Under the name TCS (Traffic Control System), SIGMATEK is introducing a **vehicle manufacturer-independent fleet management system for AGV systems** that with open standard protocols such as VDA 5050, MQTT, JSON, UDP and TC/IP, can connect anywhere. Images: SIGMATEK

THE MOBILE ROBOT AS PATHFINDER

Real-time Software SlamLoc for AGVs and AMRs Revolutionizes Intralogistics. At the SPS 2022, SIGMATEK introduced hardware-independent software products for the automation of Intralogistics. TCS (Traffic Control System) enables the integration of autonomous mobile robots (AMR), regardless of their brand, into common automated guided vehicle systems as well as their connection to the surrounding IT and automation systems. The real-time navigation software SlamLoc revolutionizes how AMRs handle environment changes with during cont-our-based navigation. Together, both give AGVs top scores in terms of flexibility, reliability, and efficiency.

By Ing. Peter Kemptner, x-technik

The so-called digital transformation can only deliver the desired results with complete automation of the production system. In addition to the machines themselves, this must also include the robots and handling devices, as well as the entire conveyor technology.

Automate Intralogistics

Key roles in making production processes more flexible in implementing adaptive manufacturing strategies are played by automated guided transport systems (AVGs) and autonomous mobile robots (AMRs). Since they can very easily be adapted to changed requirements, processes and transport routes, AVGs and AMRs are increasingly replacing static installations that were common in the past.

SIGMATEK SlamLoc is optimized for operation in 64-bit industrial pc and is also provided by SIGMATEK **as a bundle, including the hardware with WLAN connection** (below).

In this way, they form one of the foundations for the self-optimizing production processes of Industry 4.0. The range of available products reaches from fully autonomously navigating single vehicles to closed systems. SIGMATEK counts several AVG and AMR manufacturers among its customers. They use products from the Austrian provider of innovative automation systems primarily in the board control, safety and drive technology of their vehicles. Above all, they appreciate the combination of extremely small dimensions, high energy efficiency and uncompromised industrial suitability. The vehicles are mostly controlled using proprietary software systems from their manufacturer or via individual programming.

Reach Your Destination with Vehicle Independence

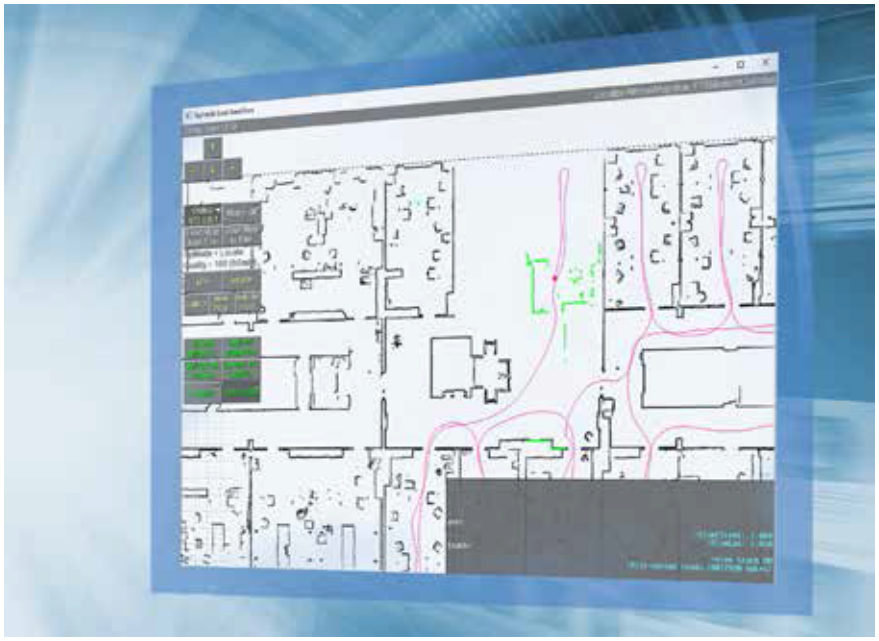
At the SPS 2022, SIGMATEK introduced hardware-independent software products for the automation of Intralogistics. One of them is the open AGV fleet management system TCS (Traffic Control System), which uses the standardized VDA 5050 interface for communication between the vehicle and master control. TCS thereby enables the integration of autonomous mobile robots (AMR) and AGVs, regardless of their brand, into common driverless transport systems as well as their connection to the surrounding IT- and automation systems. An article with detailed information on the manufacturer-independent master control can be seen in AUTOMATION 1/2022.

Limits of Navigational Freedom

Automated guided vehicles (AGV) perform their navigation tasks on-board. Thereby, they mostly follow defined routes that are often derived from transport orders in fleet management systems. The vehicles continually check the route using various navigation methods.

Thereby, contour-based laser navigation is increasingly implemented, which can operate without artificial landmarks. It also uses 2D laser scanners, which can be mounted at different heights and are required for the safety of the vehicle, to scan the surroundings and use familiar contours to determine their own position. Ideally, the scanners are mounted so that static features remain detectable.

Production- and storage halls, such as shipping and receiving areas, however, are not static landscapes with fixed contours. Not only are the hall plans often inaccurate or incomplete. Full shelving or pallets are an additional hurdle, which often blocks the view of the wall behind them. Even if transport racks are positioned differently than before, contour-based navigation reaches its limits.



SIGMATEK SlamClient is used for the **initial start-up, simulation and visualizing the navigation, as well as managing and processing maps.**

Continuous Adaptation to Reality

The SLAM (simultaneous localization and mapping) navigation method promises a solution. During the process, AMRs record the surrounding features while navigating and create the map dynamically.

"A chicken-egg problem thereby arises: To create the map, the vehicle needs perfect localization. For the localization, it needs the map", explains Otto Koller, Team Leader for image processing systems at SIGMATEK. "Both processes must therefore occur simultaneously, i.e., at the same time and interlaced.

Revolutionary AMR Navigation

Of course, there are already automated guided vehicles that navigate using SLAM. The subject matter is a huge challenge, both mathematically and software-wise, to which not every AMR manufacturer can rise. For this reason, there are considerable differences in the implementation quality of existing solutions.

As with TCS, SIGMATEK recognized a need for an open SLAM solution, which manufacturers could easily integrate into their AMR – regardless of the control technology used. The ambitious goal was to create a system that is operational in just a few minutes, does not need preinstalled plans and even with drastic contour changes, determines a position accurate to ±10 mm and ±1 ° in real time. At the same time, the software must have low hardware resource demands. After all, the box-PC on which the SLAM navigation runs cannot use too much space or power.

Precise Determination of a Vehicles Position

The SIGMATEK SlamLoc real-time localization software revolutionizes how AMRs handle environment changes using contour-based navigation. SlamLoc creates the map of the environment as a basis for route planning during the initial teaching cycle. If a "foreign body" is detected while traveling, it is taken into account and used to determine its position. The position pose, i.e. the X/Y coordinates, as well as the direction in which the vehicle is oriented, can thereby be determined much more accurately as would be possible by simply extrapolating using the drive data.

"This has nothing to do with stopping before an unexpected obstacle. That is handled by the safety system in the vehicle without the vehicle- or master control having to intervene", clarifies Otto Koller. "Likewise, avoiding or driving around a new object is not performed by SlamLoc, but a suitable guidance control system such as TCS and the on-board control system in the vehicle."

Based on the SLAM data, however, the AMR can react immediately and using the new conditions, determine the best possible route. This way, SlamLoc provides the controlling systems and thereby the vehicles, with the ability to move around obstacles or take alternative routes.

> With SIGMATEK SlamLoc, automated guided vehicles can dynamically redetect the variable position of shelving and pallets with each pass. It is now thereby possible for the first time to integrate buffer zones, goods receiving or shipping with SlamLoc into a system of AGVs.

Otto Koller, Head of Image Processing Systems at Sigmatek GmbH & Co KG

A Flashlight for AMR

"SlamLoc allows mobile robots uncompromisingly precise contour-based navigation, even when for example, the contours are blocked from view by full shelving or pallets", explains Otto Koller, who has led the two-year development project. „It's like a flashlight that shows details to a night hiker, which a map and compass alone cannot provide.

Just like the trees and bushes in the beam of the flashlight, temporary, potentially movable objects slowly come into view when approached and disappear just as slowly after passing. Normally, they are not added to the static card. "That would be dangerous, as errors could add up over time and thereby confuse the localization", explains Otto Koller. "If major permanent changes are made, a new teaching sequence in the affected area is recommended."

Complete Freedom for Variable Environments

In addition, authorized users can edit individual sections of the map created by the vehicle and manually remove features. In this way, it is possible to create completely variable areas by simply leaving things like the walls or ramps as fixed points in the plan. The vehicle then newly detects the variable position of shelving and pallets dynamically each time it passes by. By deliberately avoiding the use of familiar contours, it is now possible for the first time to integrate buffer zones, goods receiving or shipping with SlamLoc into an automated guided vehicle system.

"To record and process the resulting information into a valid image of the surroundings in real time is one of the biggest challenges of my 30-year career at SIGMATEK", says Otto Koller. "It was only possible thanks to the cooperation of a very diverse team, both professionally and personally."

Fast, Light and Suited for Industry

SlamLoc is designed so that when restarted, no complex initialization is required. The vehicles immediately begin determining their position and direction after turning on. The light structure of the software also helps with the quick start. This is installed directly into the vehicle and does not require time-consuming initialization of data bank systems or libraries. Data is exchanged with the surrounding systems via TCP/IP.

SlamLoc is available as a pure software solution or preinstalled into a robust, industrial-grade box-PC suited for use in vehicles. This communicates with fleet management systems such as TCS via WLAN. The optional "SlamClient" enables the visualization of the actual vehicle movements and dynamic mapping, as well as editing.

With TCS and SlamLoc, SIGMATEK provides new and innovative solution approaches for automating intralogistics. These allow more flexibility and efficiency, and at the same time, increase the precision and reliability of automated guided vehicle systems.