filters and a wiper ring to prevent damage from dust and dirt ingress. An integrated magnet ring and slotted aluminium profile casing make it easy to add external sensors.

To further simplify machine control and system integration, CASM cylinders are now available complete with a brushless DC motor with integrated motion controller, brake and optional fieldbus interface. By removing the requirement for an external motor controller, the brushless motor option cuts installation costs and simplifies wiring, since the motors can be powered and controlled via a single cable. Machine setup is more straightforward too, with a dedicated Ewellix programming kit that allows motor parameters to be set using a graphical user interface. Up to 14 different actuator positions with associated velocities, accelerations and decelerations can be downloaded into the motor itself, and the machine can subsequently be controlled by a PLC or simple switches, creating a highly cost-effective standalone motion control system for smaller machines.

For higher load applications, Ewellix LEMC electromechanical cylinders use a planetary roller screw instead of a ball screw design. This technology results in an actuator with a higher power density than conventional designs and also improves performance in environments where the device is exposed to high levels of external vibration. Like the CASM units, LEMC actuators use a modular design that can be configured for many different applications and a range of motor types. As well as conventional servo motors, they can be supplied with an integrated gearbox and smart asynchronous motor. This offers additional safety and machine protection capabilities with integrated soft start and capabilities and motor protection function. As a further benefit for operations and maintenance staff, the controller incorporates near field communication (NFC) capabilities, allowing it to be adjusted wirelessly using a smartphone.

Ends

About Ewellix:

Ewellix is a global innovator and manufacturer of Linear Motion and Actuation solutions used in industrial automation, medical applications and mobile machinery. Formerly part of SKF Group, the Ewellix Group consists of 16 sales units and nine factories. External net sales are approximately 2.3 SEK billion and we employ around 1400 people. Ewellix is headquartered in Gothenburg, Sweden and is owned by Triton Partners.

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