Linear actuation with a novel twist

Many production line tasks need both linear and rotary motions. But the traditional ways of achieving these combined motions have limitations. As Robin Maidment from Quin Systems* explains, a novel motor that combines linear and rotary motions in single compact drive overcomes some of these problems. The motor can also cut the time needed for closure applications, such as fitting bottle tops, by up to 60%, boosting productivity dramatically.

For complex tasks such as threading, closing, pick-and-place, stacking, or aligning, designers often need to provide a both linear and rotary motions. For example, in a PET bottle-closing machine, the closure cap needs to be placed on the bottle using a linear motion along the longitudinal axis, and then screwed onto the threads of the bottle opening using a rotary motion until a defined angle or a torque has been reached.

In the past, concentric closing machines achieved this using one of two approaches:

- In the first, the linear stroke and the rotation of the closing spindles are both derived and synchronised mechanically from the rotary motion of the carousel using cam disks (for the linear stroke) and gears with a magnetic clutch (for the rotation).
- In the second, a servomotor is used for the rotation and is moved up and down. This linear stroke is derived from the motion of the tabletop using plate cams, as in the mechanical concept. This type of closing machine is often called a servo-closer.

One drawback of the purely mechanical approach is that it lacks flexibility when selecting the process variables, such as the tightening torque and press force. The torque, which is critical to the screwing process, can be adjusted and modified only by using the magnetic clutch or hysteresis clutch on the spindle. The parameters cannot be influenced during operation.

In many applications, the limited stroke is also a disadvantage. In practice, the stroke lengths are often limited to 80–150mm, because longer strokes would slow down the closing process too much.

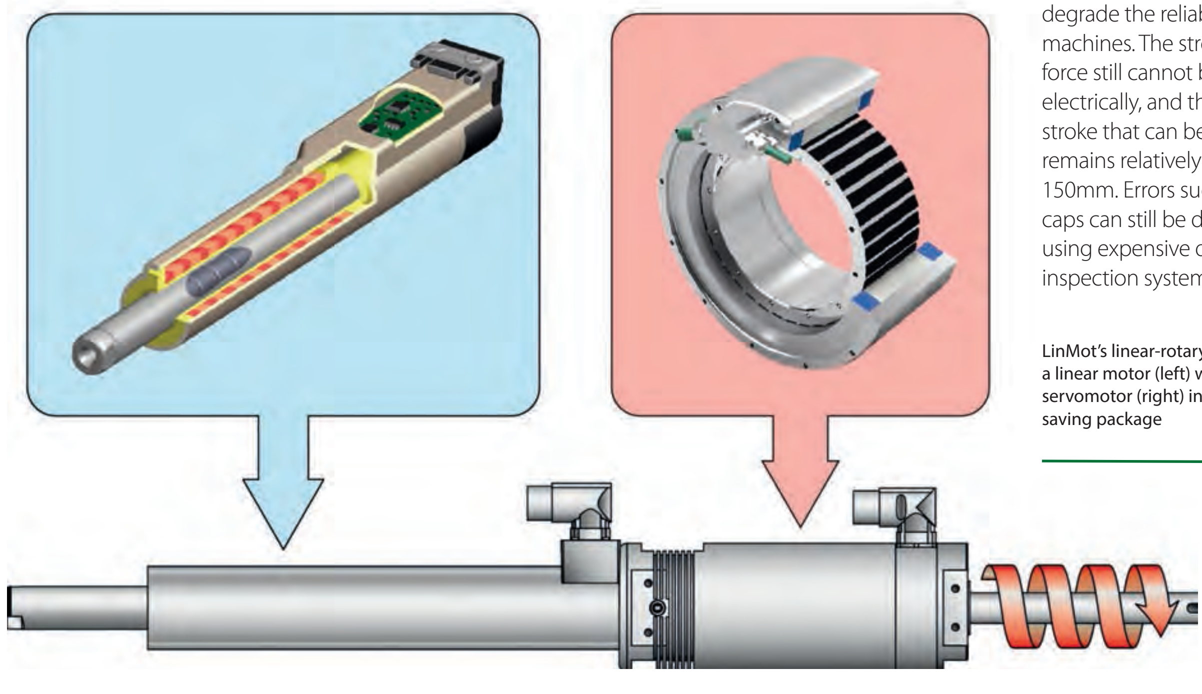
Moreover, the machine operator cannot extract any information about the wear process from within the drive system, so additional separate sensors may need to be installed and analysed for process monitoring.

In addition, the wear process for the purely mechanical concept depends on the speed of the carousel, due to the use of a direct mechanical clutch. This can degrade process stability, especially when starting and stopping the system.

Servo pros and cons

In more modern machines, a servomotor on each spindle provides the necessary rotation. But this solves only some of the problems with the purely mechanical approach. The torque can indeed be adjusted electrically, and modified while running. The actual torque applied can also be determined by analysing the drive data.

But these advantages come at the cost of a new disadvantage: because the servomotors generally have to be moved along with the closing head, expensive flexible cables are needed that can be carried in a cable guide chain. These complicate the design, make it more difficult to clean, and degrade the reliability of machines. The stroke and press force still cannot be adjusted electrically, and the maximum stroke that can be achieved remains relatively small at 100–150mm. Errors such as crooked caps can still be detected only by using expensive downstream inspection systems.



LinMot's linear-rotary motors integrate a linear motor (left) with a rotary servomotor (right) in a single, space-saving package