Belt Drive Offers High-Precision Alternative

BOSCH REXROTH ASSISTS BELL-EVERMAN WITH LINEAR ACTUATOR DEVELOPMENT

Bell-Everman, Inc., a manufacturer of rotary, linear and multi-axis motion devices, recently developed a linear actuator called ServoBelt for large-format automation applications. ServoBelt provides the speed and accuracy of a linear motor at a value that's comparable to belt-driven actuators. Bell-Everman saw a need for an economical linear actuator for smaller companies that may buy only one or two machines or OEMs that purchase multiple units. They brought Bosch Rexroth into the mix for product support to achieve their goal of a high-performance actuator at a lower cost.

"We're using cost-effective components and targeting accuracies that are usually attainable only with more expensive types of forcers—ball screws and linear motors," says Michael Everman, chief technical officer. "From

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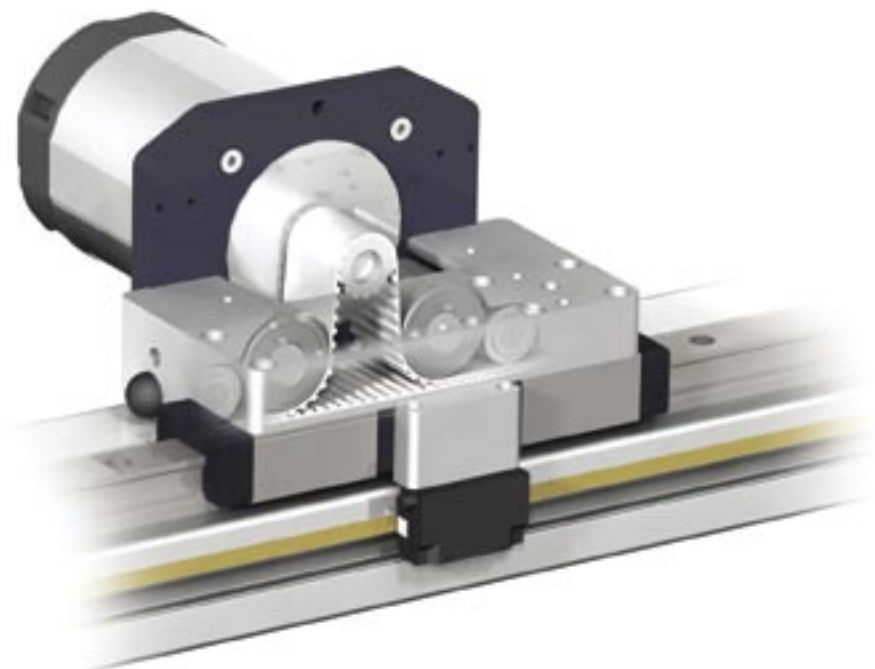

A movable carriage powered by a servo motor and belt rides on Rexroth's linear rail and aluminum framing to achieve a standard range of travel from 0.15 to 50 meters (courtesy of Bosch Rexroth).

The ServoBelt combines Bosch Rexroth ball rail guides and aluminum framing with a belt-driven carriage, providing the speed and accuracy of a linear motor at a value comparable to belt-driven actuators (courtesy of Bosch Rexroth).

a performance standpoint, a key focus is on accuracy and repeatability. And, we wanted all of the advantages of a linear motor system for far less cost."

The ServoBelt actuator is utilized for long travel and especially suited for food and packaging applications, palletizing, material handling, textile cutting, biomedical handling, large-format printing, water jets, plasma cutting, CNC wood routing and pick-and-place robotics.

The bi-directional repeatability is four to five times better than a conventional belt or rack drive +/- 60 µm, with a unidirectional repeatability of +/-10 µm, according to Bell-Everman. By using a linear encoder, the ServoBelt can match the repeatability of a linear motor. Standard range of travel for the ServoBelt is 0.15 meters to 50 meters with almost no length limitations beyond. Acceleration is in excess of 4 g with speeds up to 4 m/s with standard bearings and 10 m/s with a bearing upgrade. Life test units are recording 40,000 out-and-back cycles per day with at least 16 million stops and starts already tabulated.

The ServoBelt combines Bosch Rexroth's linear ball rails and aluminum framing as the building blocks for the system. A movable carriage or block rides on the linear rail that is mounted on a length of aluminum framing. Servo motors drive a polyurethane, steel-reinforced T5 belt for power. A static, bonded lower belt engages with the upper dynamic belt so that the active belting under tension is less than a few inches long. Stiffness, accuracy and repeatability are enhanced by the belt

mechanism, according to the company's press release. With its high open-loop accuracy, the ServoBelt mimics a linear motor by inhibiting the same force regime at a much lower dollar-per-inch cost. It offers more drive-line rigidity than conventional belt drives and can improve a machine's settling time.

"Rexroth's standard linear bearing rails are interchangeable, so we can stock lengths of rails and bearing blocks and interchange the blocks onto any rail, and it will still have the performance specs we want," Everman says.

The main hurdle in the design process was to create a belt that is rigid, as opposed to having the flexibility of a "guitar string." Everman explained that they experimented with a moving-motor belt drive, but stiffness was an issue. Rexroth's components allowed Bell-Everman to overcome this issue. One notable attribute is that the chassis of the ServoBelt is based on Rexroth T-slot aluminum extrusions, which can use a wide array of mounting hardware.

"Using the T-slot extrusions with our own belt carrier extrusion allows us to deliver standard stages in one to two weeks," Everman says. "We can cut-to-length all of the major components, with no long-travel machining operations."

Everman added that multiple carriages can also be supplied for independent motion on the same axis, and dual-motor carriages are available to double the standard linear forces. The company can also integrate other Rexroth drive and control components such as motors, pneumatic grippers, valves and a motion logic controller with robotic kinematics to produce a completely integrated robot.

"The versatility of Rexroth's linear ball rails and aluminum framing makes it easy to create the subassemblies, which makes them suitable for customers to buy in smaller quantities," Everman says. "We now have a product that is much easier to deliver as a one-off to customers who are experimenting with new machine designs. Having multiple independent carriage capability, without forcer cross-talk, is a huge plus."

Additional components such as motors, valves, a motion logic controller with kinematics and this pneumatic gripper can be integrated to produce a complete robot (courtesy of Bosch Rexroth).

"We're slated to make stages with 10 forcers on the same axis for an automated aircraft wing-fixturing system," Everman adds.

He cites the quality of Rexroth's framing products, straightness, delivery times and response to their needs as key factors in the development of the ServoBelt.

"We designed our actuator with Rexroth products because they help us remain successful in a competitive industry," Everman says.

In addition to versatility, the ServoBelt provides increased energy efficiency versus a conventional belt.

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"When the driveline is stiffer, you spend less time trying to maintain position when the machine is shaking around due to other processes or other axes in motion," Everman says. "It is definitely a more efficient use of energy, so smaller motors can be used."

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