

PIONEERING
NEW MOBILITY

```
..._operation == "MIRROR_Y":  
    mirror_mod.use_x = False  
    mirror_mod.use_y = True  
    mirror_mod.use_z = False  
..._operation == "MIRROR_Z":  
    mirror_mod.use_x = False  
    mirror_mod.use_y = False  
    mirror_mod.use_z = True
```

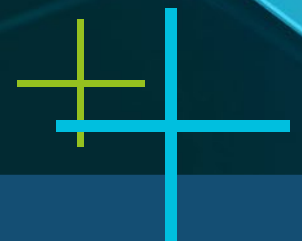
```
...selection at the end -add  
..._ob.select= 1  
..._ob.select=1
```

```
...context.scene.objects.active  
...("Selected" + str(modifier...  
...mirror_ob.select = 0  
... bpy.context.selected_obj  
...data.objects[one.name].se
```

```
...print("please select exactl  
...  
... OPERATOR CLASSES ---
```

```
...types.Operator):  
... X mirror to the selected  
...object.mirror_mirror_x"  
...mirror X"
```

```
...context):  
...context.active_object is not
```



Artificial Intelligence

Algorithms and functions

Examples of our research and engineering applications

Scenario detection



When managing test drives, the automated, in-vehicle assignment and categorization of recorded data is a great benefit. The detection of objects and whole scenarios is increasingly based on methods of artificial intelligence and enables the pre-labelling of data already during the test drive. Therefore, the processing and analysis of data is supported significantly. In addition, the labelled data can also be used for online campaign management.

Anomaly detection



During validation and development of new driving functions it is very interesting to detect data that differs from regular characteristics (outlier detection). This data indicates anomalies, outliers and can indicate a possible malfunction in the algorithm. Machine learning methods detect these anomalies, classify them automatically and support the analysis of their origin.

Image processing and time series analysis

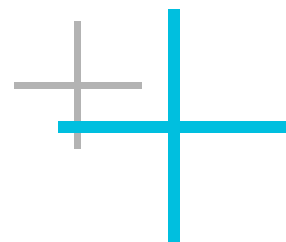


Camera-based object detection and surrounding pose estimation offers a wide range of possibilities for the automation of various situations and targeted navigation. Our deep knowledge in classic and AI-based algorithms can support the successful development and realisation of new ideas, whether it is an ADAS or robot control system project.

Simulation



For testing automated driving functions, it is necessary to modify target scenarios precisely and reproduce them uniquely. In HiL or SiL processes, there are many use cases, such as the insertion of virtual scenarios (e.g., with generative methods), development of individual SiL algorithms (e.g., GPGPU algorithms for reproducing DSPs), or intelligent management of HiL clusters.



AI-based Data Analysis

We offer innovative solutions in the area of raw data acquisition and data management of ADAS/AD test data.

With our technologies and AI know-how, we complement our portfolio and offer you comprehensive solutions from a single source. We are happy to advise you on your individual use case and develop ideas together to drive your projects forward.



Explorative data analysis



Depending on your needs, we support you in all steps of data analysis: building suitable architectures and databases for processing and storage offline or in the cloud, through the selection of suitable questions, KPIs and algorithms, through to processing and visualization.

Perception



Perception of the environment, e.g. with cameras and lidar for precise localisation and post estimation of objects, e.g. in logistics, road traffic, robot control, agriculture, etc.

Predictive Maintenance



Usage of data analytics for lifetime prediction, prediction of shutdowns and failure cases, e.g. in the area of commercial vehicles or industrial production systems.

AI in different systems

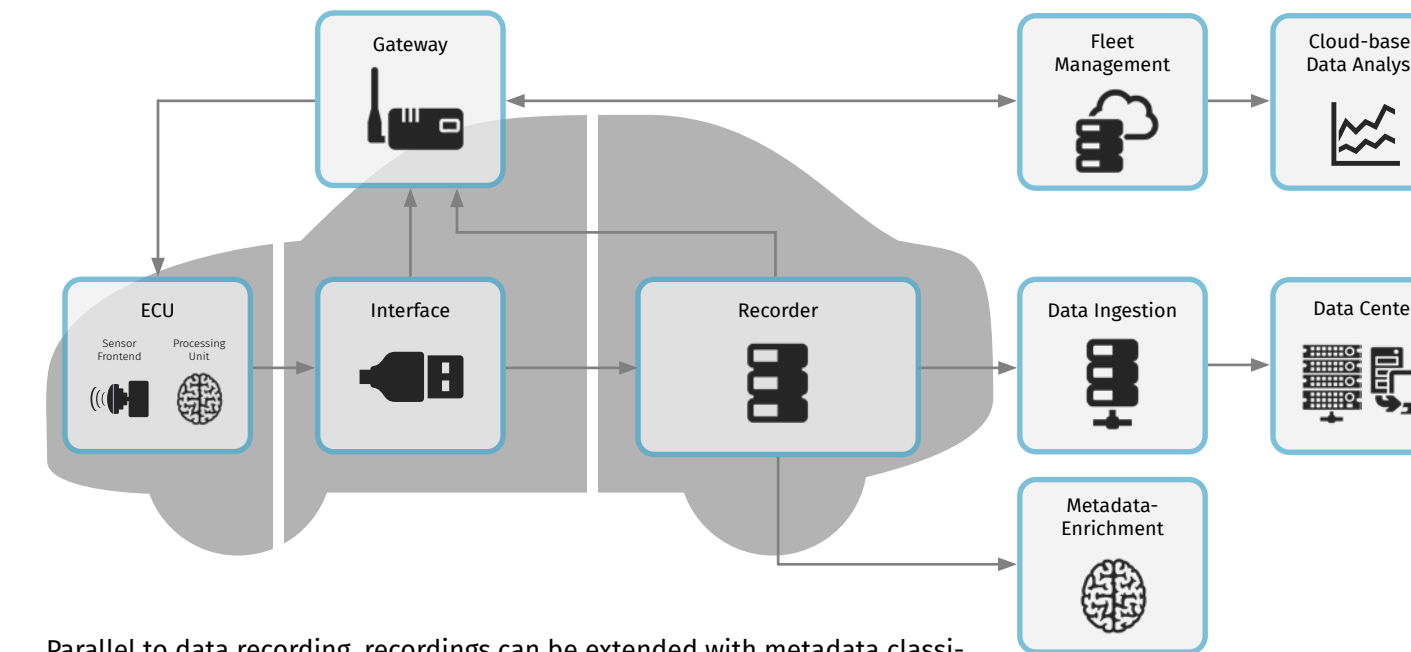


Integration of AI solutions in a wide variety of environments:

- + ROS
- + AWS / Azure
- + ECUs
- + HiLs
- + Recordings / Measurement-Software (Aveto / ADTF / MTS)

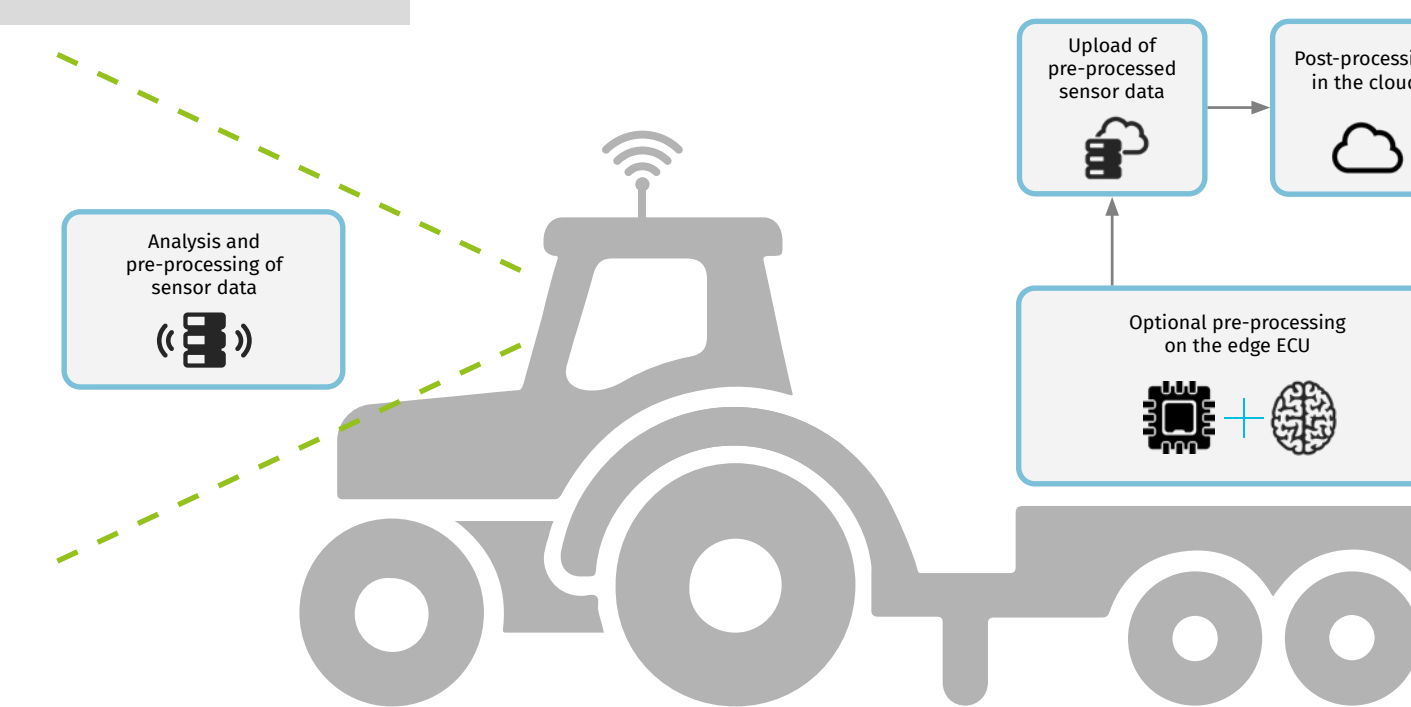
Use Cases

Metadata-Generation & Analysis



Parallel to data recording, recordings can be extended with metadata classified by machine learning algorithms. After that, the data can be specifically transferred to the cloud and be analyzed there. Intelligent pre-processing in the car (edge) enables a reduced amount of uploaded data.

Pattern Perception



There are various use cases for AI-based processing of sensor data: Direct pattern perception of sensor data, such as camera images, or high-performance processing in the cloud, where data from multiple vehicles can also be analyzed in combination (e.g., clustering or anomaly detection).

Algorithms

We offer a variety of supervised, unsupervised and semi-supervised ML algorithms

Data Processing

- + Image/video data
- + Time series, bus data
- + Radar/Lidar

Classification

- + Support Vector Machines
- + Convolutional Neural Networks
- + Sequence classification (LSTM based NN)

Image Processing / Object Detection

- + Bounding box detection
- + Instance segmentation
- + Photogrammetry
- + Optical flow (Lucas-Kanade, Wavelets, NNs)

Regression

- + Support vector regression
- + Random forest regression
- + Pixel-by-pixel regression on image data (e.g. distance estimation)

Clustering

- + DBScan
- + k-means

Feature Extraction

- + PCA
- + ICA
- + t-SNE
- + Recursive feature elimination

Anomaly detection

- + Variational/LSTM autoencoder

Postprocessing

- + Tracking
- + Bayes / Kalman-filter

Tool competence

We can support you with a variety of in-depth experience programming languages and tools for the development of algorithms:

- + AWS / Azure
- + C/C++
- + C# / WPF
- + CUDA / OpenCL
- + Docker
- + Hadoop/Spark
- + Matlab/Simulink
- + MongoDB
- + MQTT
- + OpenCV
- + PostgreSQL
- + Python
- + ROS
- + scikit-learn
- + TensorFlow/Keras
- + ...





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