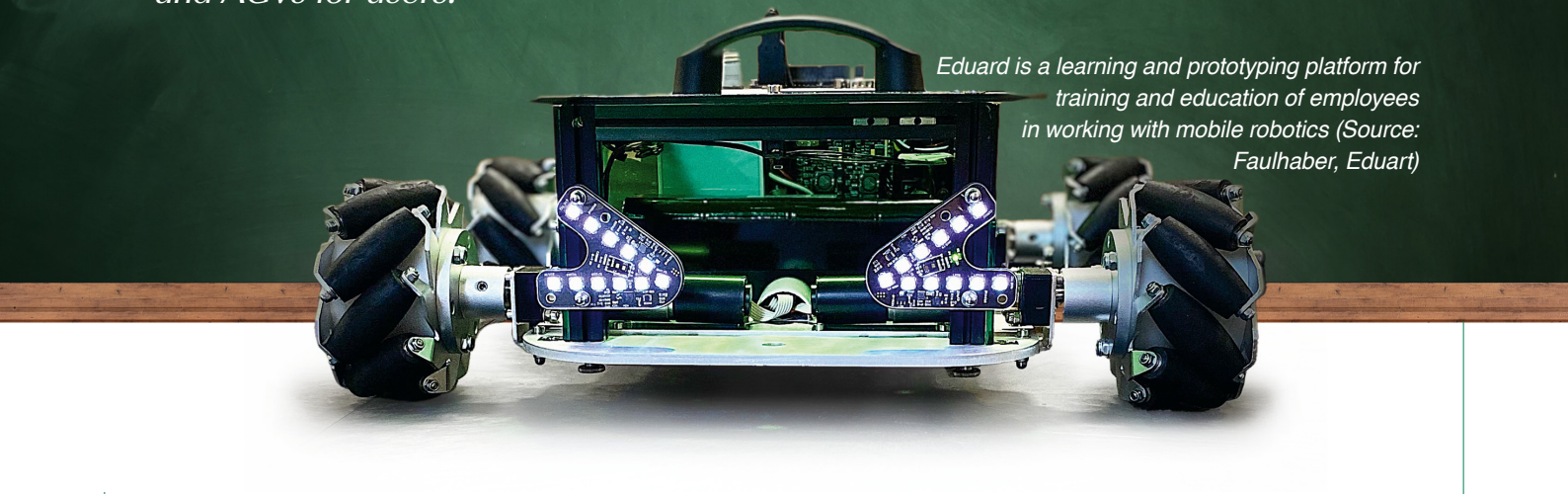
Learning platform for AMRs and AGVs

Autonomous mobile robots (AMRs) or automated guided vehicles (AGVs) become efficiency-increasing helpers in production transport and intralogistics applications. In many companies, the experience in working with these systems is still lacking. A robot learning platform from Faulhaber facilitates the entry into the world of AMRs and AGVs for users.



Eduard is a learning and prototyping platform for training and education of employees in working with mobile robotics (Source: Faulhaber, Eduart)

At the request of an industrial company, Eduart Robotik in Neunkirchen a. Sand (Germany) developed a learning and prototyping platform that can be used for the training and further education of employees in working with mobile robotics. In addition, the company provides a range of teaching and service offerings for testing and optimization.

Expandable robot learning platform

The robot learning platform called Eduard is approximately 40 cm x 40 cm x 15 cm large and weighs under 8 kg. The implemented sensor concept includes distance and inertial measurement devices as well as a battery management system. Access to the vehicle is possible via open interfaces.

Figure 1: The variant with Mecanum wheels allows the robot to turn on the spot as well as drive sideways or diagonally (Source: Faulhaber, Eduart)

Movement of the mobile robot is facilitated by either simple rubber wheels or Mecanum wheels. The latter allow the robot to turn on the spot as well as drive sideways or diagonally. It is thereby possible to navigate and precisely position even in very constrained spaces. The motors from Faulhaber are used with both wheel variants.

"These high-quality drives have proven to be ideal for our applications," confirms Markus Fenn, Managing Director of Eduart Robotik. Depending on the required speed or torque, gearheads with a gear ratio of 72:1 or 89:1 are available on the drive. Users themselves can expand the basic equipment of the robot learning platform or have it adapted by Eduart Robotik according to their needs. It is thereby possible to cost-effectively test new concepts, such as a diffe-rent sensor system.

Figure 2: Markus Fenn, Managing Director of Eduart Robotik (Source: Faulhaber, Eduart)

Drive technology

When selecting the drive systems, it was necessary to consider the future requirements of AGVs and AMRs. The chosen DC-micromotors with noble-metal commutation from Faulhaber deliver a high torque and high power-density in spite of their small dimensions. Moreover, they can be precisely controlled and are suitable for highly accurate control loops. For larger platforms, the robot manufacturers also used large DC-motors from the same provider. Depending on the application, these drives ▷

can be replaced by maintenance-free and long-lasting brushless DC-motors.

With the trend towards decreasing batch sizes and increasing numbers of variants, more robots will be needed for smaller loads, i.e., smaller robots with smaller but more powerful drives. Such autonomous industrial trucks have fewer electronics and smaller batteries, which means lower weight and decreased energy consumption.

The right choice for these and future solutions can be found in the wide selection range from Faulhaber. If the loads to be moved increase at any time, it is possible to scale up the required part of the drive unit.

Development and testing software

As a rule, it is not the hardware that is complex on AGV and AMR solutions, but rather the software. For example, good planning on the software side is important so that all mobile robots can work together seamlessly or to enable reliable fleet management. To do this, the robots need to "think" themselves, exchange information via standard interfaces and, if necessary, cooperate. The software needs only little information about the respective mobile robot. It has to calculate where the robot is located on the hall plan. The navigation, which is one of the few components that knows the dimensions of the robot, then searches for the appropriate path. In order to reach the required speed, the motor controller calculates the number of wheel revolutions required. Making this adjustment also requires only a few lines of program code or of a configuration file. Faulhaber supplies motors with high-precision gearheads and encoders for exact positioning, thus enabling optimum performance and safety. "Also important here were the corresponding interfaces to allow the drives to appropriately exchange information with the rest of the system," says Fenn. "Our communication takes place via a proprietary CAN-based protocol (at 500 kbit/s). We are currently switching to CAN FD due to the higher data rate and the wider bandwidth. We will also implement CANopen when the requirement calls for it."

The drive experts from Schönaich

Faulhaber is specialized in the development, production, and deployment of high-precision miniaturized and miniature drive systems, servo components, and drive electronics with up to 200 W of output power. This includes putting into effect customer-specific packaged solutions as well as an extensive range of standard products, such as brushless motors, DC-micromotors, encoders, and motion controllers. The devices are used worldwide in complex and demanding application areas, such as medical technology, factory automation, precision optics, telecommunications, aviation and aerospace, and robotics. From the 200-mNm (continuous torque) DC-motor to the filigree micro drive with an outer diameter of 1,9 mm, the company's standard range can be combined in more than 25 million different ways to create the suitable drive system for a particular application.

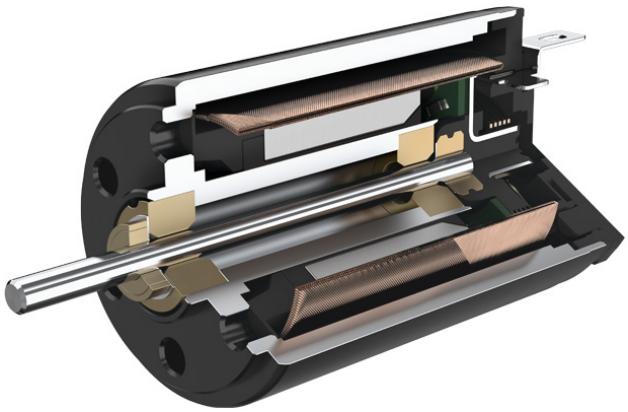


Figure 3: Eduard is driven by DC-micromotors with noble-metal commutation (Source: Faulhaber)

Safety aspects

Also important when using mobile robots is the topic safety, in terms of both security and safety. The latter can be achieved, e.g., with a motor controller that detects when one of the motors fails and the movement immediately stops as result. If a person enters the driving area, this is detected by the laser scanner. This causes braking of the system. The individual mobile robots communicate with each other via such networks as WLAN or 5G. Corresponding protection mechanisms were realized for the security reasons as well. Should a hacker attack nevertheless occur, it is important that no dangerous movements can be triggered on the robots as a result. For this purpose, the robots are equipped (among others) with a safety scanner including a distance sensor to prevent them from, e.g., running into the wall.

A look into future

The trend in the field of mobile robotics in the coming years goes to usage of several smaller vehicles instead of one large vehicle. Where, for example, four small robots work together on a transport task instead of one large robot, small motors that work very precisely are needed. The robot swarm will otherwise stumble or lose its synchronization. In order to improve reliability, encoders must be absolutely immune to interferences so that the robot is not influenced by external interferences. For this reason, Faulhaber sometimes uses two encoders on each motor. The requirements for mobile robots as well as the according drive solutions are continuously changing. As the drive company provides modularly structured drive solutions, the devices can be flexibly combined. In mathematical terms, some 25 million variants are possible from the combination of offered gearheads, encoders, controllers, etc., of which a considerable portion has already been implemented in the practice. This modular concept allows to cover the requirements of the future.

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