

Sensor solutions for the automated flow of goods

ASC sensor solutions enable the precise navigation and optimization of the driving dynamics of automated guided vehicles (AGVs). Whether in warehouses, factories or container ports, AGVs play a key role and are an integral part of automated operational processes. However, the vehicles must be able to navigate with high precision in order to find their destination quickly and safely. With high-precision sensors from ASC, exact positioning, flexible routing and optimum driving dynamics are guaranteed at all times.



How are driverless transport systems controlled?

The market for AGVs is growing steadily. According to the International Federation of Robotics (IFR), 111,000 AGVs were put into operation globally in 2018, rising to 176,000 in 2019. For the years following, the IFR forecasted an annual growth rate of around 60 percent. AGVs come in a wide variety of sizes and designs: They are used, for example, as tractors for transporting trailers as well as forklift trucks or pallet trucks for moving pallets in warehouses or containers in ports. They also move car bodies in the automotive industry from one manufacturing station to the next, transport components in aircraft production or heavy paper rolls in printing plants.

Many AGVs move along fixed routes. Routing can be carried out in several ways. A distinction is made between mechanical forced guidance, inductive forced guidance with an active guide wire or passive steel strip, and guidance via optical floor markings. These are established technologies and the components for equipping an AGV are simple and inexpensive. However, they offer little or no flexibility in terms of routing. Other disadvantages of rigid navigation include the high cost of implementing, adapting or repairing the guidance lines. The nature of the ground, too, must be taken into account and may not always be ideal for the long-term use of AGVs.

However, there is another type of driverless transport system: freely navigating AGVs. These vehicles no longer follow predetermined markings or grid points, but are guided by environmental features and navigated using lasers, radars or radio direction finding. This means the routing is as flexible as possible and can be

changed at short notice, if necessary. These vehicles are controlled either via special software on the respective AGV or a central computer.

Sensors make the use of AGVs possible

Every driverless transport system must be equipped with sensors to navigate reliably. "The more flexible routing becomes in terms of the degrees of freedom of movement, the more powerful the sensor system must be, as the requirements in terms of safety, detection of the environment and localization of the AGV become more complex, too," says DI Markus Nowack, application engineer at ASC. The company offers customized inertial sensor solutions for a broad range of diverse applications.

ASC Sensors develops and manufactures high-precision gyroscopes, accelerometers, tilt sensors and inertial measurement units (IMUs). As engineering, production and calibration all take place in Germany, the distances between development and production are very short. This has numerous advantages for customers: not only do they receive detailed, customized guidance, but also sensor solutions that are precisely tailored to their requirements.

Customized configuration guarantees optimum performance

All ASC sensors are manufactured according to a modular system, so that they are easily adapted and optimized for the respective application. IMUs, for example, are designed in a way so that gyroscopes and accelerometers can be integrated flexibly. However, not only does ASC modify its tried-and-tested sensors, but also develops completely new solutions on request. "We always coordinate closely with the customer," explains Nowack. "Our approach is based on their specifications, yet also on the nature and complexity of the application."

The compact ASC 271/273 gyroscopes and the ASC IMU 7 are particularly suitable for AGV systems. The uniaxial and triaxial gyroscopes capture rotational movements of the vehicles and are, therefore, particularly suitable for optimizing curve and turning speed. If linear components also need to be monitored – like when controlling driving behavior during acceleration and braking – the use of the ASC IMU 7 is recommended. Thanks to its six degrees of freedom, the localization/position monitoring of the AGV is ensured, in addition to controlling the driving dynamics.

Gyroscopes ensure safe transportation, high working speed and optimum route guidance

Low noise density ($0.02 \text{ }^\circ/\text{s}/\sqrt{\text{Hz}}$) and a low angular random walk ($0.2 \text{ }^\circ/\sqrt{\text{h}}$) as well as very good bias stability ($12 \text{ }^\circ/\text{h}$) enable the precise measurement of angular velocity. This allows for the optimization of the AGV's operation speed, to prevent cargo from slipping. ASC 271 (uniaxial) and ASC 273 (triaxial) series gyroscopes are responsible for the exact calibration of curve dynamics meeting application-specific requirements, with measuring ranges from $\pm 75 \text{ }^\circ/\text{s}$ to $\pm 900 \text{ }^\circ/\text{s}$ and a sensitivity of

13.2 to 1.1 mV/°/s. The sensors are based on MEMS vibrating ring elements made of silicon. Their micromechanical design minimizes the shocks and vibrations that occur during driving, so that the measured values are not distorted.

ASC gyroscopes determine, for example, the position of AGVs moving freight in container ports. As these AGVs are often equipped with an absolute positioning system already, determining rotation rate around the Z-axis with the uniaxial ASC 271 is sufficient for localizing their position. For three-dimensional orientation, ASC offers the triaxial version ASC 273.

The AGVs reach working speeds of up to 6 m/s (22 km/h), which is only feasible due to the excellent response behavior of the gyroscopes used. Their analog signal is sampled 50 times per second, processed by the electronics installed in the vehicle and transmitted as digital data to the AGV's on-board computer. The latter calculates a position value which is sent on to the control center. Based on this input, a central computer then determines the optimum route for each vehicle.

ASC sensors extend AGV applications

ASC IMUs are suitable for AGVs without integrated absolute positioning system. Their integrated gyroscopes and accelerometers enable precise route guidance. They are further ideal for bridging AGV navigation gaps when the radio or satellite signal is disrupted.

One example are straddle carriers that stack containers delivered by AGVs. They are usually controlled through Global Navigation Satellite System (GNSS). To date, these special vehicles could not operate in the vicinity of ship-to-shore cranes on the quay, as the cranes' steel constructions would compromise the satellite signals. With IMUs from ASC, however, temporary losses of the GNSS signal can be compensated and the working range of straddle carriers and pallet trucks significantly extended.

The ASC IMU 8 easily achieves the required positioning accuracy of ± 0.5 m over 200 m. Its tactical grade performance and outstanding long-term stability ensure reliable real-time monitoring and control of position changes in all six degrees of freedom, with maximum reproducibility. It is based on three gyroscopes, characterized by high bias stability (< 0.1 °/h) and excellent angular random walk (< 0.01 °/√h).

In addition, the ASC IMU 8 features three accelerometers of excellent bias stability during operation (3 to 45 μ g), depending on the measuring range from ± 2 g to ± 30 g. ASC sensor solutions, therefore, can play a crucial role in the further development of freight, warehouse and transport logistics, contributing essentially to the rapid, efficient, productive and sustainable flow of goods.

Mehr erfahren: <https://www.asc-sensors.de/en/sensor-portfolio>