Drives for speed in intralogistics

Microdrives and motion controllers from Faulhaber are used in the Toru picker robot from Magazino (Source: Magazino, Faulhaber)

CANopen-capable drive systems from Faulhaber (Germany) have proven their performance in many intralogistics applications, from sorting through transporting to a wide range of different robotics solutions.

Suitable transport structures in intralogistics are a prerequisite in all industries to withstand competitive pressure in the future. Storing, retrieving, and preparing items in warehouses for dispatch are being taken over by automatic storage and retrieval machines, driverless transport systems, and logistics robots.

Such logistics solutions are often driven by high-performance micromotors, placing high demands on the used drives:

- They must be capable of releasing high forces under confined conditions,
- Work reliably in continuous or stop-and-go operation, and
- Perform highly precise positioning tasks.

The speed also plays an important role. Many thousand orders need to be processed every day in large warehouses. CANopen-capable drive systems from Faulhaber are used for sorting and transporting as well as for storage and retrieval. Thanks to the modular design, the motors can be combined with a variety of encoders for precise positioning tasks and with high-performance gearheads for high torque requirements. There are also compact motion controllers that can either be integrated in the drives or arranged externally.

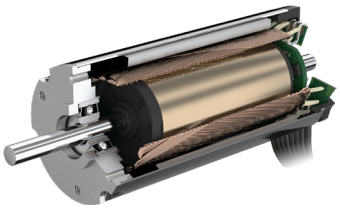

Figure 1: BX4 series brushless DC servomotor (Source: Faulhaber)

Autonomously driving and self-contained logistics robots are used for storage as well as removal and dispatch preparation. They optimize material flow, relieve employees and replace, e.g., conventional lift trucks or pallet trucks. For example, autonomous picking robots typically comprise a lifting column and a gripper. As a drive unit, it contains, e.g., BX4 series brushless DC servomotors with integrated motion controller and planetary gearhead from Faulhaber. Used in the gripper, this combination enables precise positioning during storage or retrieval operations. As the complete drive unit weighs about 300 g, no counterweight is required even when the gripper is fully extended. With a diameter of 32 mm and a length of 85,4 mm, the compact servomotors enable to design the gripper very flat, allowing it to also pick up packages stored just above the ground. Expensive storage areas can thus be optimally used. Due to the brushless commutation, the motors are long-lasting and reliable. They deliver high torques and are quiet running. With the integrated current control, the torque demands are limited and the drive is protected against overload.

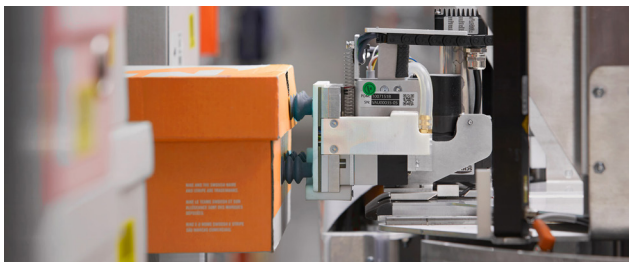

Figure 2: Storage and retrieval is performed by a vacuum gripper arm driven by Faulhaber motors (Source: Faulhaber)

Compact drives for rapid start/stop

When products are transported on conveyor belts or roller conveyors, they are separated and moved to the desired processing track by means of track switches, flaps, or slides. Not only in large warehouses in which thousands of packages per hour are transported on such conveyor systems, the speed of the automatic sorting systems is a key factor. The track switches must be moved to exactly the right position in a fraction of a second.

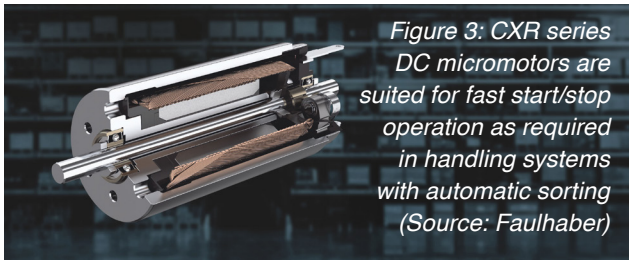

Figure 3: CXR series DC micromotors are suited for fast start/stop operation as required in handling systems with automatic sorting (Source: Faulhaber)

Graphite-commutated DC micromotors of the CXR series combined with matched gearheads have proven themselves in handling tasks. Their commutation system is very robust and well suited for dynamic, high-performance applications with fast start/stop operation as is required in many handling systems with automatic sorting, e.g., where switches are used to change routes on transport paths. With their linear characteristics, the DC motors are easy to control. Combined with high-resolution encoders, this makes them suitable for precise positioning tasks. Neodymium magnets and the Faulhaber winding provide a high power density in a compact design. Thus, the motors can be installed directly in the handling elements. In spite of their small size, they can lift considerable weights there.

Transport in production processes

Automated guided vehicles (AGVs) are the means of choice when it comes to ensuring flexible transport in production processes. Among the important requirements for the AGV drives are availability, speed, flexibility, and often, low space requirements. The current consumption also plays a role in ensuring that the vehicle battery is as long lasting as possible. For example, brushless DC servomotors of the BP4 series are suitable to drive the wheels, whereby the motor power can be transferred to the wheels via planetary gearheads and drive belts. The efficient motors with the company's winding technology allow for a high copper content and keep losses to a minimum thanks to high winding symmetry.

Figure 4: Automated guided vehicles (AGVs) are increasingly used for transport in production processes (Source: Faulhaber)

Magnetic incremental encoders of the IE3-1024 series built onto the servomotors for position detection are available with different resolutions and feature a standardized, electronic encoder interface. The resolution, direction of rotation, index width, and index position can be adapted to the application. A motion controller with e.g., a CANopen interface controls the servomotors and communicates with the central controller. The CANopen interface supports the CiA 402 CANopen device profile for drives and motion control (IEC 61800-7-201/-301). Such drive systems are also used for mobile robot platforms, which move autonomously in industrial halls without a preinstalled guidance system. Above all, their high power density is evident in the wheel modules. Thus, the small drive systems from Faulhaber can be found in almost all areas of intralogistics.

For limited space

If there is a limited installation space for wheel drives in the axial direction, the high-torque flat motors of the BXT series are an option. Thanks to innovative winding and optimized design, the motors are 14 mm, 16 mm, and 21 mm in length and deliver torques up to 134 mNm, within a diameter of 22 mm, 32 mm, and 42 mm respectively. For precise speed control or high positioning accuracy, diameter-compliant encoders or speed controllers are integrated into the housed motor variants, whereby the drive is increased by 6,2 mm. Speed control is performed by Hall sensors integrated in the motors. Thus, a speed range from 200 rpm to 10000 rpm is available. The compact drive combination is suitable for space-critical applications and simplifies installation and commissioning. The matching metal planetary gearheads of the GPT series are characterized by a short design, high torque, and fine graduations of the reduction ratios.

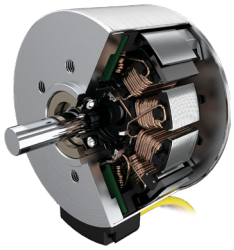

Figure 5: If installation space is limited in the axial direction for wheel drives, the high-torque flat motors of BXT series are suitable (Source: Faulhaber)

Motion controllers

The motion controllers ensure positioning using DC motors, BLDC motors, linear motors, as well as stepper motors. They enable the four-quadrant regulation of the motor movement matched to the respective application. The three most important components of a motion controller are the processor, control electronics, and the output stage. From the predefined parameters and the feedback data from the drive, the microprocessor calculates the dynamic control variable used to control the motor movement. The control electronics process the relevant signals. The output stage is responsible for supplying power to the motor.

Motion controllers receive feedback about the motor movement e.g., via an analog value, Hall sensor signal, or an encoder signal. They are available with or without housing. Devices with housing are connected using screw terminals. Those without housing are plugged directly into a master board. In order to network the motion controller, a CANopen interface is available, for example.

Motion controllers define the required speed for the motor by adjusting the power supply voltage (analog value) or by means of pulse width modulation (PWM). From the feedback, the motion controller calculates the extent of the performed movement and adapts control to the specifications. The preinstalled firmware allows the execution of complex sequence programs for motion control as well as automatic operation of the connected motor. The available operating modes include:

- Positioning mode to move to predefined target positions,
- Movement profiles with predefined acceleration and brake ramps as well as maximum speed,
- Autonomous mode with freely programmable sequences,
- Speed control of the predefined target speed,
- Current control as a protective function with integrated thermal models.

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