



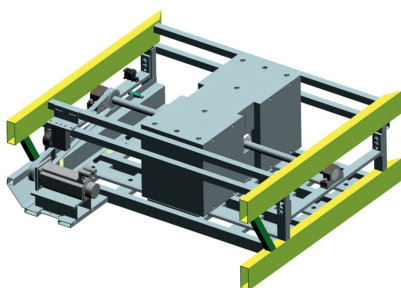
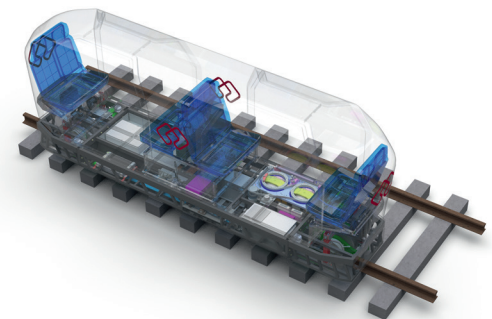
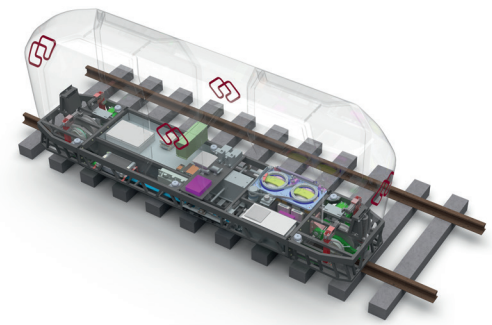
# THE MONOCAB

Technical Leaflet – Project MONOCAB  
[www.monocab-system.com](http://www.monocab-system.com)

**Abstract –** The MONOCAB is a compact, autonomous monorail vehicle. In contrast to other so-called „monorail“ vehicles, it stabilizes itself on a single conventional rail without mechanical support. A narrow vehicle body allows a simultaneous operation in both directions on single-track lines. Therefore, MONOCABs can be used to implement very innovative rail-based mobility concepts with „Service-on-Demand“ as an attractive alternative to conventional solutions, especially for reactivating disused railway lines in rural areas.

## INTRODUCTION

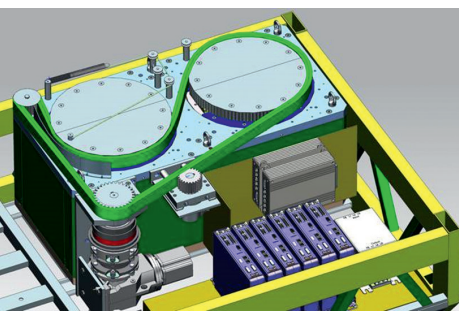
The MONOCAB project was initiated to develop an innovative vehicle concept for sustainable mobility in rural areas. Currently, there are few attractive, effective, and ecologically or economically viable alternatives to private cars in sparsely populated regions. Reactivating disused railway lines is a sensible solution as the infrastructure already exists. Flexible rail-based mobility concepts with „on-Demand“ services on these lines could connect to transport hubs in medium-sized centers, forming the backbone of a future multimodal mobility system.



## STABILISATION

The basic technical feasibility of monorail vehicles is out of question, since a first vehicle was already realized and successfully tested in 1906 by Louis Brennan, [1]. The vehicle's stabilization system [2] consists of two control moment gyroscopes, each weighing 250 kg, which rotate at 4800 revolutions per minute. These gyroscopes are implemented as a dual-gyro system with opposite rotational and precessional movements to prevent unwanted torques while driving through curved tracks. This is supplemented by a trim mass, approximately 600 kg, that can be shifted laterally.

While control moment gyroscopes are used to compensate transient disturbances (e.g. wind gusts, track irregularities), the trim mass is required to compensate stationary imbalances (e.g. uneven loading). The stabilization system requires a control device for compensating disturbances and achieving a desired inclined position in curves. The control uses an inertial measurement unit (IMU) sensor to estimate the roll angle of the vehicle. Such sensors can be also found in smartphones, drones, navigation systems, and wearable technology.



# AUTONOMOUS OPERATION

A core feature of the MONOCAB is its ability to operate autonomously without the need for human intervention. Automated Train Operation (ATO) is critical to ensuring the safe and efficient function of the MONOCAB, especially in scenarios where it must share tracks with other vehicles or operate in high-density environments, [3].

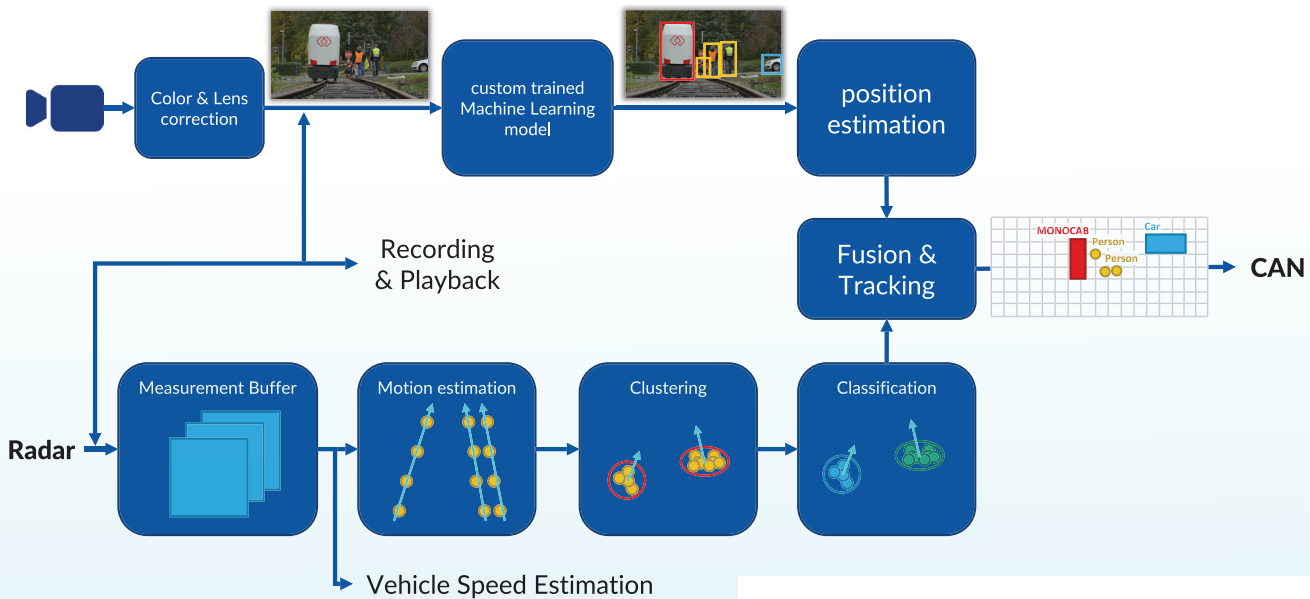
The ATO system detects other traffic participants, responds to obstacles, and independently controls braking and acceleration processes. Current research focuses on the fusion of multiple sensor systems to ensure reliable and robust environment perception even under poor visibility conditions.

Currently, the MONOCAB uses a perception system that processes radar and camera data through a dedicated software pipeline. This includes sensor correction, alignment, and fusion, followed by real-time object detection and motion estimation using a custom-trained machine learning model.

For safe operation and effective fleet management, the vehicle is also equipped with a multifunctional communication system. This enables vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, remote control via an external control center, and coordination within a MONOCAB fleet. Ongoing research is investigating the use of 5G technology, particularly with regard to low-latency, real-time data transmission [4].

# VEHICLE DESIGN

The vehicle is compact and specifically designed for operation on single-track lines with standard gauge (1435 mm). The MONOCAB has a total width of 120 cm, with 50 cm located within the track area and 70 cm extending beyond it. This asymmetrical geometry requires a carefully considered placement of components to ensure static balance. All technical subsystems are housed within a 40 cm high compartment beneath the passenger cabin. Heavy components such as the gyroscopes, battery and drive system are deliberately positioned on the narrower side of the vehicle to lower the center of gravity and enhance overall stability.



## REFERENCES

- [1] <http://www.catskillarchive.com/rrextra/odgyro.html>
- [2] Griese, Martin, et al. „HIL simulation of a self-stabilizing monorail vehicle.“ IECON 2022–48th Annual Conference of the IEEE Industrial Electronics Society, IEEE, 2022.
- [3] Tagiew, Rustam, et al. „Sensor system for development of perception systems for ATO.“ Discover Artificial Intelligence 3.1 [2023].
- [4] Bröring, Andre, et al. „A communication concept using 5G for the automated driving monorail vehicle MONOCAB.“ KOMMUNIKATION IN DER AUTOMATION [2023].

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