TECH BRIEFS
ENGINEERING SOLUTIONS FOR DESIGN & MANUFACTURING

Electric Actuators Deliver Energy Efficient, Low Maintenance Solutions

Machine designers and end users find themselves balancing sometimes opposing priorities such as improving energy efficiency while minimizing adverse impact on the environment, at the same time ensuring performance (e.g., precision, reliability) is not compromised. A key trend towards meeting the challenges has been to shift from hydraulic actuation towards electric actuation, especially in applications characterized by high degree of responsiveness, space constraints, high uptime/low maintenance, low energy consumption, and minimal environmental impact.

In the past, the transition to electric actuation was limited by the long payback periods driven to a large extent by the cost of high power density motors, higher cost and lower reliability of power electronics and roller/ball screws. Additionally, the transition was hampered by the shortage of mechatronic skill sets at customers, which are vital for specifying the required performance of electric actuation and installing and commissioning the same.

Thankfully, significant advances in permanent magnet technology, improvements in semiconductors, and improved reliability of key components over the last two decades have dramatically increased the power/capability-to-cost ratio in high performance motors and servo drives by more than 40%, raising the economic attractiveness of such electric options. Innovations in design, materials engineering, and manufacturing processes have enabled the development of ball screws that can deliver equivalent or better life than competing technologies with improved accuracy, precision, and a compact footprint, all at a very attractive cost of ownership. The price premium (20-40% depending on the application) for an electric actuation system over a hydraulic system can be recovered in 1-3 years through lower power consumption, lower maintenance and greater flexibility.

Additionally, some suppliers have reduced the risk of transition by providing a complete solution, including sizing software to specify the actuator requirements, a matched servo drive-actuator combination and easy-to-use commissioning software that offsets customer reluctance to adopt new electric technologies. Some recent examples of applications that have successfully transitioned to electric actuation include flight simulation and sub-sea oil production.

In flight simulation, a Six–Degrees of Freedom (6DOF) robotic platform in a high payload, high fidelity and a highly responsive closed-loop system switched from hydraulic to all-electric technology. In sub-sea oil production, electric actuation provides reliable control of valves in very challenging environments. These are all sterling examples of electric actuation enabling solutions that are energy-efficient, compact, highly productive, and environmentally-friendly, yet with quick payback periods.

While electric servo actuation may not be the solution for every application, advances in technology and innovations by suppliers have made electric actuation a viable alternative, especially in today's environment favoring lower power consumption, less environmental impact and lower cost of ownership. Payback periods, depending on the type of application, can be as low as one year. Proactive suppliers of electric actuation with expertise in designing mechatronic systems have introduced tools that are accelerating the adoption of electric actuation.

Advances in ball screw design to further improve power density (i.e., increase linear force without increasing actuator envelope) will enable electric solutions to further penetrate high force applications – traditionally the domain of hydraulics. This is being enabled by advances in FEA (Finite Element Analysis) techniques that lead to deeper understanding of the issues related to boundary layer lubrication. Additional contributions come from advancements in material development, improvements in surface engineering, precision machining, and metrology techniques. Servo drive technology continues to leverage the advances in semiconductor manufacturing, leading to smaller device sizes and higher computing power. All of these technology advances taken together will increase the options for machine builders and end-users looking to find better ways to meet the challenges of the future.

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