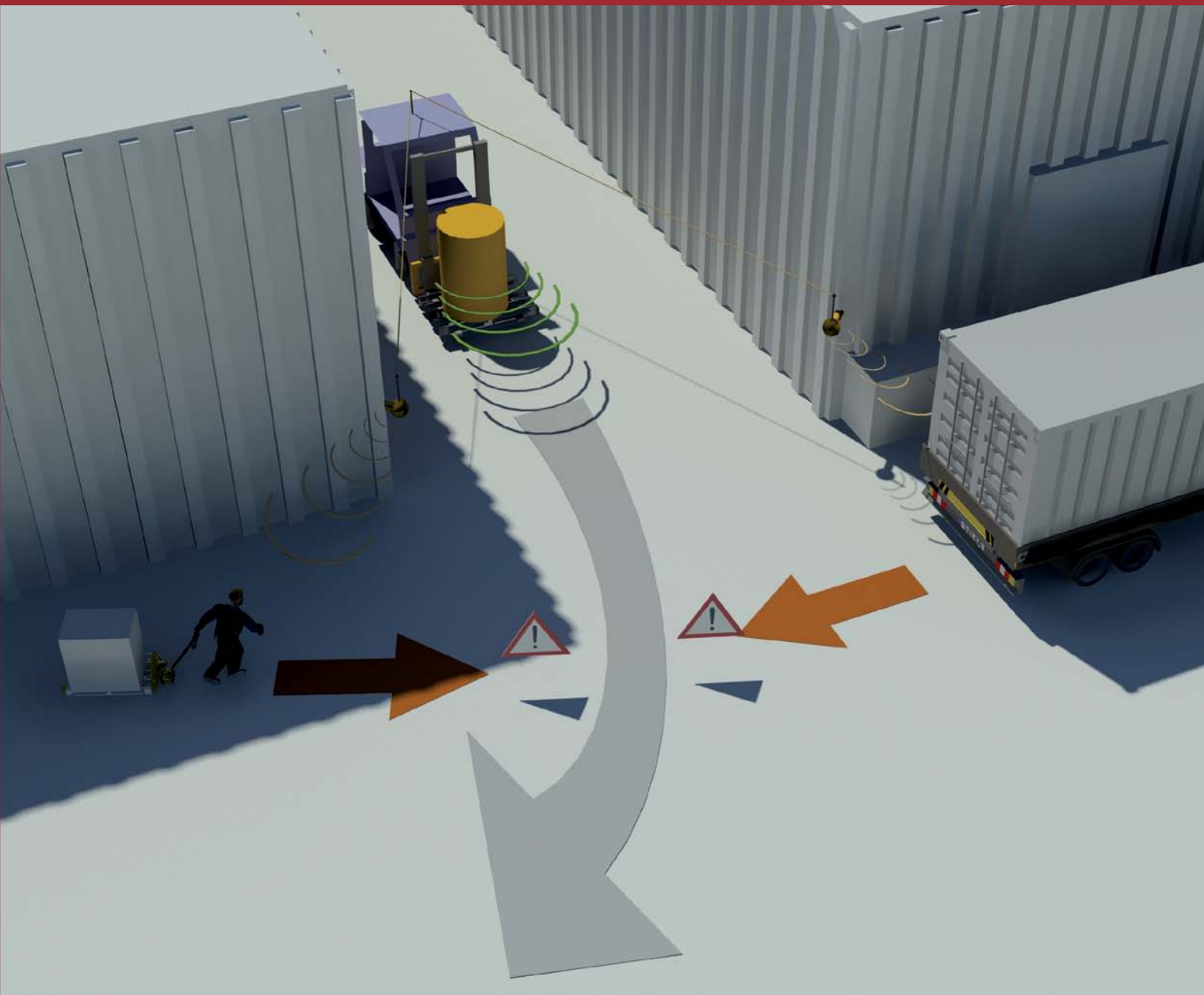


# SALSA – SAFE AUTONOMOUS LOGISTICS AND TRANSPORTATION VEHICLES IN OUTDOOR AREAS





# SALSA – Safe Autonomous Logistics and Transportation Vehicles in Outdoor Areas

## Situation

Up to now, automated guided vehicles demand a clear decision between a high degree of efficiency and safety in dealing with the environment, especially people. Current automated guided vehicles are equipped with collision avoidance systems like bumpers or safety laser range finders and operate at low velocity. For a higher economic attractiveness and higher efficiency, these vehicles must drive faster and have to be safe at the same time.

## The Answer: SaLSA

Automated/Autonomous and accident-free – The collaborative research project SaLSA is aiming at safe autonomous transport vehicles in outdoor applications. AGVs at a snail's pace are history. (AGVs at a snail's pace are obsolete). For the last decades AGVs optimized material flow in production areas – for safety reasons at only walking speed. In other application fields, e.g. agriculture or automotive industry only support systems, like the well-known ABS, are applied. Soon, AGVs are about to cover long distances at significantly high speeds. During the project SaLSA new automated vehicles are developed which, for the first time, share the same area with standard fork lift carriers, lorries and people in a safe and adequately fast manner. This joint project is a collaboration between Götting

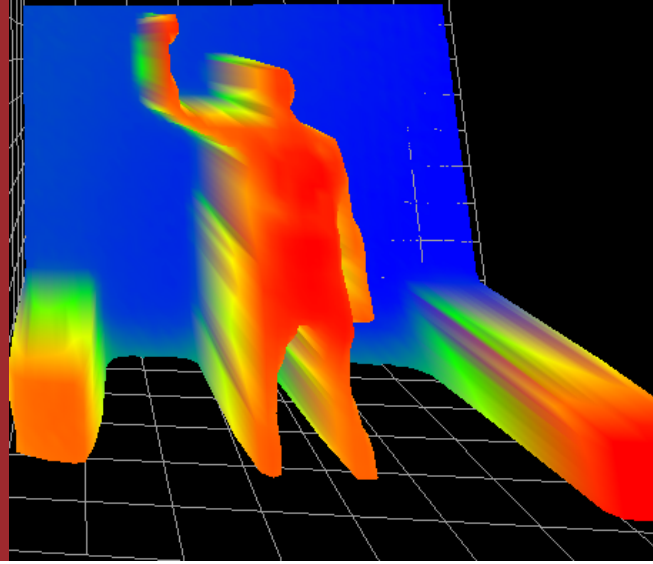
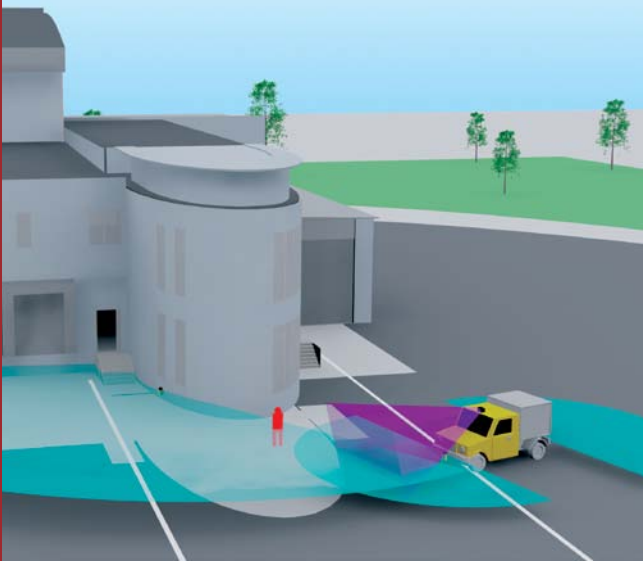
KG, InnoTec DATA GmbH & Co. KG, ifm electronic GmbH, the Institute for Information Technology OFFIS e.V. and the Fraunhofer Institute for Material Flow and Logistics.

## Safe Environment Capture

The technical challenge of the project lies within the fusion of the sensor data of the involved vehicles, stationary sensors as well as other sources information, e.g. geographical data and process information. Additionally, the development of novel sensors and safe sensor data evaluation for outdoor application is also a part of the project. All acquired data will be fused to a holistic environment model by the assistance of especially developed algorithms. By the use of predictive techniques this model becomes a real-time planning tool for all possible actions of present objects – thus, AGVs use this data for their own path planning. Hence, a safer, faster and more efficient path can be determined. Besides technology, other aspects especially legal terms (risk of liability) for this scenario are addressed.

## Contribution to the safe Photonic Mixer Device Camera

The elaboration of a concept for the further development of PMD sensors for safe environment capture for autonomous transport vehicles is also a component of project SaLSA.



Compared to conventional safety sensors, PMD cameras offer a significant cost advantage and allow coverage of a three-dimensional working space. In this context the cooperation with Institution for Statutory Accident Insurance and Prevention and ifm electronics will point out weak points of the PMD camera as a safety sensor and will systematically compensate these by the help of appropriate methods. In this manner robust methods for the development of a safety PMD camera are chosen based on tests of plausibility and multiple data evaluation. The most appropriate methods are being evaluated. At the end of the project, the reliability of the safe environment capture and sensor fusion results will be depicted in a technology demonstrator.

### **Simulation and Safety Analysis**

Beforehand the application is tested in a newly developed simulation, in a way that in the most earliest stage/phase the number and position of sensors for a safe and efficient transport can be determined. In this test environment, AGVs including their autonomous behaviour, path and speed control are realised. An interface to higher level warehouse management systems is also implemented – the whole system can be virtually started up directly after the planning phase. All sensors like light barriers, motion sensors, CCD cameras, ultra sonic sensors, laser range finders and 3D cameras are

simulated with all consisting measurement errors. Subsequently, the simulated data allows safety analysis. It contains a complex evaluation of reliability of the sensor data, vehicle velocity, the environment and a prediction of all human and non-automated participants.

### **Application scenarios**

The project SaLSA presents more efficiency for material flow to applicants of numerous industrial sectors. Possible fields of application are the entire branch of production, logistics hubs or airports. In particular, the main focus is on applicability of the safe outdoor environment capture – under all weather conditions. The project started in 2009 and will be finished in the first quarter 2013.

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