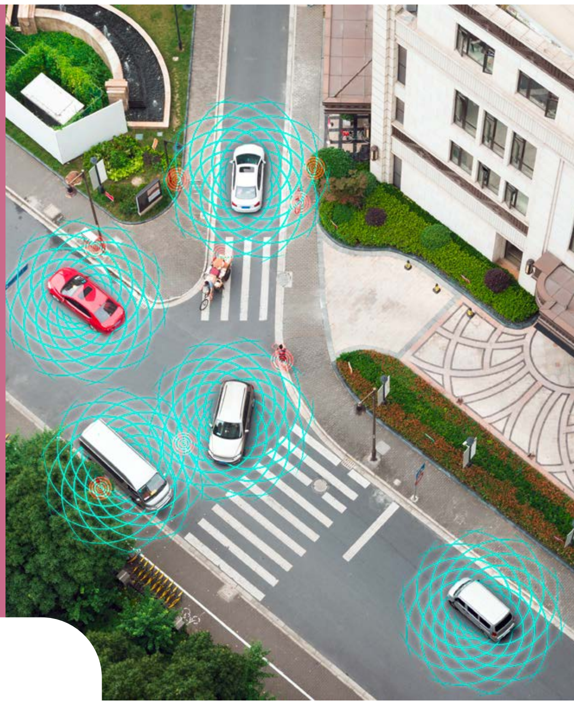
Lernende Systeme
GERMANY'S PLATFORM FOR ARTIFICIAL INTELLIGENCE

Potentials for cross-industry fleet learning



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Executive Summary

Whether in transportation, logistics, individual transport, or local public transport – transport is achieving ever higher levels of automation thanks to Artificial Intelligence. Automated driving can help increase traffic safety, optimize traffic flows, and reduce pollutant emissions. Increasingly powerful AI and machine learning techniques are improving automated driving technology so that it works in real-world tests in more than 99 percent of situations.

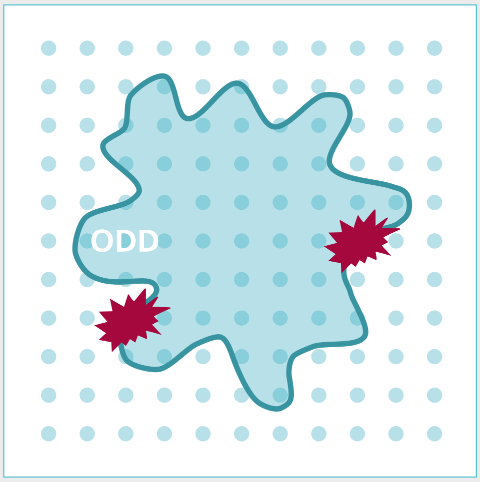
A residual risk for possible misbehavior occurs in so-called edge and corner cases. AI systems may not be sufficiently trained and tested for these rarely occurring special cases. To tap the potential of cross-industry fleet learning, the experts of the working group *Mobility and intelligent Transport Systems* of Plattform Lernende Systeme therefore propose the establishment of a collaborative AI mobility data platform. This platform should enable the exchange of mobility data and contribute to risk minimization in automated driving.

Contribution of AI methods to automated driving

The most promising approaches for the further development of automated driving are mainly based on AI methods, in particular machine learning (ML). When using ML the system behavior is not programmed using descriptive rules like classical software, but based on a representative set of training data, a large „data sample" from which application domains are learned, for example with neural networks. A prerequisite for the effectiveness of ML approaches is that the collection of the data sample from the input space of the respective „Operational Design Domain" (ODD) is comprehensive, which means that the data cover all representative and typical cases as far as possible.

Operational Design Domain (ODD) of an autonomous system describes the operational condition for which it is functionally designed. This includes, for example, traffic types (road, rail vehicles), the environments in which it operates (highway, country road, inner city, within a closed campus or rail depot), local restrictions (for example, to certain cities, suburbs), weather conditions, and many more.

Figure 1: Operational Design Domain (ODD) of an Autonomous System



Note: The **Operational Design Domain** (ODD) describes the boundary within the set of possible operating conditions. Possible corner cases (red symbols) often occur in the marginal areas of the parameters.

AI platform for data exchange in mobility

Through so-called fleet learning, vehicle manufacturers can optimize their vehicles by training with usage data on corner cases on a cross-industry platform. By collecting data on identified corner cases, the platform will serve as a basis for training AI systems across the mobility sector. This will create the conditions for cross-industry fleet learning. As a technical mediation platform (web service), the collaborative AI platform for sharing mobility data will collect examples of corner cases. In a further step, it can also create a reference line for risk assessment and provide a way to validate ML models. Thus, the platform serves both the common good of increased safety for society and the economic interests at the national and european level. This is because automated vehicles will still need to respond to corner cases during operation, despite a high volume and quality of training data.

It is therefore important to be able to classify these cases and share them with the entire vehicle fleet. After all, it is never possible to fully determine which faults (so-called „unknown unknowns") are still to be expected in the future. This implies a permanent need for such a platform. The goal of the mobility platform is to learn from the collected data of already identified corner cases to be able to transfer these insights to other AI systems.

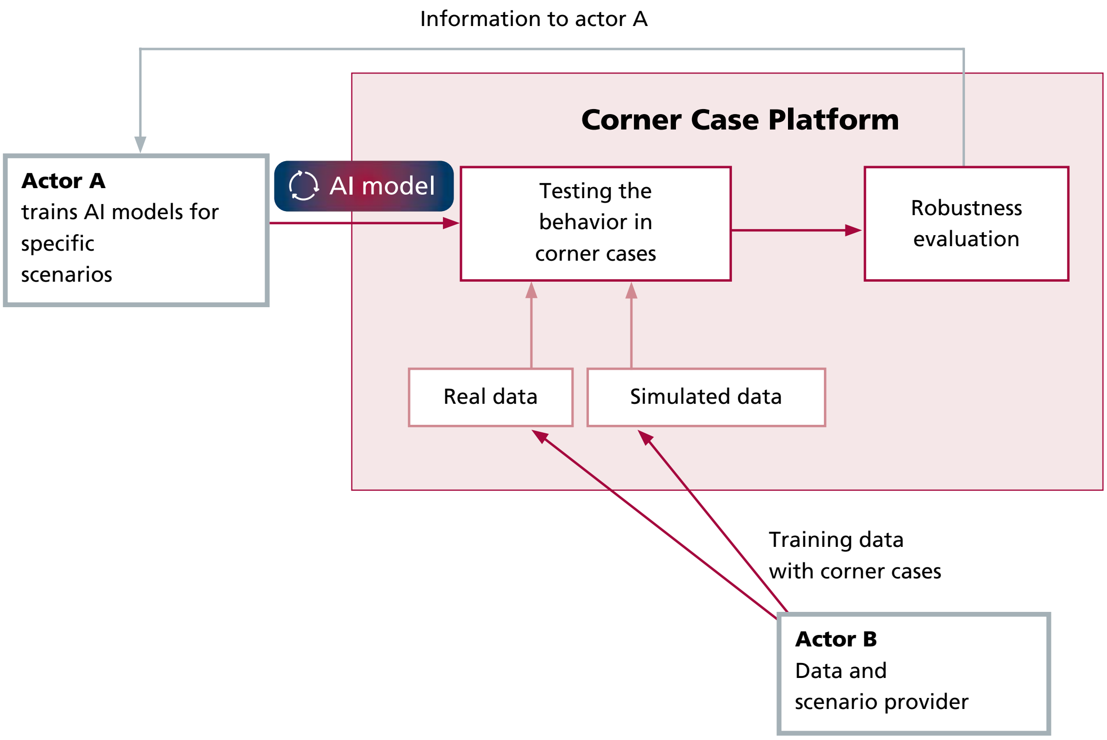
The platform should therefore:

1. aggregate data that can be used to test different AI models. The dependency on specific sensor modalities and configurations should be made explicit.
2. drive the development of an annotation format and standards to enable the comparability of different models.
3. make training and test data available for research and development and thus lead to further insights regarding the operation in the presence of unknowns.

The platform enables all players in the entire value chain to use the same infrastructure to test and evaluate the robustness of their own AI models for corner cases. This assumes that the software artifacts have similar basic architectural requirements and can be executed on one platform. This excludes models that can only be operated on specific hardware platforms. For this purpose, scenarios with corner cases must be available on the platform. AI models can be uploaded, and the behavior of the AI systems regarding these scenarios can be checked and evaluated. The evaluation is then communicated as feedback to fleet operators, for example, so that they can update their corresponding models and in turn distribute them in their fleets. In a further expansion stage, it is conceivable that follow-up training of the AI systems can take place directly on the platform and certified up-dates can be distributed via the platform. The platform thus enables exchange both between actors, such as fleet operators who want to test their models and improve their robustness, and between actors who own corner-case scenarios or training data that can be used to retrain perceptual errors and thus make models more robust (see Figure 2).

The resulting information about differences between the original training and the post-training can be taken as an adaptation of underlying labeling models (connotation models) and contribute to the improvement of knowledge about the corner cases.

Figure 2: Simplified illustration of the mode of operation of the corner case platform



Design of the operator model of the AI mobility data platform

The platform should be operated by a neutral institution; the operator model of the platform provides for a transaction-based service so that the platform is financially self-supporting. To be able to upload models to the platform and have them validated the actors interested in the service are to make a small financial contribution. This in turn benefits the actors who improve the robustness of the models. To realize a platform for cross-industry fleet learning, participating companies and research institutions need high-performance networks or data carriers for data processing and transfer so that the data can be collected in the respective vehicles and read out later. For the implementation of effective fleet learning, it is also important to ensure the quality of the newly learned models, including a suitable selection of validation scenarios.

The key conditions for the success of the AI mobility data platform include standards for modeling and data exchange formats (e.g., standardized data formats, interfaces, and protocols) that enable access to common tools and technologies. Further design options include among others the establishment of a community for the AI mobility data platform as well as the promotion of further research projects for the description, identification, and evaluation of corner cases.

With this concept for the establishment of a joint AI mobility data platform, the experts of Plattform Lernende Systeme would like to contribute to risk minimization in autonomous driving and encourage the promotion of standardization and regulation of AI systems in mobility.

Imprint
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