# Sensoren für Fahrerassistenzsysteme – Von Komfort- zu Sicherheitssystemen

## *Sensors for Driver Assistant Systems - From Comfort to Safety Systems*

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Hella KGaA, Lippstadt

***Sensoren für Fahrerassistenzsystem –***

*Von Komfort- zu Sicherheitssystemen*

*Jürgen Seuss, Leiter Produktkoordination Fahrerassistenzsysteme*
Aachen, 11.10.2006

*Fig. 1*

Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Definitionen
Lidar
Front Kamera
Fusion
24 GHz
2
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*Fig. 2*

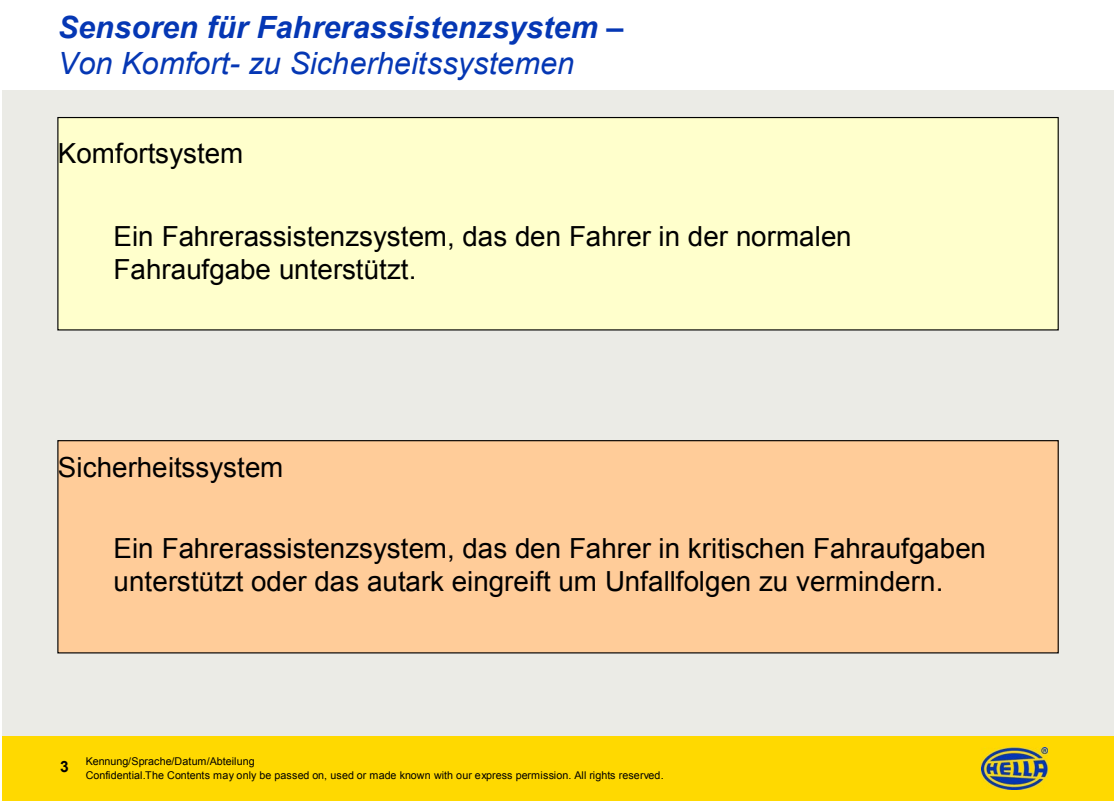
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Komfortsystem
Ein Fahrerassistenzsystem, das den Fahrer in der normalen Fahraufgabe unterstützt.
Sicherheitssystem
Ein Fahrerassistenzsystem, das den Fahrer in kritischen Fahraufgaben unterstützt oder das autark eingreift um Unfallfolgen zu vermindern.
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*Fig. 3*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*

- Definitionen
- Lidar
- Front Kamera
- Fusion
- 24 GHz

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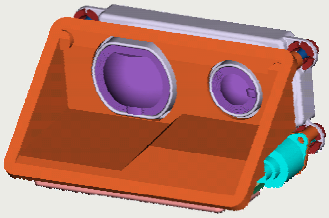
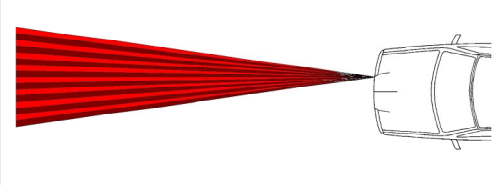
*Fig. 4*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*

### *Hella LIDAR Sensor*





| | |
|---|---|
| • Measurement Range | 150m (200m) |
| • Azimuth Angle | 16°/12° |
| | (16x1°/12x1°) |
| • Distance Resolution | 0.1 m |
| • Distance Accuracy | +/- 1% |
| • Velocity Resolution | 0.1 km/h |
| • Velocity Accuracy | +/- 1km/h |

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*Fig. 5*

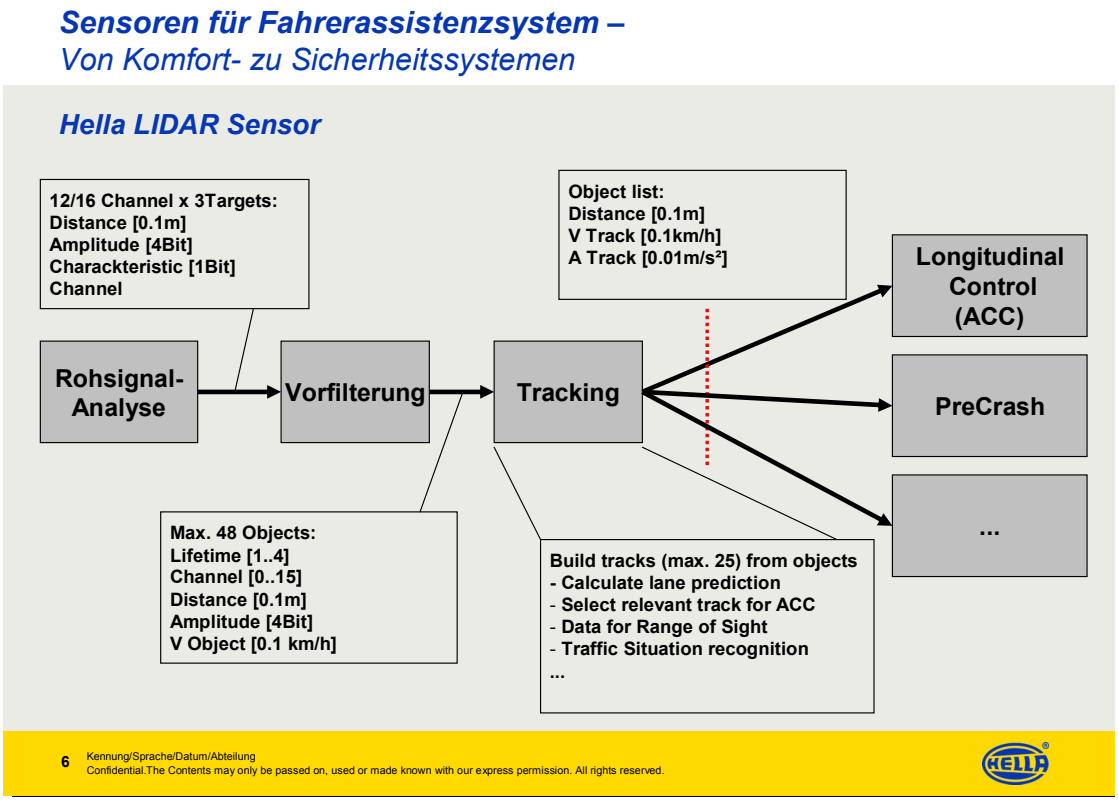
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Hella LIDAR Sensor
12/16 Channel x 3Targets:
Distance [0.1m]
Amplitude [4Bit]
Charackteristic [1Bit]
Channel
Object list:
Distance [0.1m]
V Track [0.1km/h]
A Track [0.01m/s²]
Rohsignal-Analyse
Vorfilterung
Tracking
Longitudinal Control (ACC)
PreCrash
...
Max. 48 Objects:
Lifetime [1..4]
Channel [0..15]
Distance [0.1m]
Amplitude [4Bit]
V Object [0.1 km/h]
Build tracks (max. 25) from objects
- Calculate lane prediction
- Select relevant track for ACC
- Data for Range of Sight
- Traffic Situation recognition
...
6
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*Fig. 6*

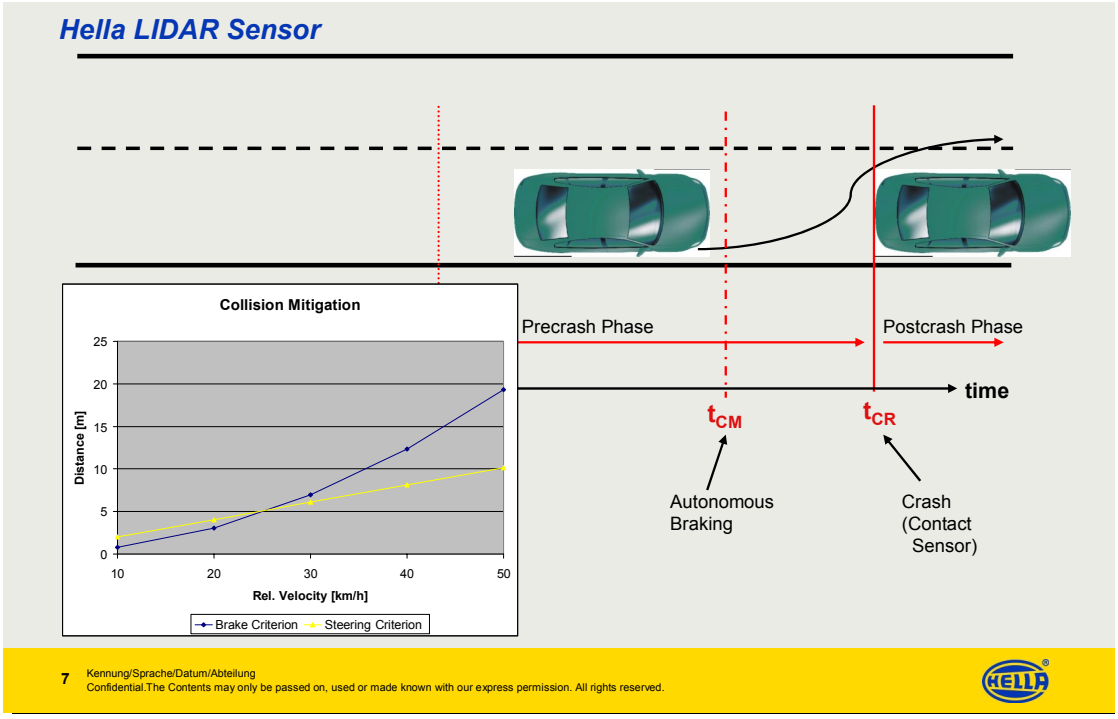
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Hella LIDAR Sensor
Collision Mitigation
Distance [m]
Rel. Velocity [km/h]
Brake Criterion
Steering Criterion
Precrash Phase
Postcrash Phase
time
tCM
tCR
Autonomous Braking
Crash (Contact Sensor)
7
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*Fig. 7*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*

- Definitionen
- Lidar
- Front Kamera
- Fusion
- 24 GHz

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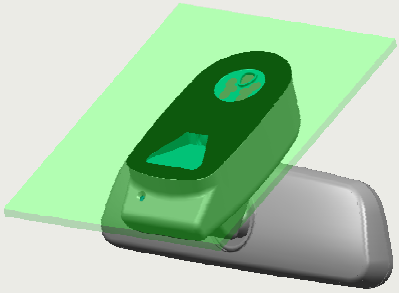
*Fig. 8*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*

### *Hella Frontkamera*



- Kamera
  - Winkel (H x V): 46° x 30°
  - Auflösung: 768 x 488 Pixel
  - Type: CMOS monochrom
  - Auflösung lateral (50m) 0,07 m
  - Zykluszeit 40 ms

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*Fig. 9*

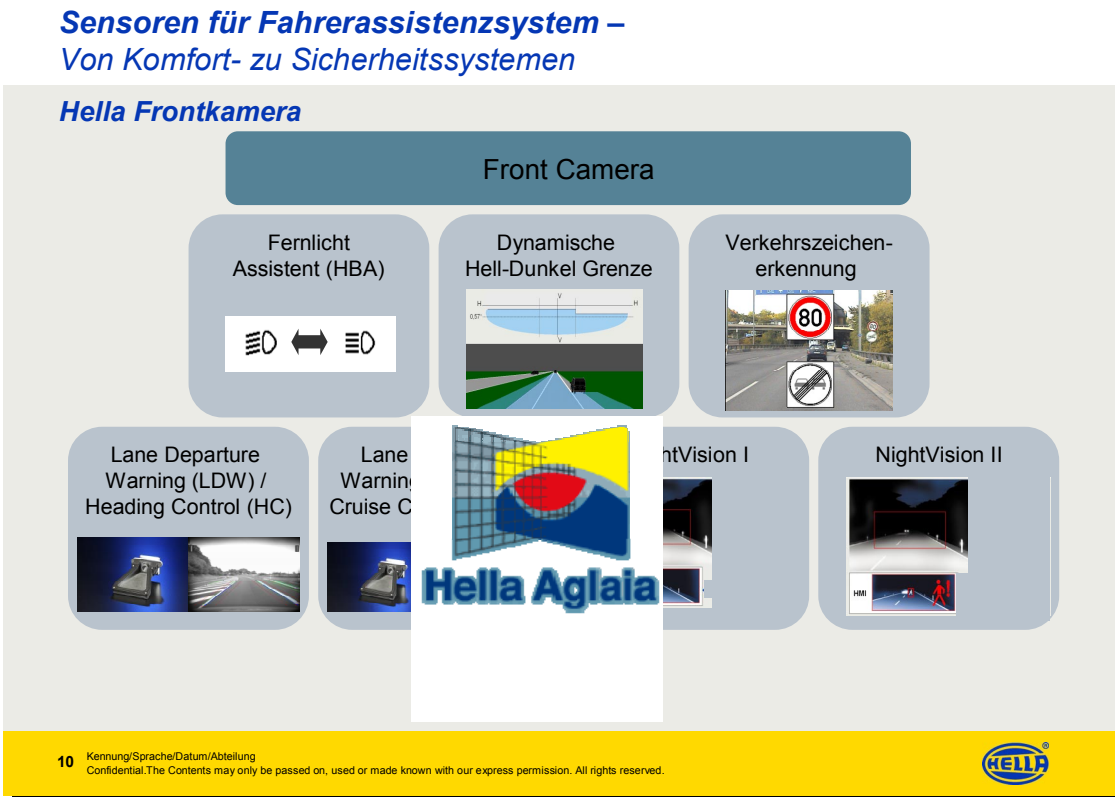
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Hella Frontkamera
Front Camera
Fernlicht Assistent (HBA)
Dynamische Hell-Dunkel Grenze
Verkehrszeichen-erkennung
80
Lane Departure Warning (LDW) / Heading Control (HC)
Lane Warning Cruise C
Hella Aglaia
ntVision I
NightVision II
HMI
10
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*Fig. 10*

Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Definitionen
Lidar
Front Kamera
Fusion
24 GHz
11
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*Fig. 11*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*

*Sensor*

*Integration*

- LIDAR Multi-Beam (NIR 905 nm)
- Time-of-flight, Mehrzielfähigkeit pro Kanal
- 16 Kanäle horizontal angeordnet
- Applikation: ACC, Objektdetektion
- Integration: Fahrzeug-Frontbereich / Windschutzscheibe

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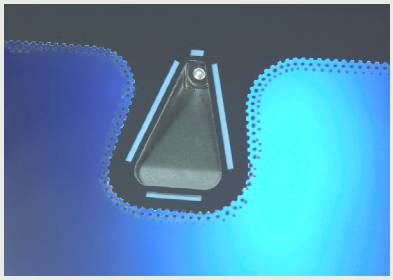
*Fig. 12*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*

*Sensor*



*Integration*

- HDR CMOS-Bildsensor
- Bildsignalverarbeitung
- 1-Box, 2-Box (Trennung Kamerakopf und ECU)
- Applikation: LDW, Fahrspurdetektion, Verkehrszeichenerkennung, NightVision, ...
- Integration: Windschutzscheibe

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*Fig. 13*

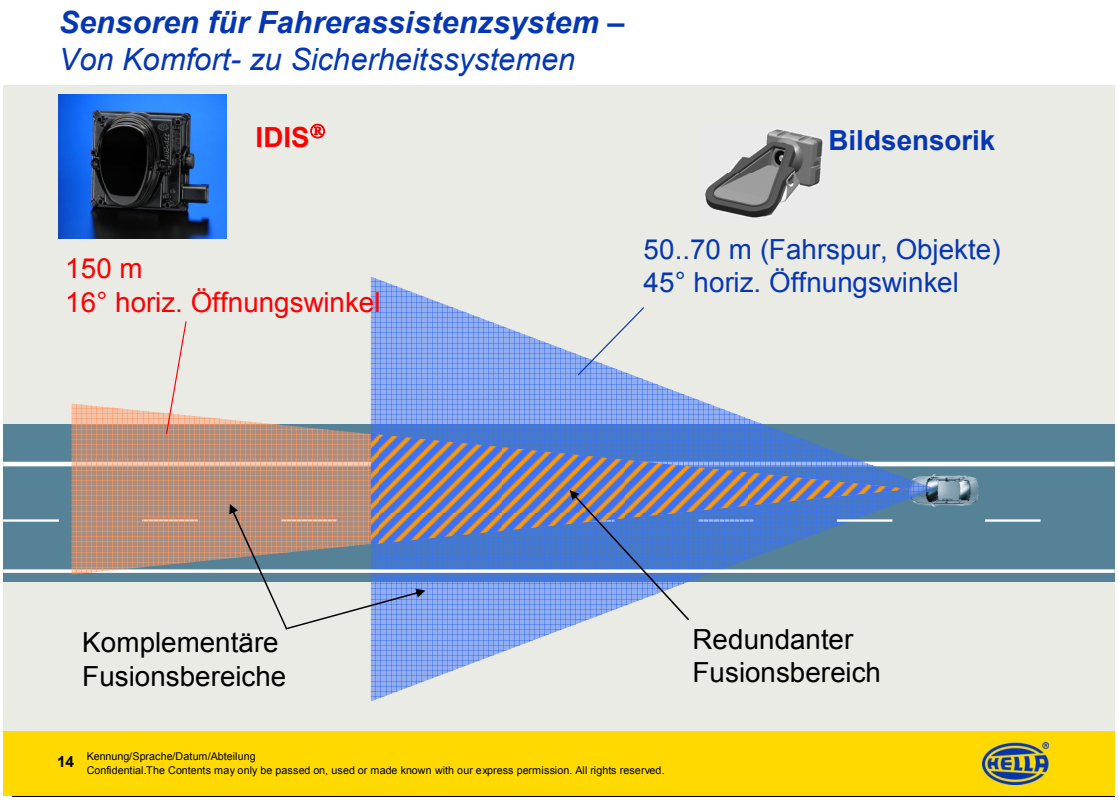
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
IDIS®
Bildsensorik
150 m
16° horiz. Öffnungswinkel
50..70 m (Fahrspur, Objekte)
45° horiz. Öffnungswinkel
Komplementäre
Fusionsbereiche
Redundanter
Fusionsbereich
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*Fig. 14*

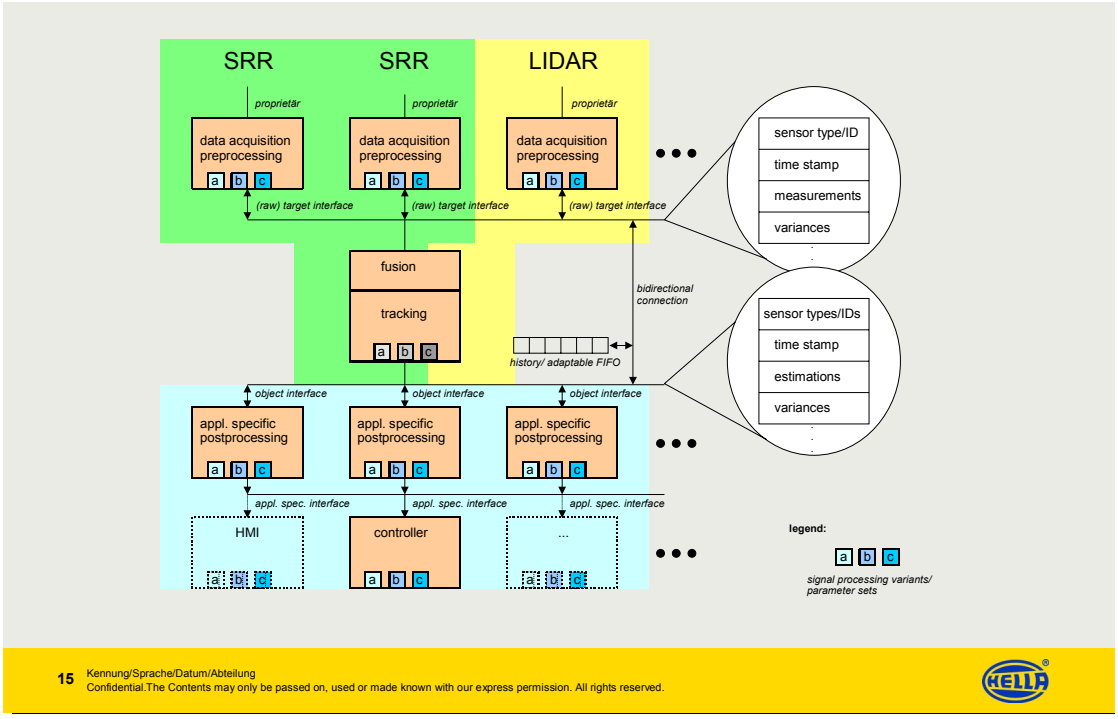
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
SRR
SRR
LIDAR
proprietär
data acquisition preprocessing
(raw) target interface
fusion
tracking
bidirectional connection
history/ adaptable FIFO
sensor type/ID
time stamp
measurements
variances
sensor types/IDs
time stamp
estimations
variances
object interface
appl. specific postprocessing
appl. spec. interface
HMI
controller
...
legend:
signal processing variants/ parameter sets
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*Fig. 15*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*

- Definitionen
- Lidar
- Front Kamera
- Fusion
- 24 GHz

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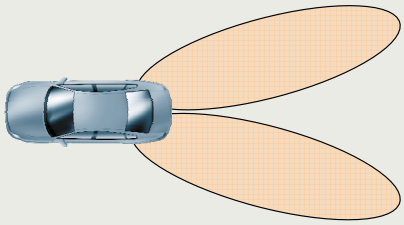
*Fig. 16*

## *Sensoren für Fahrerassistenzsystem –*
*Von Komfort- zu Sicherheitssystemen*



| | |
|---|---|
| Basis Frequenz | 24 GHz (K-Band) |
| Bandbreite | 100 MHz (76 MHz) |
| Zyklus Zeit | 36 ms |
| Messreichweite | 0.75 m ... 55 m |
| Field of View – Azimuth | ±50° … ± 70° |
| Angle of Integration | 21° |

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*Fig. 17*

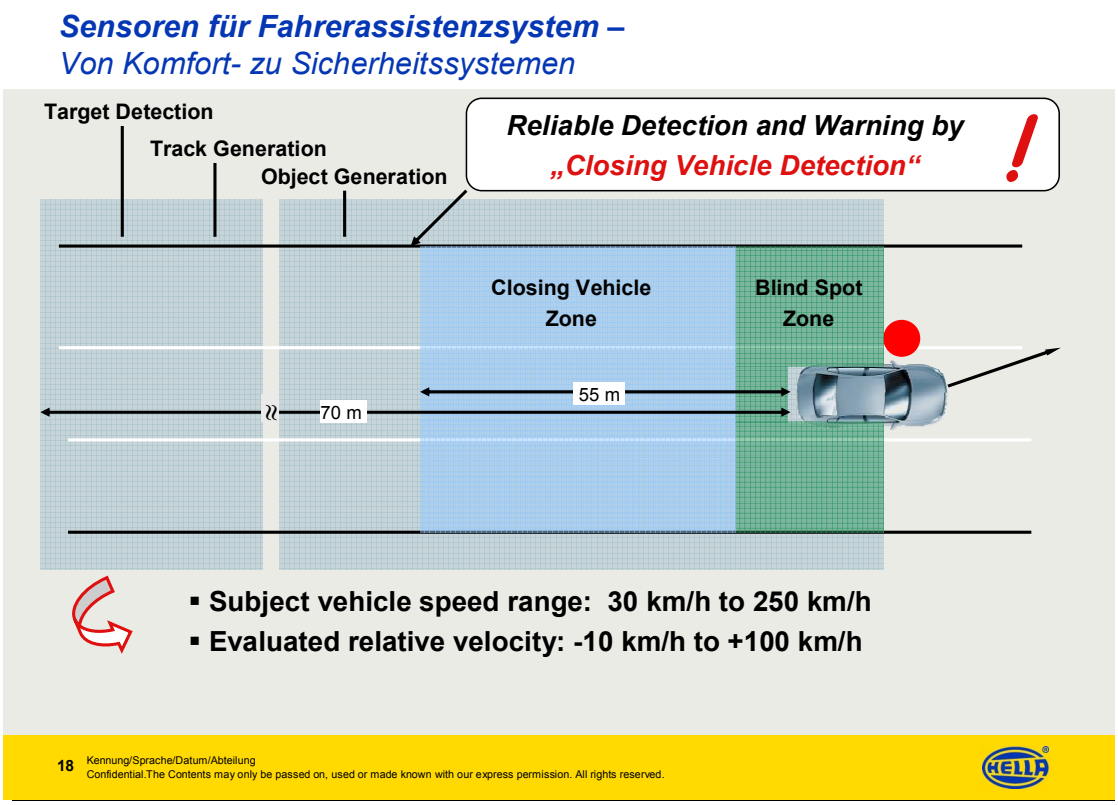
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Target Detection
Track Generation
Object Generation
Reliable Detection and Warning by
„Closing Vehicle Detection“
Closing Vehicle Zone
Blind Spot Zone
55 m
70 m
▪ Subject vehicle speed range: 30 km/h to 250 km/h
▪ Evaluated relative velocity: -10 km/h to +100 km/h
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*Fig. 18*

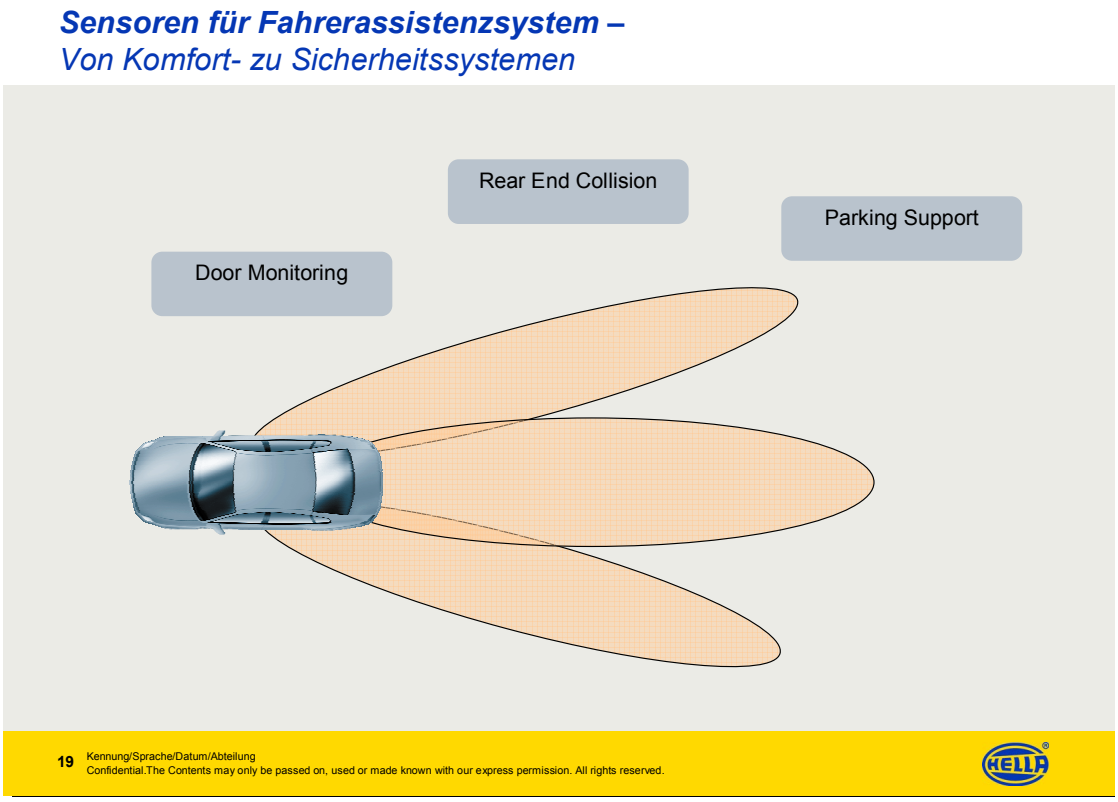
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Rear End Collision
Parking Support
Door Monitoring
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*Fig. 19*

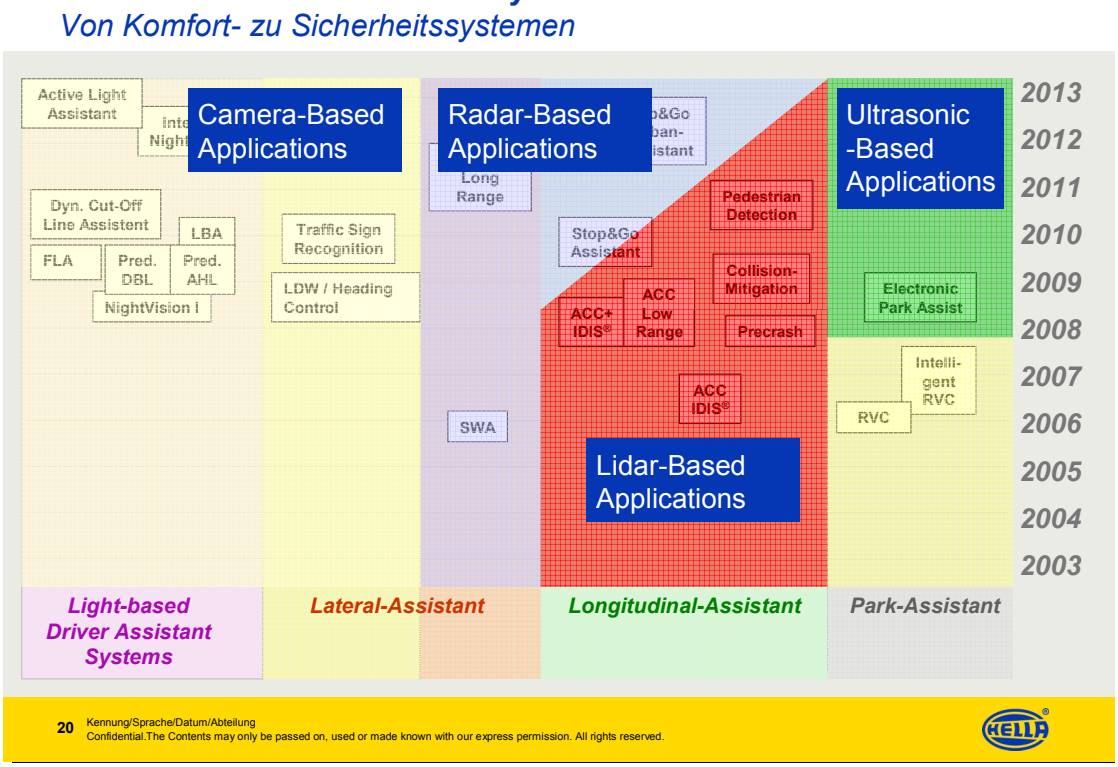
Sensoren für Fahrerassistenzsystem –
Von Komfort- zu Sicherheitssystemen
Camera-Based Applications
Radar-Based Applications
Ultrasonic -Based Applications
Lidar-Based Applications
Active Light Assistant
Dyn. Cut-Off Line Assistent
LBA
FLA
Pred. DBL
Pred. AHL
NightVision I
Traffic Sign Recognition
LDW / Heading Control
Long Range
SWA
Stop&Go Assistant
Pedestrian Detection
Collision-Mitigation
ACC+ IDIS®
ACC Low Range
Precrash
ACC IDIS®
Electronic Park Assist
Intelli-gent RVC
RVC
2013
2012
2011
2010
2009
2008
2007
2006
2005
2004
2003
Light-based Driver Assistant Systems
Lateral-Assistant
Longitudinal-Assistant
Park-Assistant
20
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*Fig. 20*