



Alexander Melkus

## Fork without a Truck

Concepts like driverless fork systems are designed to help optimize transport and storage logistics processes. The requirements for the automation technology integrated in such systems are enormous: In addition to complex control technology, guaranteeing data security as well as different data exchange media must be brought together „under one roof“ in real time.

In every industry, Euro-pallets are the most widely used product handling and transport equipment today. The supply and removal is mainly handled with manually operated pallet trucks or forklift trucks. With the goal of increasing automation in logistics and thereby reducing costs, the Böblinger industrial solution provider Eisenmann developed a new concept – the so-called „LogiMover“. The new automated guided vehicle consists of two autonomous parallel tines,

which have no physical connection. These move under the Europallets automatically, lift it off the floor and accelerate, depending on the path, at up to  $0.3 \text{ m/s}^2$ . The optical track guiding system in the tines follows linear floor markings, such as commercial adhesive tape.

The lanes can be installed, changed or removed quickly and easily. Later installation in an existing logistics facility is possible at any time and without structural changes, as is required with induc-

tion loops. With a net weight of less than 60 kg, the transport system can carry loads up to one ton with the rotational motion of the four drive units with a speed of 1 m/s. Each tine has two drive units, with which they move, steer and lift. The drive axes can move freely in all directions, which makes the system extremely agile and able to maneuver in narrow lanes.

The pallets can also be placed closer together, so significantly less space is needed for transportation areas and maneuvering. Since there is no mechanical connection between the two single tines, they can also pass under several pallets. Pallets in the back of a storage area for example, can be reached without any rearrangement. For complex transport and logistics tasks, several tine pairs can be used at the same time.

Through the E-MES or storage logistics management system, motion tasks and

(Image: Eisenmann / Sigmatek)

optimal routes are coordinated, as well as the flow of material controlled.

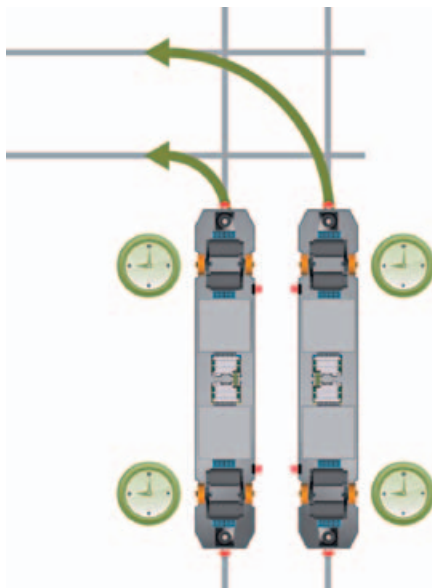
An essential corner stone of such modular concepts is a consistent, flexible network – from sensors and actuators to the management level or cloud.

### Control and Regulation in Tight Spaces

The automation technology in Eisenmann's new automated guided vehicle was developed in cooperation with Sigmatek and based on the control and I/O system S-DIAS. Each LogiMover tine contains its own controller and I/O unit. Due to the dimensions of the tines – 1180 mm length, 210 mm width and 90 height – an extremely compact construction was required to modularly install the system in such a tight space. Since Safety is also a part of the S-DIAS system, Safety technology can be seamlessly integrated into the standard system. In the LogiMover tines, different Safety as well as standard modules were

combined. The connection of the IrDA transceiver, which is essential for the communication between the tines, is also included. This complete integration ultimately results in response times for signal processing within the range of a few milliseconds. With the LogiMover, Safety in combination with collision protection, is extremely im-

portant since safe and automated transport should take place among traffic from personnel and other conveyor vehicles. This requires a concept with coordinated Safety components, which can detect a person in the danger zone for example. Currently, there are no monitoring methods available on the market with laser scanners, which



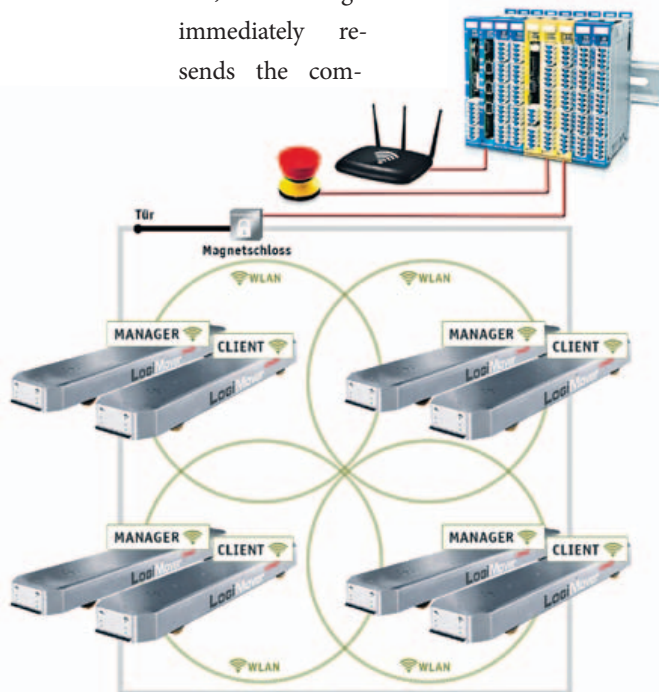
#### Synchronized motion:

**The tines communicate wirelessly and pair themselves automatically. One tine assumes the master function and synchronizes the slave tine in the millisecond range.**

– due to the limited space in the tines – could perform these tasks. For this reason, Sigmatek takes a different approach to the solution for avoiding collisions in which special cameras are used. This model is currently undergoing TÜV validation. The S-DIAS Safety system is already TÜV certified and fulfills SIL 3 in compliance with IEC 62061 and EN ISO 13849-1, category 4 PL e.

### Communication from the Tines to the Management Level

All components – i.e. the control and I/O system including Safety, the motor controllers, drives as well as cameras – are integrated into a closed circuit in the tine. Both standard as well as Safety communication with the driverless transport system is made via the real-time capable Ethernet bus system VARAN, which sends packet-oriented data with seamless confirmation. The client immediately responds to each command from the manager. If after a defined timeout, a command receives no answer, the manager immediately re-sends the com-



**The tines communicate with the head station wirelessly with 2.4 or 5 GHz via WLAN. If an emergency stop command is sent, a central emergency stop is broadcast through the Safety control in the head station to all tines.**

mand (Retry). This means that at the end of the bus cycle, the data is always valid and consistent. The same physics is also applied to connect the head station with the tines via WLAN. This guarantees high data security, since the protocols are uniform. Through the redundancy of the total system, communication with the main computer is secured. The fail-safe stability, functional reliability and operational safety are significantly increased. For communication between the safety components, the „Black-Channel“ principle is used, hereby the bus does not assume any safety-relevant tasks but serves only as a data exchange medium. The Safety protocol is thereby embedded in the standard VARAN frame. In the VARAN Safety telegram, the data and addresses are encoded twice and saved with a check sum (CRC) and a timestamp. The header control with integrated Safety control regulates the tines in hard real time. From here, synchronous motion, controlled cornering, real-time monitoring of motor currents, obstacle monitoring and synchronization of the motors are controlled. Obstacle monitoring plays an especially important role in ensuring that the operating areas are clear and none of the chassis components are blocked. For this reason, the motor currents of the tines are permanently recorded and analyzed. Preventative maintenance is performed on the carriage at the same time. In the next stage of development, moving in trains is planned. The tine control then regulates the distance by measuring the distance to the preceding tine and depending on the load and speed, increase or shortens the distances accordingly. The generated position data is sent to the head station via WLAN. In the future, common storage and collection of pallets in storage blocks will be possible.



**The twin tines of the LogiMover fit exactly under a Euro-pallet, lift it and automatically transport it to the desired location.**

The twin tines communicate via VARAN OL (Optical Link) and IrDA (Infrared Data Association), by which a manager/client relationship is formed between the two tines. The manager tine takes over the lead role and continuously synchronizes the client in the millisecond range. The twin tines move in parallel and synchronously in any situation. As previously mentioned, the two tines communicate with the central S-DIAS head station over VARAN wireless via WLAN in a frequency range of 2.4 or 5 GHz. If an emergency stop command is sent, a central emergency stop is broadcast through the Safety control in the head station to all tines.

Data communication with the guidance system is enabled via the TCP/IP WLAN interface. Here, the fork system is managed, right-of-way regulated and task distribution handled. The TCP/IP integration of VARAN allows the participants to be integrated into a cloud. The LogiMover can also be operated manually using any commercial WLAN tablet or mobile panel from Sigmatek. The possible applications for this transport concept are many and range from material receiving or removal for machines to supply of storage areas to demanding commissioning tasks and applications in supermarkets. At the Logimat 2014 industry trade show, the system was awarded best product in the category “Procure, Move and Store“.

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