LAKE FUSION Technologies
Solutions beyond perception

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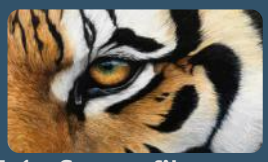
LFT OFFERS COMPREHENSIVE PRODUCTS AS WELL AS DEVELOPMENT & CONSULTING SERVICES AROUND SOFTWARE & ALGORITHMIC PROCEDURES FOR AUTONOMOUS DRIVING.

PRODUCT PORTFOLIO

Safety Critical SW Application

LIDAR–PERCEPTION

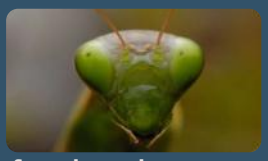
ASPP TigerEye® SW-Features



- TE-1 Sensor filters
- TE-2 Free space
- TE-3 Lane detection
- TE-4 3D-objects clustering/ tracking
- TE-5 Online calibration
- TE-6 Detection performance/ monitoring
- TE-7 Detection of relevant small obstacle
- TE-8 Dynamic collision warning

DATA FUSION

ADFS MentisFusion®



Safety-based output generation of dissimilar inputs to control and actuation systems

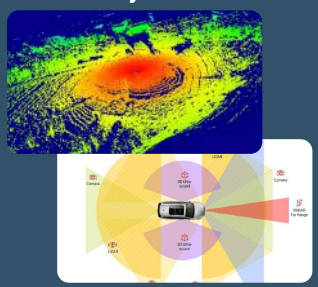
- MF-1 Lane marker fusion
- MF-2 Free space fusion
- MF-3 Object fusion
- MF-4 Combined object tracking

Environment Perception System

REFERENCE SYSTEM

- Time-syn. data
- Multi-source raw-data fusion LiDAR/Cam./Radar
- Test bed diff. sensors in identical conditions
- Data acquisition (environmental model)

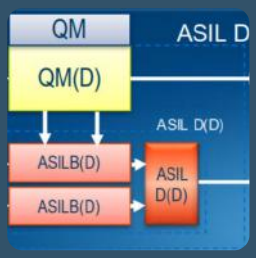
SW&HW perception System



- Diff. sensors
- Perception app.
- Up to 360° coverage

Safeguard of System

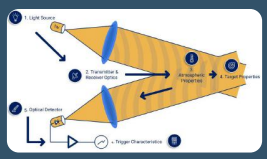
SAFETY ENVELOPE



- Safety by design
- Proof functional safety (ISO26262)
- Proof safe performance (SOTIF) at each level (ISO21448)
- Safeguarding of AI stack
- System safety engineering
- Functional hazard analysis (FHA)
- Safety concept based on system architecture

LiDAR Service

DESIGN–CALCULATION TEST–VALIDATION



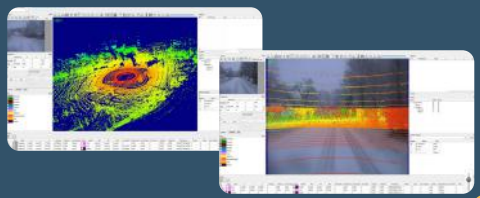
- Design, specification consultant:
  1. Efficiency improvement
  2. Impact of environmental effects
  3. Sensor validation & comparison

LIDAR MEASUREMENT

- Reflectivity measurement

Visualization & Framework Tool

- Visualization of sensor views, SW-application
- Generation of RAW fusion of any sensor
- Display and visualization
- LFT LiDAR perception products are integrated in the visualization tool chain



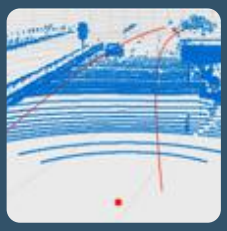
Safety Critical Software Application

ASPP TigerEye®

The LAKE FUSION Technologies' product ASPP TigerEye® (Advanced Sensor Perception Processing) is a modular SW suite for processing LiDAR data. It is based on LFT's experience in LiDAR data filtering, segmentation and classification in the aerospace industry and uses only classical deterministic algorithms. Accordingly, they do not need to be trained like AI-based procedures. By reducing the amount of data already in early processing phases, the computing time required is low.

ASPP TigerEye® consists of 8 main modules up to ASIL B which together comprise the complete LiDAR data processing chain for environmental perception and monitoring:

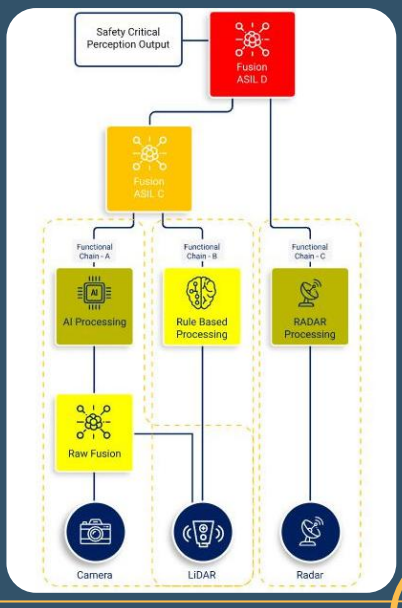
TE-1:	Sensor filters	LiDAR sensor data filtering to remove weather or sensor related artifacts (false pixels) from LiDAR depth images
TE-2:	Free space detection	This application uses LiDAR data to determine first the ground area and then the free space in front of the vehicle
TE-3:	Lane detection	I.e. the derivation of lanes from the LiDAR image
TE-4:	3D object tracking	Segmentation, clustering and tracking of raised 3D objects
TE-5:	Offline / online calibration	SW for online calibration / calibration verification of LiDAR sensors
TE-6:	LiDAR detection performance monitoring	Live monitoring of the current visibility of the sensor system (sensor pollution detection / detection of different types of degradation)
TE-7:	Detection of relevant small obstacles	LiDAR sensor data are used to detect small obstacles (e.g. tires, wooden pallets)
TE-8:	Dynamic collision	Dynamic objects trajectory prediction for collision avoidance



ADFS MentisFusion®

The LAKE FUSION Technologies' product ADFS MentisFusion® (Advanced Data Fusion System) consists of deterministic, rule-based algorithms and SW packages for data fusion that accept pre-processed inputs like 2D and 3D images as well as segmented 3D data points from the various data sources. Data sources are e.g. the processed camera, LiDAR and database information (including cloud based information) as well as RADAR information.

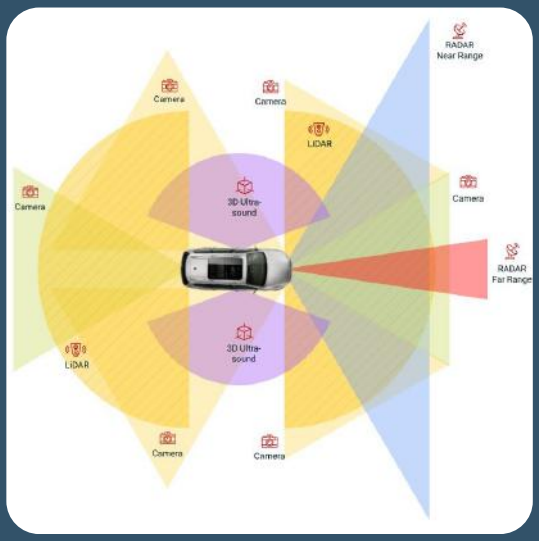
The purpose of sensor data fusion is to compensate for systematic gaps in the individual technologies by combining different sensors and thus to cover the entire environment with the same quality over the widest possible range of applications. In order to meet the high requirements for data integrity, the data is first calculated in independent functional chains and only then merged. Mutual monitoring and support ("Doer - Checker" principle) of the multiple sensor functional chains with different technologies is thus an important part of data fusion.



Environment Perception System

The LFT product Environment Perception is a holistic system for recording the vehicle environment and transferring it to the downstream vehicle system. It contains corresponding sensors HW (e.g. LiDAR, camera, radar) for the acquisition of the scenery, process SW for the acquisition of the scene understanding on the basis of the respective data (both AI-based and deterministic) and fusion processes which are required for the functional safeguarding of the environment perception.

The latter is a prerequisite for safe operation and thus certification of a vehicle with a higher level of autonomy. The functional decomposition, the selection of the sensor technology and the structure of the processing chains and fusion procedures must be adapted to the reliability and safety requirements of the "intended function" to be delivered. Here, too, mutual monitoring and support ("Doer - Checker" principle) of dissimilar sensors is a prerequisite for a complete provision of the "intended function''.



Reference System

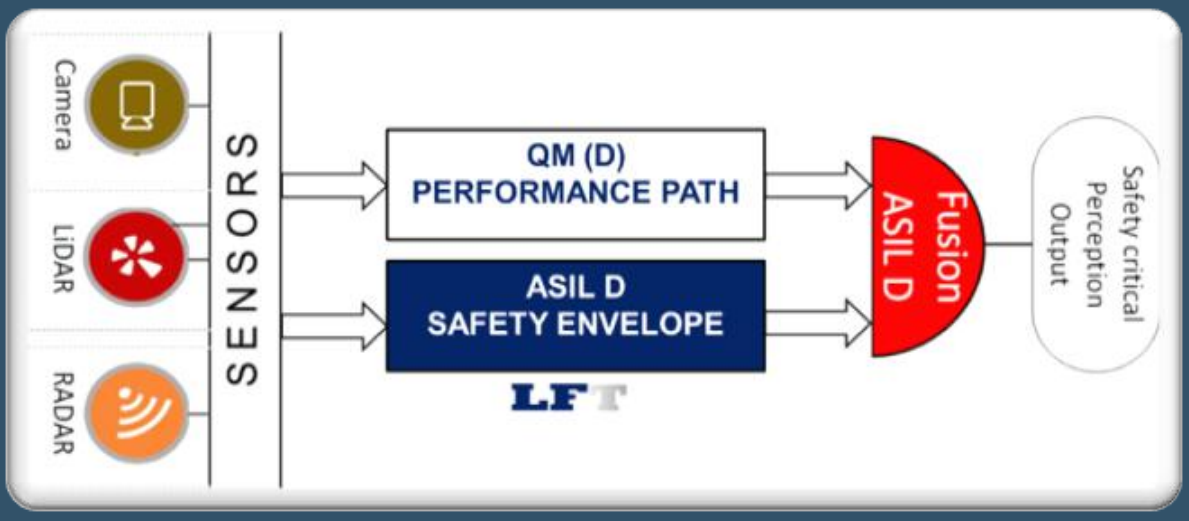
LFT provides a Reference System for recording time-synchronized and georeferenced raw data from automotive sensors. The angular calibration & time synchronization of the recorded sensor data has precision well above the sensors resolution.

The Reference System is also applicable to obtain raw data for the development and validation of our LiDAR Perception products. It is also used to optimize sensor calibration and performance monitoring procedures. Due to its scalability it is also designed for the rapid validation of new sensor technology.

Safeguard of System

Safety Envelope

LFT offers a holistic safety concept based on the system architecture, which enables the approval of autonomous vehicles. LFT presents a safety and risk assessment process, which is proven in aviation and regulated in the automotive environment by the ISO26262 and ISO21448 (SOTIF). LFT covers the entire process chain of system safety engineering, starting with the definition of the intended function, continuing with the functional hazard analysis (FHA) and ending with the safety concept and its system architecture. Another focal point is the safeguarding of the AI performance branch.



LiDAR Service

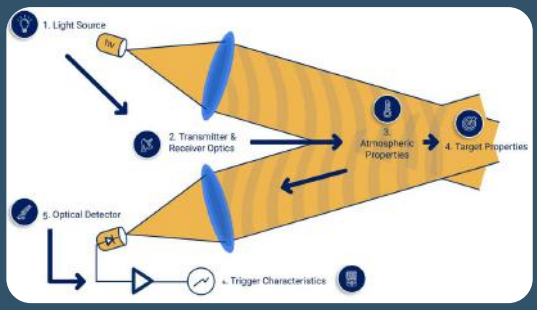
LFT offers an extensive LiDAR engineering service for the development of the LiDAR sensors. This service includes, among other things, the LiDAR sensor design, LiDAR simulations, reduction of interference effects by optimizing the optical and electrical path, smart receiver management, etc.

With the LiDAR reflection measuring device developed and produced in-house, LFT offers a unique service that enables the optical backscattering of various scattering bodies (traffic signs, vehicle paint, etc.) to be measured.

Design-Calculation-Test-Validation

The LFT team has more than 20 years of experience in the design of airborne LiDAR sensor technology which LFT's customers can access. Among other things LFT advises you on the following topics:

- LiDAR sensor design, LiDAR simulations, reduction of disturbing effects by optimizing the optical & electrical path
- Eye safety analyses according to DIN EN 60825
- Environmental and EMC hardening & qualification of LIDAR sensors
- Smart receiver management with focus on increasing accuracy and suppressing atmospheric effects



LiDAR Measurement

LFT's LiDAR reflection meter measures the bidirectional reflectivity (BRDF from Bidirectional Reflectance Distribution Function) in a specific angular relationship. BRDF measurements are usually carried out by special testing houses or institutes. For most materials, only a few backscatter values are available in the literature. If at all, only the angle-dependent scattering in the case of perpendicular lighting is usually given. As a rule, no measured values can be found for inclined impacts. With LFT's LiDAR reflectance measuring device, LFT offers a unique service that makes it possible to measure the optical backscattering from various scattering bodies (traffic signs, vehicle paint, etc.).

Visualization & Framework Tool (VFT)

The Visualisation Framework Tool (VFT) is a scalable visualisation platform that is able to playback and process the recorded 3D in real time and synchronously.

VFT offers the possibility to create a RAW fusion of any sensor and can provide every kind of display for visualisation. At the same time, the LFT LiDAR Perception products are integrated into VFT and can be evaluated. It is also possible to connect other data sources to evaluate fusion processes.

VFT offers our customers such unique features, benefits and added value as:

- Multi point cloud management
- Time synchronisation of data acquisition from different sources (multiple LiDARs, cameras, RADARs and navigation data)
- Hosting of LFT LiDAR perception algorithms
- Distance, height, reflectivity and labels colouring scheme
- Colouring of camera images projected onto LiDAR pixels
- Display of detailed data in tables
- Hiding of terrain/road pixels (vehicles/pedestrians/bicycles etc.)
- Hiding pixels with fog/snow/rain artefacts
- Marking of data (tags on the timeline, jump to the selected tag in the file)
- 3D labelling of LiDAR data
- and much more