Electromechanical Actuation - A Benefit for Military Vehicle Design

Vehicle Design Improvements

Balancing tight cost constraints, addressing program viability questions, and dealing with severe environmental variables puts military vehicle designers in a constant search for measureable, impactful changes in their systems designs. With an ever-increasing focus on efficient designs, increased survivability, and stealth capabilities designers need technology that can meet the program demands. Further, designs that offer improved power efficiency, size and weight optimization can help provide reduced life-cycle costs. With those ideals in mind, many designers are looking at actuation systems within the vehicles as a means to providing much of the needed improvements.

Legacy designs have traditionally relied heavily on hydraulic actuation. However, with increasing regularity, industrial motion control has moved and is moving away from hydraulics. And the defense industry has begun to follow this trend. The primary drivers to cause machine and vehicle designers to move away from hydraulics include both high maintenance costs and high power consumption associated with those systems. The move to electromechanical motion control promises to reduce those headaches associated with the legacy systems. However, the right electromechanical devices can promise even more.

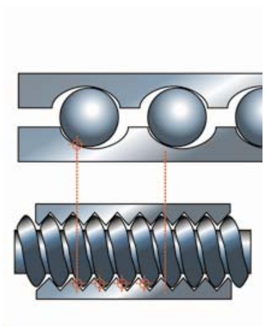
Electromechanical actuators, providing energy efficiency, simplified designs and weight and size optimization, do not require additional power capabilities to be designed into the vehicle. Moreover, the simplified designs also lend themselves to increased survivability. Re-routing power or providing uninterruptable power no longer requires running new or redundant fluid lines or replacing a complex series of valves, pumps or sensors.

The bottom line is that what may have been “close enough” is no longer good enough. It is no longer acceptable to choose between features – military vehicle designers need them all. Actuation systems require the long life and power capabilities of the legacy hydraulic systems but also need the power efficiency and the maintainability of an electromechanical solution. Along with that, the system must minimize size and weight and be as quiet as the hybrid engines increasingly used in military vehicles. Long-term viability can also be dependent on commercially available, proven technology. And, of course, the system must withstand the harsh operational environment a military vehicle is designed to meet.

The Roller Screw Alternative

Choosing the right electromechanical actuator matters. Traditional ball screw driven devices may offer some power consumption efficiencies sought by the system designers. Unfortunately, ball screw devices often did not – indeed, cannot – live up to the life and thrust capabilities of hydraulic actuators. There is only one proven electromechanical alternative to hydraulic actuation. Roller screw devices offer the mechanical efficiencies of the ball screw, but can also provide greater load carrying capabilities in a smaller package, run at much higher speeds and offer up to 15 times the service life. What's more, noise levels are significantly reduced and designs are inherently resistant to harsh environmental conditions, not only meeting your actuation requirements but providing tangible vehicle design improvements over legacy systems.

Roller screws convert rotary torque into linear thrust in the same manner as acme and lead-screws. A comparably sized roller screw, however, has greater efficiency than an acme screw and can carry larger loads than a ball screw. In addition, they can cycle more often and turn significantly faster than either, suiting them to precise, strenuous-duty applications. The radiused flanks of the rollers of the roller screw deliver point contact like that of ball on a raceway. In the design of a roller screw, however, only the contact region of the radius is part of the profile. Therefore, a much larger radius and a high number of contact points can be packed into the available space. The result is much lower stresses within the components. Comparatively, a roller screw has a load capacity as much as 15 times that of a similarly sized ball screw.



The depiction above illustrates the limited number of contact points in a ball screw compared to the contact points in a planetary roller screw design.

The continuous rolling contact between the roller screw components has low friction which, in turn, yields high efficiencies. And, because the rolling members are fixed relative to each other and never come into contact with adjacent rollers, roller screw can turn at speed up to 5000rpm.

Relatively low stress on the rollers which results from a radius larger than that of ball screws determines performance, such as high speed. Profiles on the mating parts further maximize performance through low friction and stress. In addition, radiused flanks on the rollers deliver point contact like balls on a raceway. A large curved radius and numerous contact points can produce a load capacity up to 15 times that of similarly sized ball screws.

Exlar Roller Screw Actuators
Exlar Corporation offers roller screw linear actuators that perform in harsh environmental conditions. In fact, Exlar is among the world leaders in electromechanical actuation with an installed base of more than 60,000 industrial grade rod style linear actuators. Exlar offers a complete range of proven Commercial Off-the-Shelf (COTS) actuators, designed and built in the USA. Built to perform, Exlar

actuators are designed for and used in severe environmental conditions such as military ground vehicles and navy ships, and in unforgiving industrial environments, requiring 24-7 operations.