

**Fraunhofer Institute for Transportation  
and Infrastructure Systems IVI**

Director: Prof. Dr. Matthias Klingner  
Zeunerstrasse 38 | 01069 Dresden  
Phone +49 351 4640-800

[www.ivi.fraunhofer.de/en](http://www.ivi.fraunhofer.de/en)

**CONTACT**



**FRAUNHOFER INSTITUTE FOR TRANSPORTATION  
AND INFRASTRUCTURE SYSTEMS IVI**

**AUTONOMOUS  
COMMERCIAL VEHICLES**  
TECHNOLOGIES FOR THE MOBILITY OF THE FUTURE

**Fraunhofer Institute for Transportation  
and Infrastructure Systems IVI**

Dr. Sebastian Wagner  
Group Leader »Vehicle Control and Sensor Systems«  
Zeunerstrasse 38 | 01069 Dresden  
Phone +49 351 4640-669  
[sebastian.wagner@ivi.fraunhofer.de](mailto:sebastian.wagner@ivi.fraunhofer.de)

[www.autotruck-projekt.de](http://www.autotruck-projekt.de)

Elke Sähn  
Group Leader »Communication and Design«  
Zeunerstrasse 38 | 01069 Dresden  
Phone +49 351 4640-612  
[presse@ivi.fraunhofer.de](mailto:presse@ivi.fraunhofer.de)

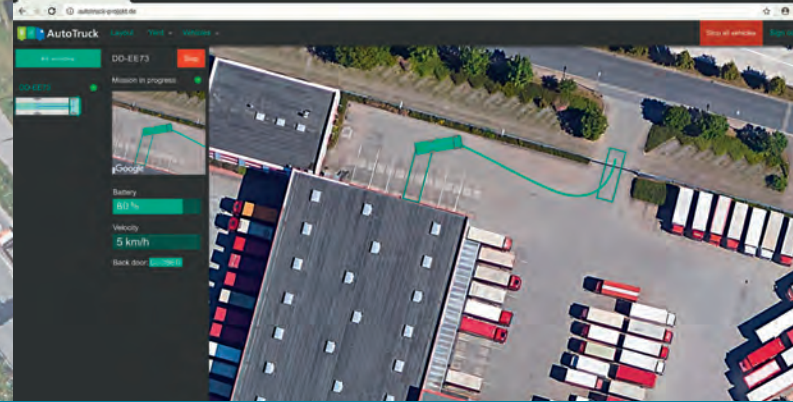
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# THE AUTONOMOUS FUTURE



TruckTrix® – digital visualization of a critical narrow



helyOS – Online Yard Operating System



AutoTruck – e-truck with steer-by-wire and drive-by-wire system

Countless experts are currently working on projects in the field of automated driving, which has gained much importance in recent years. Before the first fully-automated production vehicles are able to drive on public roads, however, there are still many technical challenges to be met.

The automation of commercial vehicles in gated areas is an ideal migration path in this regard. There are numerous application fields, including ports, factory premises, logistics centers, (open-cast) mines as well as agriculture. The economic interest in suitable solutions is extremely high as new lucrative business models are evolving.

Key technologies are needed for these application fields. With TruckTrix® and helyOS, the Fraunhofer IVI is developing solutions to tackle these challenges. The insights gained in the process might also be used for autonomous driving on public roads in the future. The advantage of gated areas is that developments can be transferred into regular operation faster – especially with regard to legal regulations.

## »TruckTrix®« – ONLINE MANEUVER PLANNING

The TruckTrix® algorithm, developed at the Fraunhofer IVI, automatically determines maneuvers that enable vehicles to reach a certain destination. The basis for this are digital maps which contain trafficable areas and obstacles.

In contrast to conventional methods, TruckTrix® can also plan routes for multi-unit vehicles – including maneuver operations, if necessary. The maneuver calculation considers the following factors:

- vehicle geometry,
- vehicle kinematics,
- trafficable areas and obstacles.

Thus, the maneuvers are always collision-free and actually manageable for the vehicle.

The TruckTrix® algorithm has been implemented as a web service and is available online at all times. TruckTrix® is already in active use – the online platform [www.HeavyGoods.net](http://www.HeavyGoods.net) automatically evaluates whether heavy haulages will be able to pass critical narrows.

## »helyOS« – ONLINE CONTROL CENTER

HelyOS (highly efficient online yard Operating System) is a control center for gated areas and is based on up-to-date web technologies. It connects the autonomous vehicles and uses a browser-based user interface. With this, the user can:

- control the gated area,
- provide missions for vehicles and
- request status information from the vehicles.

The system is designed to be used both locally or via the internet. Therefore, the vehicles can also be monitored and controlled in remote logistics centers using a browser.

In the connected gated areas, the vehicles communicate with each other and with external sensors. Stationary cameras, for instance, monitor areas which are difficult to observe.

The TruckTrix® algorithm is also a key technology for this application. HelyOS calculates suitable routes and synchronizes them. Thus, collisions are avoided and the users are able to coordinate several autonomous vehicles at the same time.

## EQUIPMENT

The routes that are calculated by TruckTrix® can be visualized using DriveLab – a demonstrator developed especially for this purpose. Maps, combined with the proposed route, are projected on the floor. Model vehicles operate on these maps.

For the testing of positioning and sensor systems as well as for driving tests, the Fraunhofer IVI has its own test track located directly on institute premises.

A fully-licensed 18-ton e-truck with integrated drive-by-wire and steer-by-wire system (AutoTruck) offers the possibility to test many technologies, such as

- positioning and navigation,
- collision avoidance,
- car2infrastructure communication,
- real-time maneuver planning,
- cooperative driving and
- high-precision driving (e.g. docking).

The infrastructure at the Fraunhofer IVI is available for future research and development projects or studies.