DREAM

DRIVING AIDS POWERED BY E-GNSS AI AND MACHINE LEARNING

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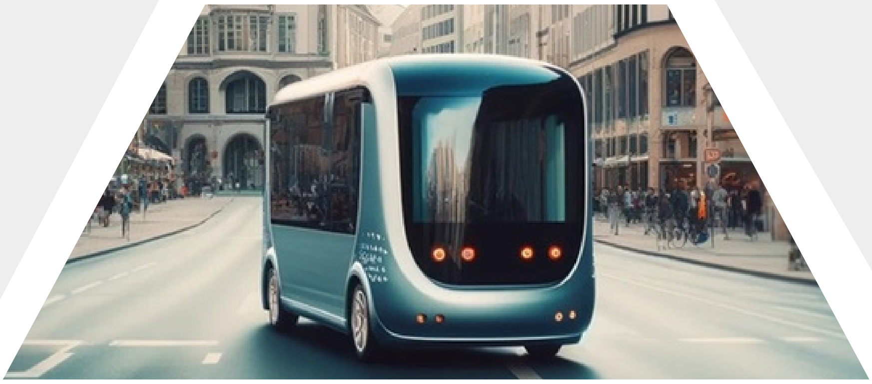


1. Project Status

As planned in the project roadmap, we are now finalizing both the software and hardware development activities and are steadily approaching the Test Readiness Review (TRR) milestone. This marks a significant step forward, as the TRR will confirm that the developed product is ready to transition into the testing phase.

The milestone is scheduled for November 6, and will validate that the different algorithms and AI-based solutions are prepared to undergo extensive testing in a wide variety of scenarios.

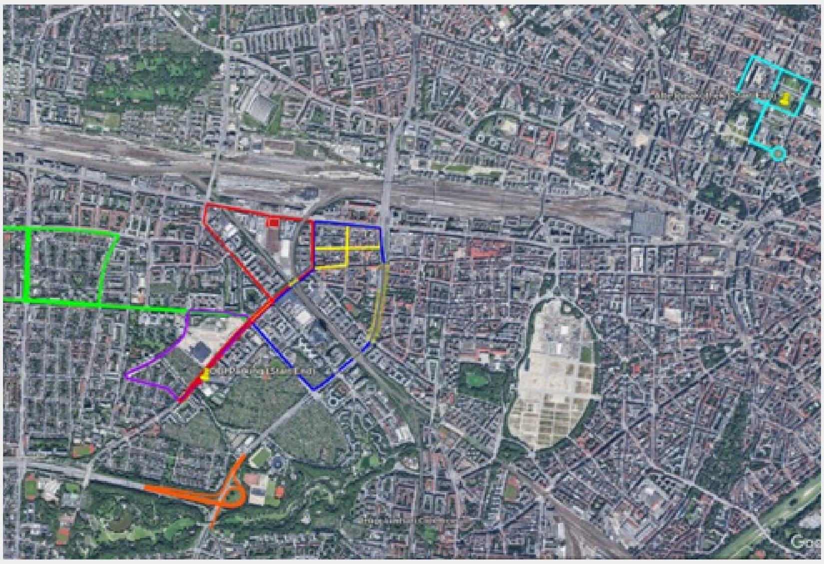
Following the TRR, the project will move into its next stage: system-level evaluation in real-world conditions. This phase will include end-to-end testing on board a bus, with a particular emphasis on the driving assistance features developed within the project. This includes Red Light Violation Warning, Curve Speed Warning, Collision Avoidance, and Wrong-Way Driving aids.

2. Verification Campaign

The system has been installed on one of our dedicated test vehicles, which serves as a platform for validating multi-sensor fusion and AI-based localization algorithms. The complete sensor configuration is illustrated in Figure 1.

The validation campaign was conducted in an urban environment in the city of Munich. Multiple scenarios have been recorded, includes segments of wide streets with open visibility. These sections provide suitable conditions for assessing baseline system performance. In contrast, the trajectories also covers narrow streets surrounded by high buildings and dense vegetation, creating challenging multipath and non-line-of-sight conditions. These segments stress the robustness of the GNSS subsystem and the ability of the fusion framework to maintain positioning accuracy in degraded environments.

A particularly demanding part of the scenarios is a full indoor section consisting of three loops inside an indoor parking facility. This environment completely denies GNSS signals and requires localization to rely exclusively on inertial and vision/LiDAR-based subsystems. Additionally, the trajectory includes bridge crossings, which cause temporary GNSS signal blockages. These conditions provide further opportunities to assess the capability of the system to bridge short-term outages and quickly recover once signals are reacquired.



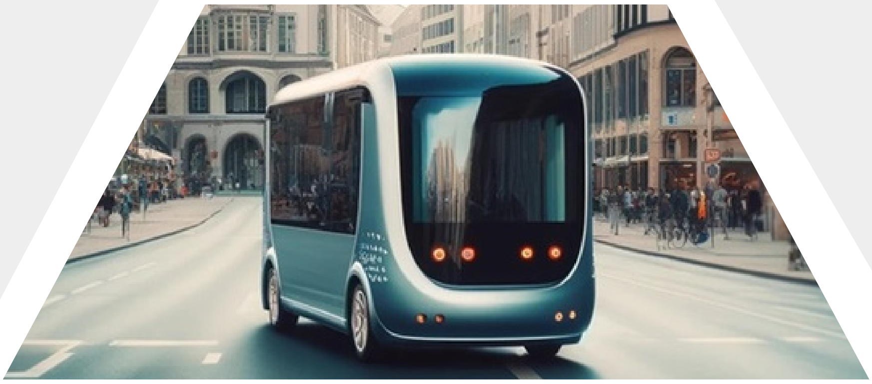


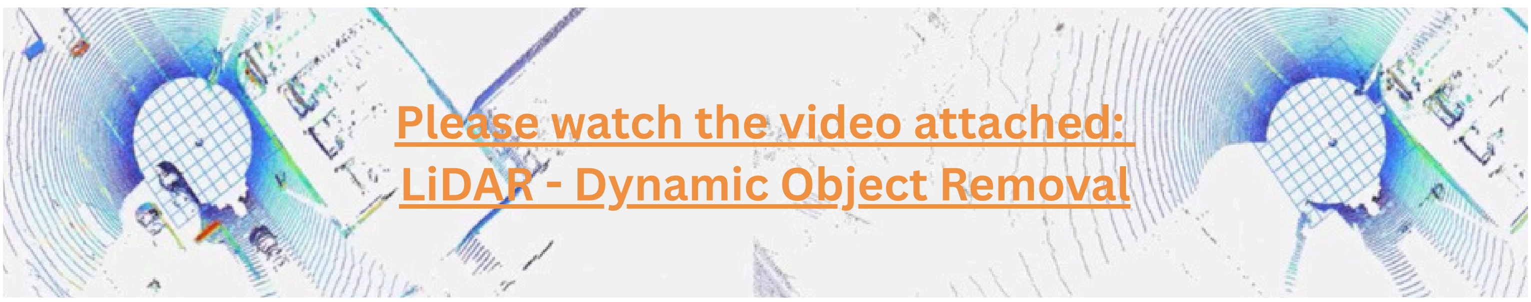
Figure 1: Experimental vehicle set-up. The main localization sensors include an Ouster OS1-128 LiDAR (blue), two forward-looking Basler stereo cameras (yellow), and dual GNSS antennas (red) for precise attitude determination. Surround cameras (green) and an additional OS0-128 LiDAR at the front are used primarily for object detection. Onboard processing is performed by a Car PC (bottom left) running computer vision algorithms and the ANavS AROX system (orange, top right), which hosts the tightly coupled GNSS/IMU filter and the multi-sensor fusion algorithm.

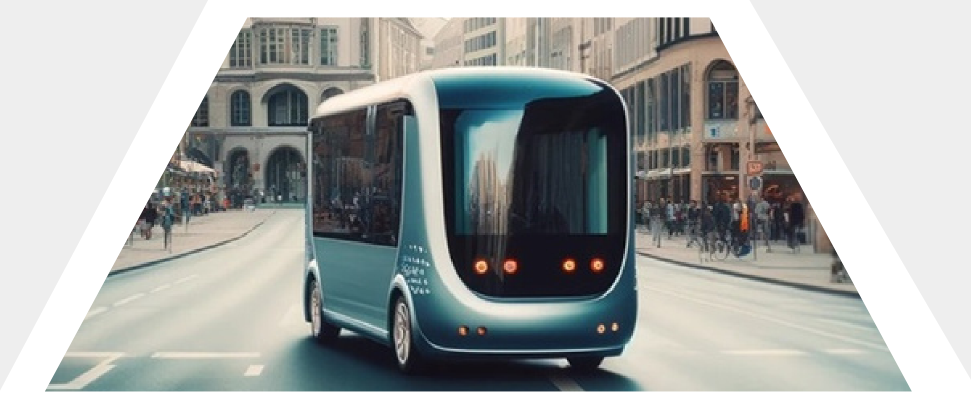
3. System Results

DREAM system incorporates AI-based techniques at multiple levels: improving GNSS reliability under degraded conditions, refining IMU calibration and measurement adaptation, and enhancing SLAM accuracy through the detection and removal of dynamic features. The entire solution is implemented on embedded hardware, ensuring real-time operation under the resource constraints imposed by automotive platforms.

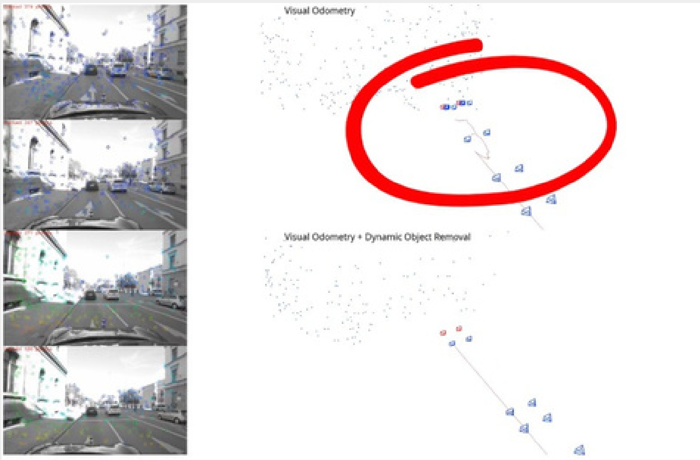
We have also developed perception-oriented modules to automatically detect, classify, and track road users (e.g., cars, pedestrians, bicycles) using 3D bounding boxes, along with the detection of traffic lights and their current state. Another outcome of the project is the generation of 2D maps with lane-level information, enriched with semantic data such as driving direction, traffic lights and signals. These new localization, perception and mapping features will be progressively integrated into our ANavS product portfolio in the coming months.

To illustrate some of the results achieved so far in the project, the following figure shows an example of the AI-based dynamic object removal applied to LiDAR scans. Left: Raw LiDAR point cloud including moving objects such as cars. Right: Filtered point cloud after applying the proposed algorithm, where dynamic features have been removed, leaving only static features for robust localization and mapping.





Similarly, for Visual SLAM, dynamic features are removed from the scene to improve the odometry estimation.



Impact of dynamic object removal in visual odometry. Top: classical method, where features from both static and moving objects are used, leading to an erroneous trajectory estimate when the ego vehicle is stationary. Bottom: proposed method with AI-based dynamic object removal, where features from surrounding vehicles are excluded, yielding a stable and correct position estimate.

Please watch the video attached: VIO - Dynamic Object Removal

With the AI-based dynamic object removal developed in DREAM, combined with other improvements in the LiDAR and visual SLAM algorithms, we obtain a reliable odometry estimate that supports the localization module in GNSS-degraded or indoor conditions. By filtering out moving objects and relying only on static features, the system maintains accurate tracking.

The following video shows the odometry estimated by the LiDAR- and camera-based algorithms in such environments: VIDEO

Further results and videos will be included in the website in the upcoming weeks.

4. DREAM in International Conferences

European Navigation Conference in Wroclaw, Poland - May 21-23, 2025

ION GNSS+ in Baltimore, USA - September 8-12, 2025