

Figure 1: AGVs are increasingly used in different applications, therefore a broad range of vehicles has been developed; in the future the commissioning will be AI-based requiring real-time data from the vehicles (Source: Adobe/Stock)

Last year's CiA motto at the SPS fair in Nuremberg was: CANopen feeds AI (artificial intelligence). CANopen-connected sensors provide information preprocessed in controllers or directly via gateways to high-performance AI-software-running computers. One of the application fields is an optimized commissioning of AGV (automated guided vehicle) and AMR (autonomous mobile robot) fleets.

For 30 years, CiA exhibits at the SPS (Smart Production Solutions) tradeshow: first in Sindelfingen and now in Nuremberg; both locations are in Germany. The SPS exhibition has daughter events in Parma, Italy (May 28 to 30, 2024), Guangzhou, China (March 4 to 6, 2024), and Atlanta, U.S.A. (beginning of 2025). In November 2023, more than 1200 companies presented their automation products to about 50000 visitors in Nuremberg. Many exhibitors showed CANopen devices, especially drive and motion control suppliers, which have implemented the CiA 402 profile.

The benefit of a standardized data model such as specified in the CiA 301 application layer and communication profile is obvious: Application data objects are specified by means of standardized attributes and can be processed by any CANopen host controller. The

access to these data objects is standardized by means of a 24-bit address (16-bit index plus 8-bit sub-index). These application data objects and the CANopen communication data objects are part of the CANopen object dictionary.

The broad range of standardized CiA profiles (CiA 4XX series) enables interoperability of CANopen devices. Furthermore, standardized remote access functions specified in the CiA 309 series allow to collect sensor fusion data and forward them to AI controllers. A typical future AI application on the factory floor and in logistic centers is the management and commissioning of AGV and AMR fleets. The AI application can optimize, for example, the AGV/AMR resources by means of minimizing the trips. This means, the AGV/AMR receive their targets respectively tasks from the AI software via gateways to the in-vehicle respectively in-robot CANopen networks, which provide links to drives and motion controllers as well as other actuators.

The gateways provide the link to the CANopen networks embedded in AGVs/AMRs. On the other side they communicate wirelessly with AI host controller. Such gateways are often embedded in the AGV/AMR host controllers. Stand-alone gateways connecting CANopen networks with wireless links (i.e. WLAN) are also available. ESD Electronics offers even a wireless CAN bridge between two CAN networks.

There are several AGV types on the market. This starts with very small and simple AGVs. The navigation systems of these automatic guided carts range from simple magnetic tape to complex sensor-based solutions that use AI to guide the vehicles. They are not only used



Figure 2: AMRs equipped with CANopen drives are also used increasingly in the agriculture industry (Source: Dunkermotoren)

in industrial applications: They also operate in hospitals to distribute meals and empty food trays, clean of soiled linens, biohazard waste, or sterile supplies.

Another type is a forklift AGV. They are applied often in logistic centers transporting pallets. There are also so-called towing AGVs or tugger automated guided vehicles pulling non-powered load carry vehicles. The variety of AGVs is high and new types as well as subtypes appear frequently. But navigation and moving is nearly the same in many applications.

Single- or multi-drive control units

The embedded AGV/AMR CANopen host controller can control all connected drives and motion controllers individually. But it is also possible to control up to eight CiA 402 logical devices by one CANopen interface. In this case, the AGV/AMR designer can unburden the AGV/AMR controller from some control tasks such as synchronizing and coordinating individual drives and motion controllers. By the way, this CANopen feature is available since its introduction in 1994, but has not been implemented in many CANopen devices.

On the SPS tradeshow, several companies presented special drive and motion controllers dedicated for AGV/AMR applications. The Franz Morat Group uses CiA 402 compliant drives from Dunkermotoren for its RNA250 and RNA500 wheel hub drives. These modular products comprise the wheel, the gear, the brake, the motor, and the CANopen interface compliant with the CiA 402. Typical applications include intralogistics, hospital logistics, and autonomous cleaning machines. A new application field are wheel hub drives for outdoor use in agriculture. The CANopen drive systems for AGVs by Dunkermotoren are based on the BG 95 dPro DC servo controllers with an integrated encoder. They are combined with KG 120 or KG 150 bevel gears.

Wittenstein is another supplier of servo controllers for AGVs. The cyber iTAS system 2 is a servo drive system

for AGV/AMR products with masses between 1 t and 3 t. It features optionally a CANopen interface compliant with CiA 402. The company states on its website: "The integrated safety architecture of the cyber iTAS system 2 requires fewer cables and connectors, fewer interfaces, components, and modules." This reduces the risk of errors as well as the effort for assembly and documentation.

There are also other providers of dedicated motion control products for AGVs and AMRs. Kofon offers differential speed 2-wheels sub-systems with an optional CANopen interface. Metronix has developed in co-operation with DPM and Fritz Antriebstechnik an AGV using the BL4840-M servo controller. This forklift AGV is used in the production line at Porsche. The MW500 wheel drive system by Maxon is suitable for loads up to 500 kg. It features a CANopen interface and provides an integrated encoder based on a Hall sensor. Heidrive's CANopen motion controllers are used in the Wheelmax series of wheel drive systems offered by the Allied Motion, the parent company. The Heimotion HMP and HMD motors can be combined with cycloidal, in-wheel, and reinforced planetary gearboxes. The drive controllers come with an optional CANopen interface. Variants with the STO (safe torque off) function are available.

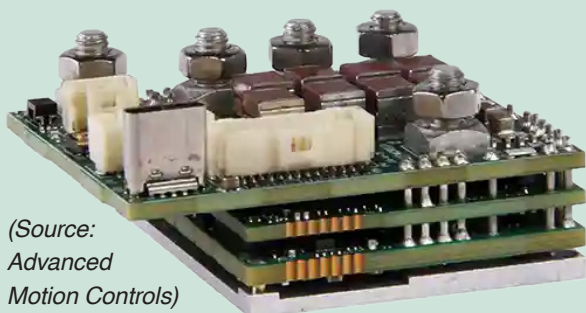
STXi exhibited at the SPS 2023 its AGV/AMR wheel drive system comprising a wheel, a planetary gearbox, a brushless servo motor with integrated brake and encoder, and a CANopen-compatible servo drive. It can be connected to a CANopen host controller, e. g. a programmable logic controller (PLC). The wheel drive system features an STO function, which turns off the torque and stops the AGV or AMR safely. This feature eliminates the need for external parts such as safety relays. Other manufacturers of wheel drive systems offer an STO function, too. For example, the MobiMS wheel drive system by STXi, which is used in AGVs by Safelog.

Nanotec, a CiA member for 20 years, presented in Nuremberg its CANopen-connectable wheel drive systems designed for AGV/AMR applications. They are suitable for loads up to 400 kg. The company produces two types of wheel drives: Modular wheel drives that combine wheel, gearbox, and bearing in a space-saving unit as well as compact integrated wheel drives that consist of wheel, gearbox, brushless DC motor, and encoder, thus reducing the number of moving parts and connections.

Advanced Motion Controls (AMC) manufactures CANopen servo drives for AGVs and warehouse automation systems. The company has supplied its CANopen product to an automated guided cart able to carry 1000 kg of cargo weight. The applied brushless servo motor features an integrated incremental encoder. A warehouse automation AGV by Omron has been also equipped with a servo drive by AMC.

The Ewheel by B-Drives offers a dual-axes motor controller with STO functionality. The CANopen drive controller is voltage-resistant up to 60 V with a peak current of 60 A. The two motors have integrated individual incremental encoders. According to the company, the speed can be reliably recorded in functional terms by balancing both signals with appropriate electronics. ▶

100-A servo drive



(Source:
Advanced
Motion Controls)

Advanced Motion Controls has introduced the shown CANopen servo drive with a 100-A continuous output capability and a specified peak current of 200 A. This is not a typo. The size of the servo drive is less than half a business card. This product is available in both PCB-mountable and embedded form factors with a CANopen interface.

Additional standardization would simplify AGV/AMR design

Standardized interfaces simplify system design for the original equipment manufacturers (OEMs). On the other hand, the OEM loses knowledge on the deeply embedded functionality. PLCopen, the nonprofit association for the IEC 61131 standards, has developed standardized interfaces for robots. This includes a 6-axes control interface. A similar approach for AGV/AMR multi-axes control function would perhaps make life easier for system designers. If such a CANopen multi-axes interface would be supported by the open-source Robot Operating System (ROS), the effort for system integration could be reduced dramatically. ROS is already adapted in several AGV/AMR projects based on CiA 402 compatible drives and motion controllers. There are also ROS modules available for radars and lidars (light detection and ranging). Both kinds of sensors are used in AGVs. Goetting (Velodyne), Pepperl + Fuchs (OMD-8000), and Sick (S100) offer 2D-lidar sensors. For inertial navigation systems, other CANopen

sensors could be also connected to the AGV/AMR host controller. A typical example is the HG G-84300 CANopen gyro sensor by Goetting. The company also offers the HG G-98630 two-dimensional magnet localization sensor, which comes with a CANopen interface. ◀

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AGV for the pharmaceutical industry

EK Robotics has supplied its CANopen-based X Move transport platform for an AGV used in the pharmaceutical industry. At the customer, the challenge in integrating the automated guided vehicle system (AGV) was to ensure an optimally timed material flow on sometimes narrow route areas and simultaneously integrate prioritized transports of refrigerated goods into the new automation process. EK Robotics has provided a solution based on its X Move series: in future, twelve mobile transport robots will take over the safe and efficient transportation of pallets with pharmaceuticals between the production areas in two-shift operation. Each of the adapted products is equipped with a roller conveyor, handles around 90 transports per hour, and is responsible for picking up and dropping off loads at 22 conveyor technology stations between the production and storage areas.

The partner, for whom EK Robotics is implementing the transport solution, is already familiar with an automated guided vehicle system from a market competitor, which previously handled the intralogistics processes involved in pharmaceutical production. The system will now be implemented step by step over several weekends by EK Robotics so that ongoing production and operations are not interrupted. "With the new AGV, our customer is able to prioritize important refrigerated transports that were previously carried out manually. The new system is also much more flexible with a higher number of vehicles than before and communicates directly with the SAP system," explained Ronald Kretschmer from EK Robotics. Initially, 13 transport robots were planned for this application, but with a material flow simulation, the AGV experts were able to reduce the ideal number of vehicles for the overall system from 13 to 12 X Move units during the project planning phase.

In Switzerland, the customer is a major pharmaceutical manufacturer and can look back on a century-long history in the pharmaceutical industry. The driverless transport system from EK Robotics enables the customer to link different production or logistics areas even more efficiently and is a key factor for sustainable profitability and site security. With 60 years of expertise, EK Robotics provides long-term support for intralogistics projects and offers a wide range of solutions for further customized automation processes. Software solutions for system optimization, expansion of existing automated guided vehicle systems, and their long-term spare parts supply are also part of the portfolio. hz



X Move 1200 transport platform is equipped with a roller conveyor with lateral load securing and transports pallets between 22 conveyor stations for the customer from the pharmaceutical industry (Source: EK Robotics)