ACTIVE SAFETY 3.0

Prof. Kompaß, VP Fahrzeugsicherheit, 14. April 2016

BMW GROUP

THE NEXT 100 YEARS

Rolls-Royce Motor Cars Limited

THE NEW BMW 7 SERIES DRIVER ASSISTANCE PROVIDES COMFORT AND SAFETY AT THE HIGHEST LEVEL.

Crossing traffic warning rear / front

Distance information

Night Vision

Lane keeping assistant with active side collision protection

Speed Limit Device

Active cruise control with Stop&Go function

Lateral parking aid

Rear collision prevention

Lane departure warning

Steering and lane control assistant

Speed limit and No Pass information

Panorama View

3D View

Lane change warning

Top View

Speed Limit Assist

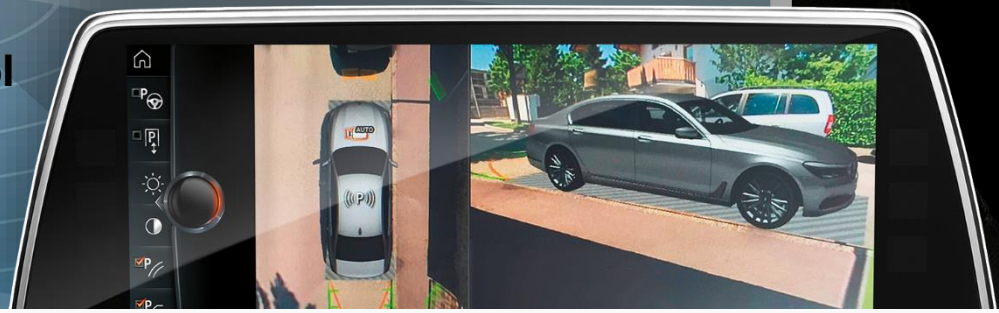
Parking assistant

Approach control warning with braking function

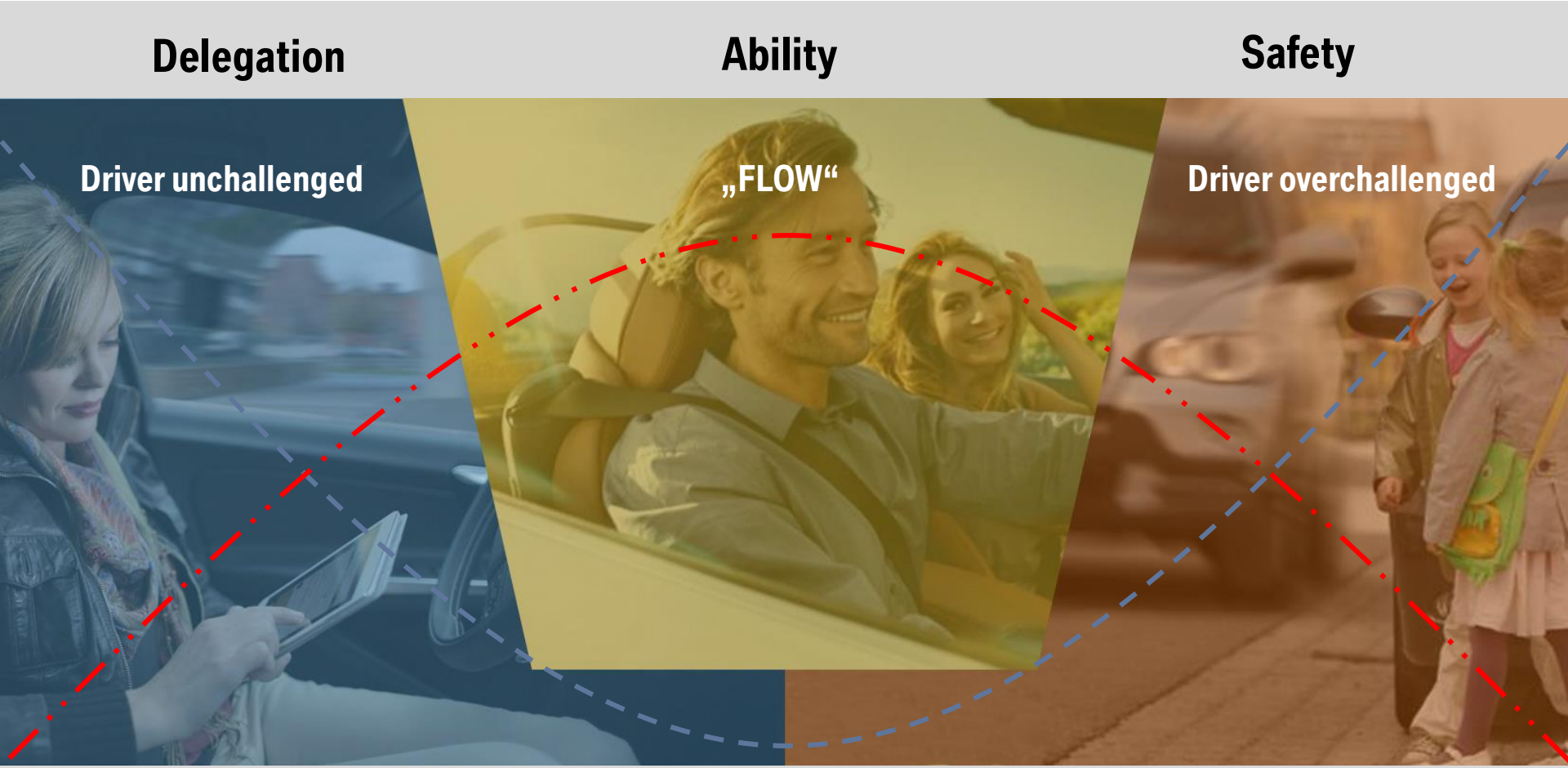
Active Park Distance Control

BMW Selective Beam

Remote Control Parking



ACTIVE SAFTEY 3.0 –
CUSTOMER BENEFIT AS THE FOCAL POINT.



ACTIVE SAFTEY 3.0 – THE INTEGRATED APPROACH OF VEHICLE SAFETY.

Object Detection
– Camera

Driver Warning
– Acoustic Acute Warning
– Active Brake Assist

Pedestrian Protection
– Head Impact
– Upper-Leg
– Lower-Leg

Automatic Emergency Braking (AEB)

Double-Stage System Reaction:

1. Optical and acoustic warning to the driver including pre-conditioning of brake system.
2. Automatic brake reaction when driver reaction is late, weak or absence.

Only passive protection
Mitigating consequences by passive safety.

Accident is accepted.

Driver in the Loop	Collision unavoidable	Fail-Safe Operation
Support of driver's own accident avoidance capabilities	Driver is no longer able to avoid an accident	Default: Basis protection by passive safety.

Aim is to avoid the accident!

ACTIVE SAFTEY 3.0 – SYSTEM DESIGN BASED ON ANALYSIS OF SAFETY.

Requirements on automated systems from a driver‘s point of view.

A driver should always …

- …be aware of the actual system status.
- … know the limits of the system and is able to identify these limits at an early stage.
- … pay adequate attention to traffic and the automated system or
- … have reasonable time to take over the control of the vehicle.

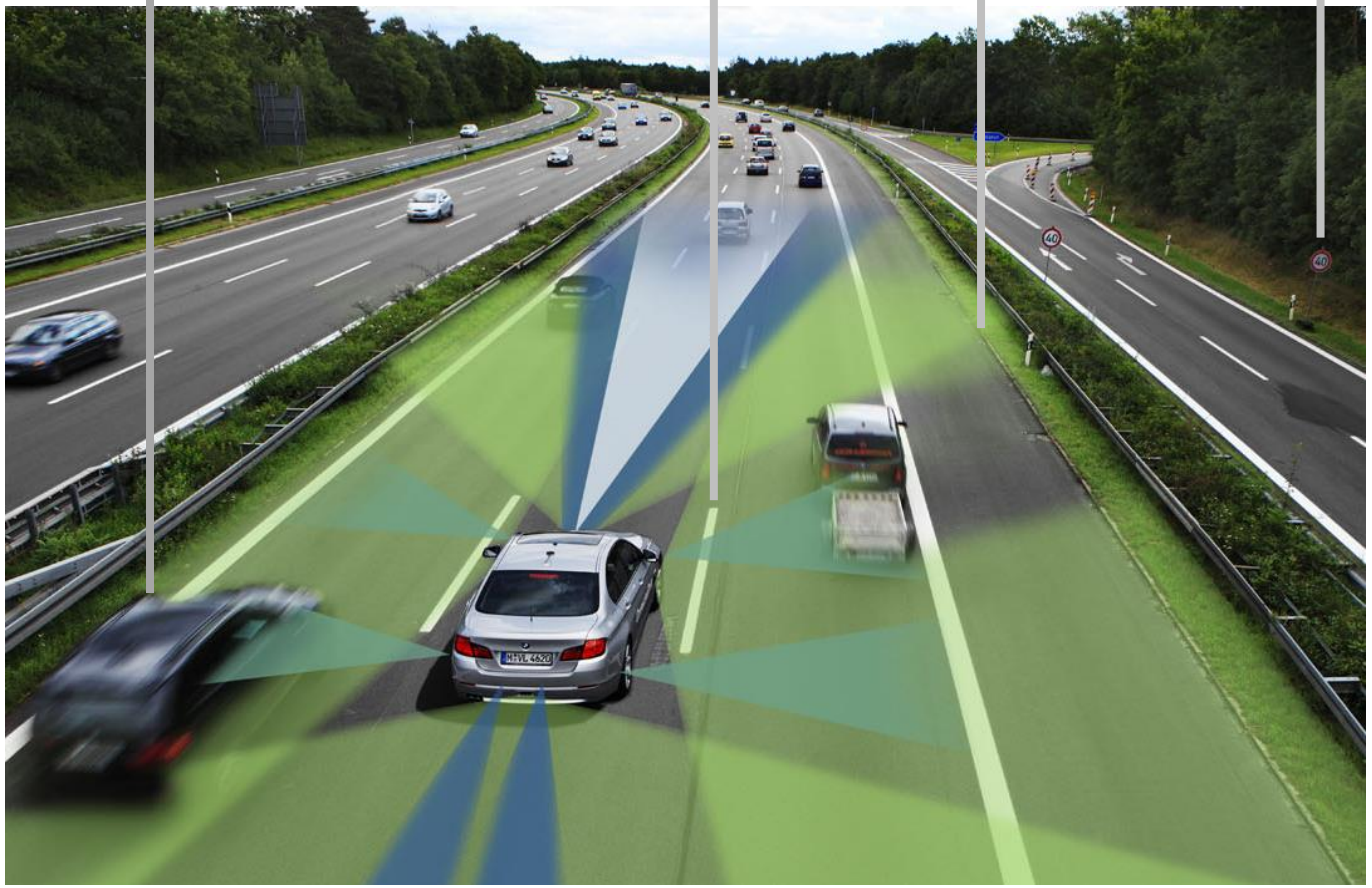
ACTIVE SAFTEY 3.0 – EXTENSION TO BROAD ENVIRONMENT PERCEPTION.

Dynamic objects (vehicles, pedestrians)

Lane markings

Crash barriers, shoulders

Traffic signs



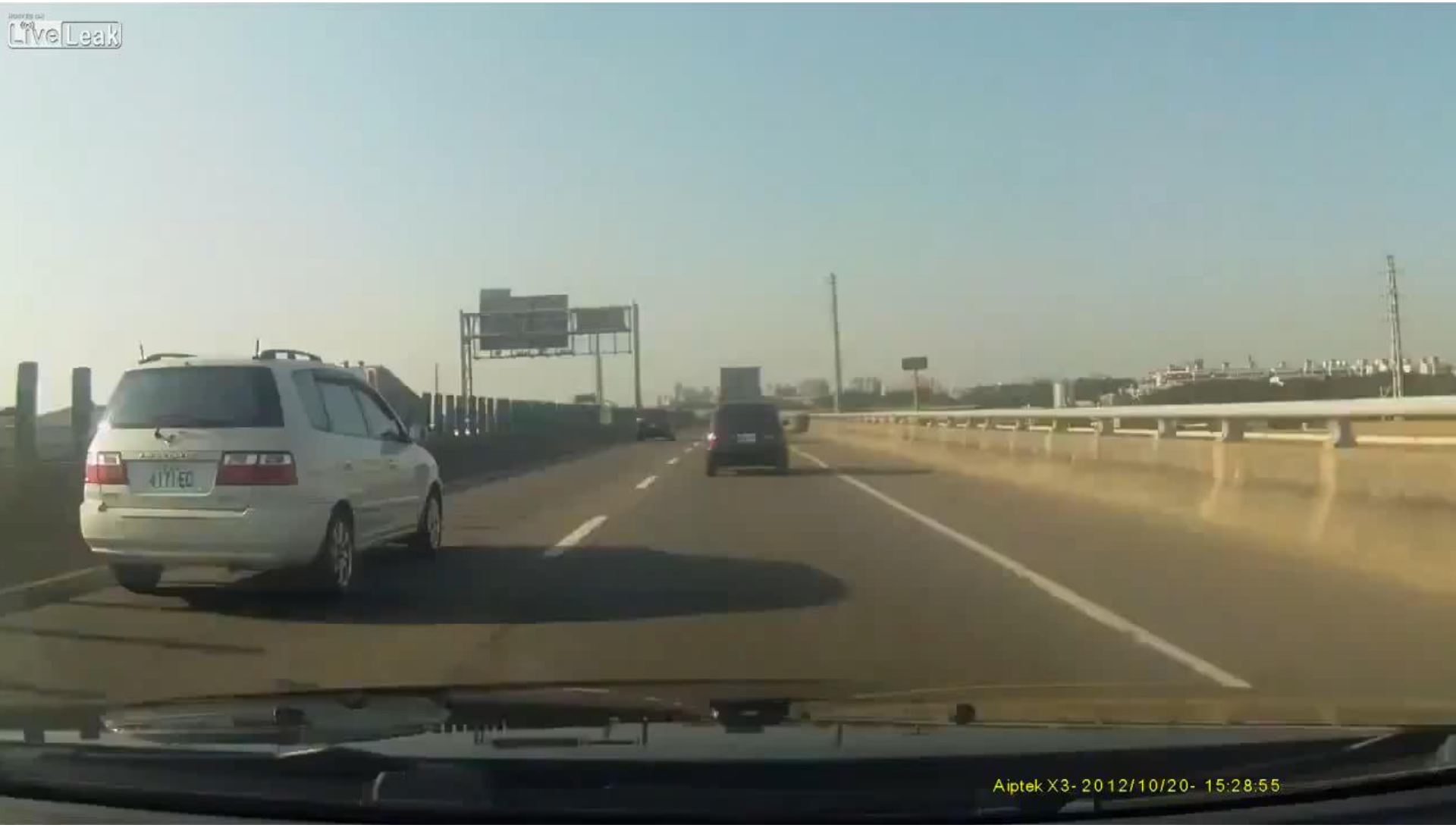
Sensors

- Mono / stereo camera
- Surround-view cameras
- FIR-camera
- Ultrasonic sensors
- Radar sensors
- Lidar sensors

- High accurate positioning / accurate maps

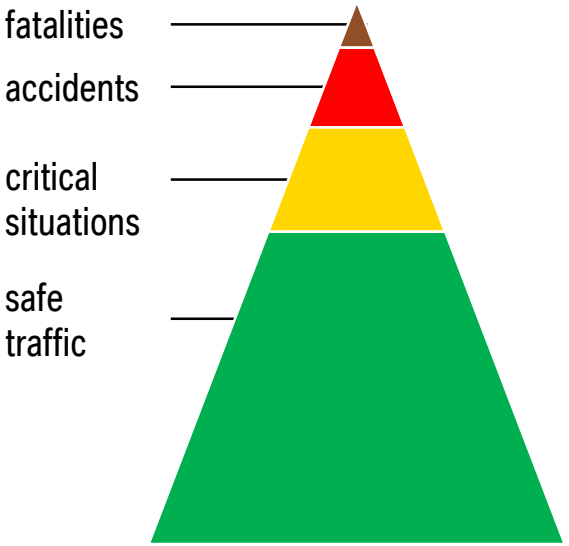
- Cooperative perception: Backend as a sensor / data provisioning

ACTIVE SAFTEY 3.0 – CONTROLLABILTY / DRIVER AWARENESS.

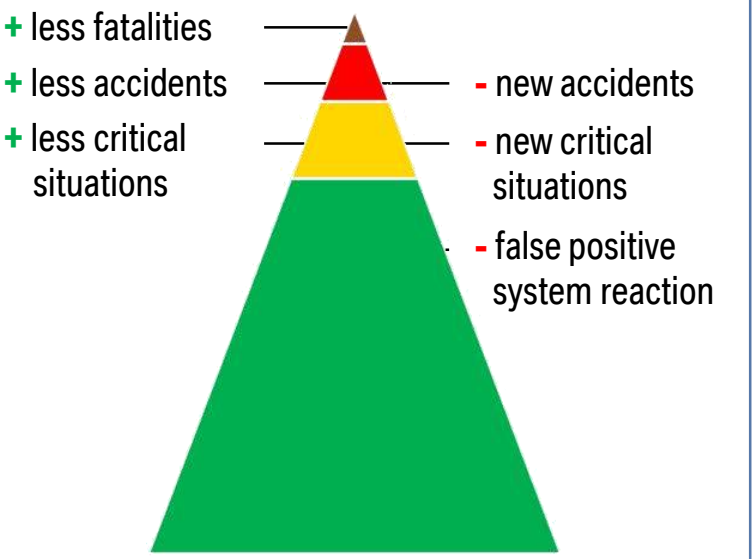


ACTIVE SAFTEY 3.0 – EVALUATION OF SAFETY EFFECTS IS ESSENTIAL.

Traffic – Baseline



Traffic with Function



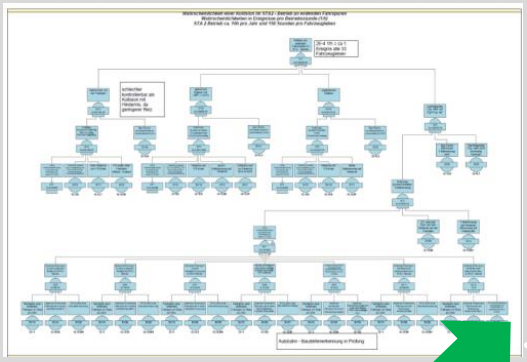
The overall safety evaluation shall…

… consider varying boundary conditions.

… quantify positive effects as well as possible undesirable effects.

… be able to illustrate complex results .

ACTIVE SAFTEY 3.0 – PROCESS OF ANALYSIS OF SAFETY.



Analysis of situations

Screening of potential critical situations

Likelihood

Controllability

Risk evaluation

Acceptable risk

Experts‘ evaluation in vehicles

Measurements

ACTIVE SAFTEY 3.0 – EFFECTIVENESS ANALYSIS – GENERAL APPROACH.

„sreening procedure“

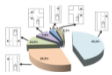
- risk analysis (GeSi, …)
- endurance tests (virtual, real)
- additional methods to derive new scenarios

traffic data (incl. accidents)

- accident types and causes
- FOT, NDS, road tests
- critical Isituations
- typical , non-critical situations
- …

scenarios

- type of street
- visibility
- driving direction
- traffic densitiy
- daytime
- brightness
- …



scenario range

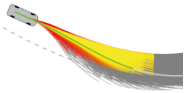
- definition and selection of relevant scenarios
- identifikation and description of relevant parameters
- Definition of influencing factors
- …

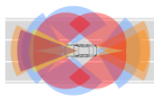
influecing factors / model development

- driver reaction.
- pedestrian reaction.
- capabilities of vehicle.
- environment
- …

driver assistant systems

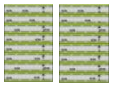
- Sensor model
- environment model
- system algorithms.





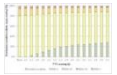
variation

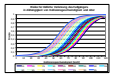
- stochastic variations (MonteCarlo).
- generating of numerous virtual, but representativ traffic scenarios



simulation/evaluation

- definition of evaluation matrix
- calculation of systems benefit and risk





Detailed description of all relevant scenarios for effectiveness analysis.

Including of additional data e.g. driver‘s performance.

Modeling of function and stochastic simulation.

Calculation of:

- avoided accidents
- mitigated accidents
- new accidents

ACTIVE SAFTEY 3.0 – STAKEHOLDER EFFECTIVENESS EVALUATION.

Independent institutions

Accident data

Traffic data

Human behaviour

Stochastical scenarios

ADAS model

Simulation

Results

Car manufacturer

Case selection

Vehicle validation tests

Results

Weighting of simulation results

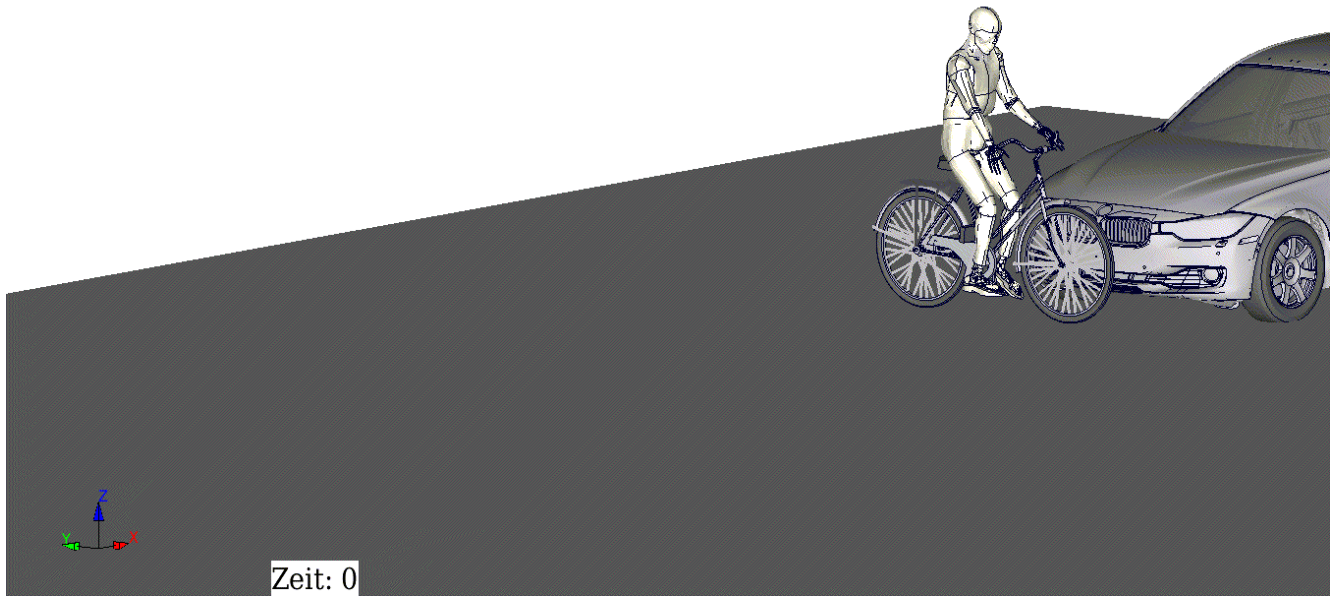
Rating

Test institutes

ACTIVE SAFTEY 3.0 – SIMULATION OF ACCIDENT BETWEEN CAR AND CYCLIST.

Basic scenario:

- car is driving straight, cyclist is crossing from near side
- impact position / overlap 10 %
- vehicle speed 40 kph, no braking → impact speed 40 kph
- bicycle speed 20 kph

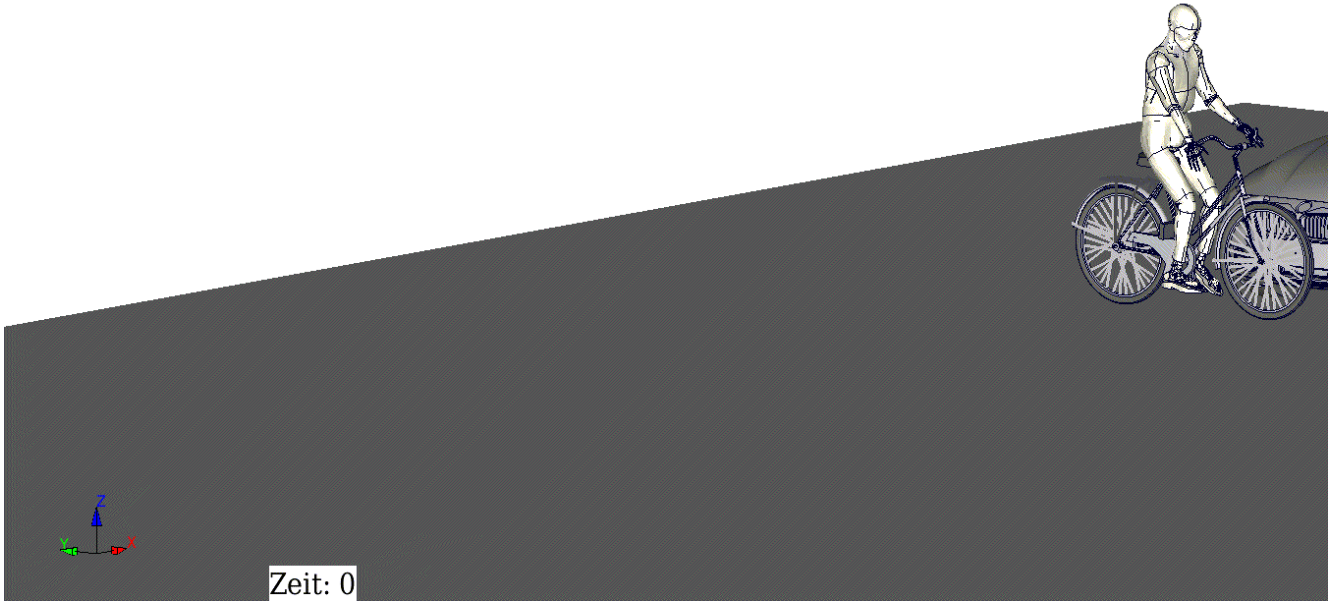


Scenario is not realistic → it can be expected, that driver will start braking latest after the collision

ACTIVE SAFTEY 3.0 – SIMULATION OF ACCIDENT BETWEEN CAR AND CYCLIST.

Braking scenario:

- car is driving straight, cyclist is crossing from near side
- impact position / overlap 10 %
- vehicle speed 40 kph, **braking after impact** → impact speed 40 kph
- bicycle speed 20 kph

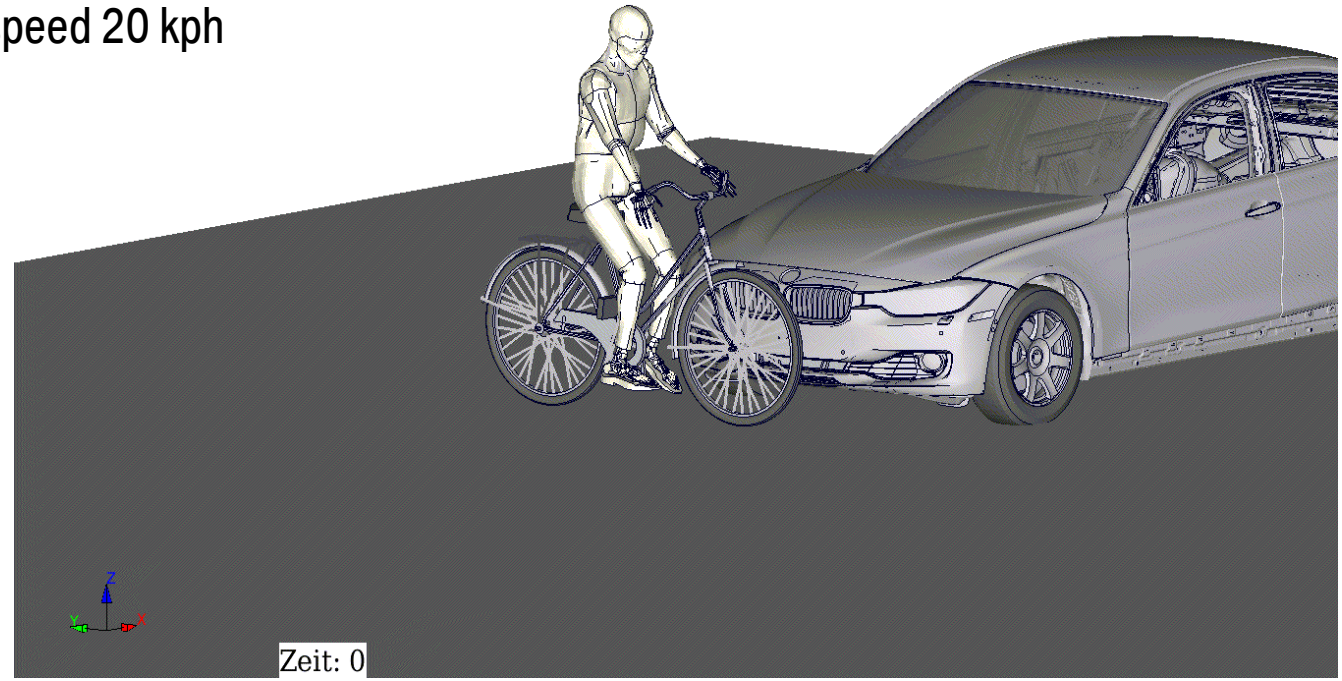


- head impact on windscreen, high resulting HIC-value
- second head impact on street with higher HIC-value than on windscreen

ACTIVE SAFTEY 3.0 – SIMULATION OF ACCIDENT BETWEEN CAR AND CYCLIST.

Anticipated AEB scenario:

- car is driving straight, cyclist is crossing from near side
- impact position / overlap 10 %
- vehicle speed 40 kph, **braking before impact → impact speed 20 kph**
- bicycle speed 20 kph

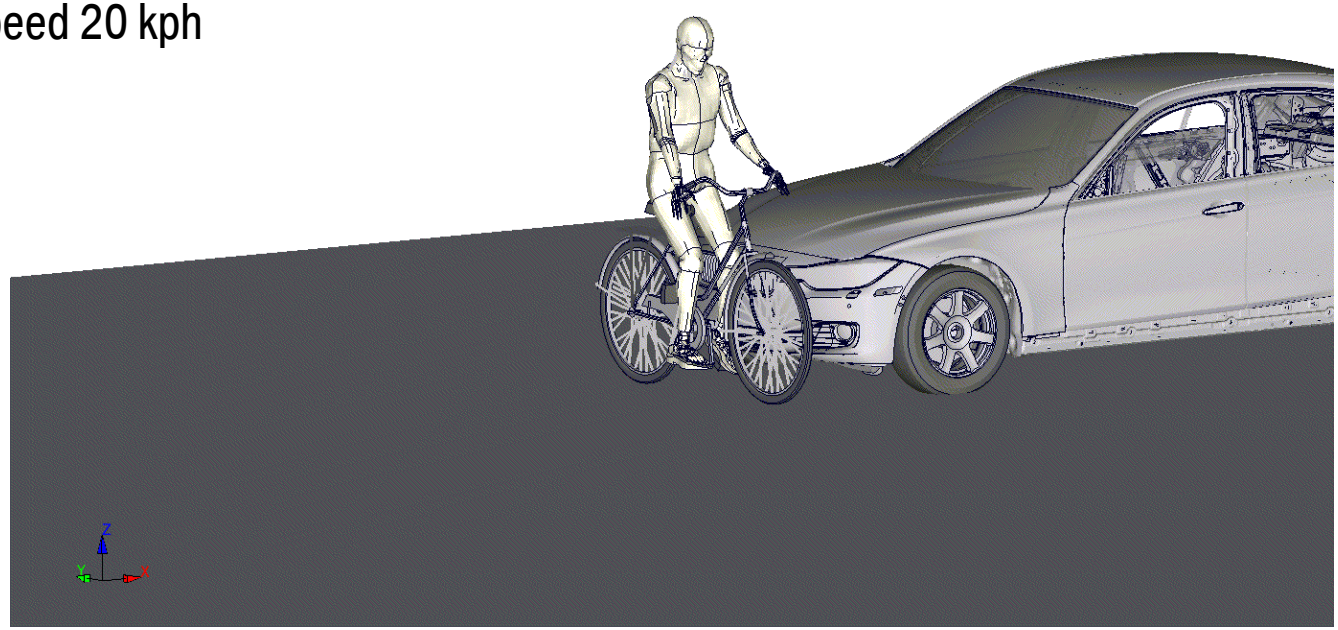


- head impact on bonnet, very low resulting HIC-value
- second head impact on street also with higher HIC-value than on bonnet but as well on low level

ACTIVE SAFTEY 3.0 – SIMULATION OF ACCIDENT BETWEEN CAR AND CYCLIST.

High overlap scenario:

- car is driving straight, cyclist is crossing from near side
- **impact position / overlap 50 %**
- vehicle speed 40 kph, braking after impact → impact speed 40 kph
- bicycle speed 20 kph



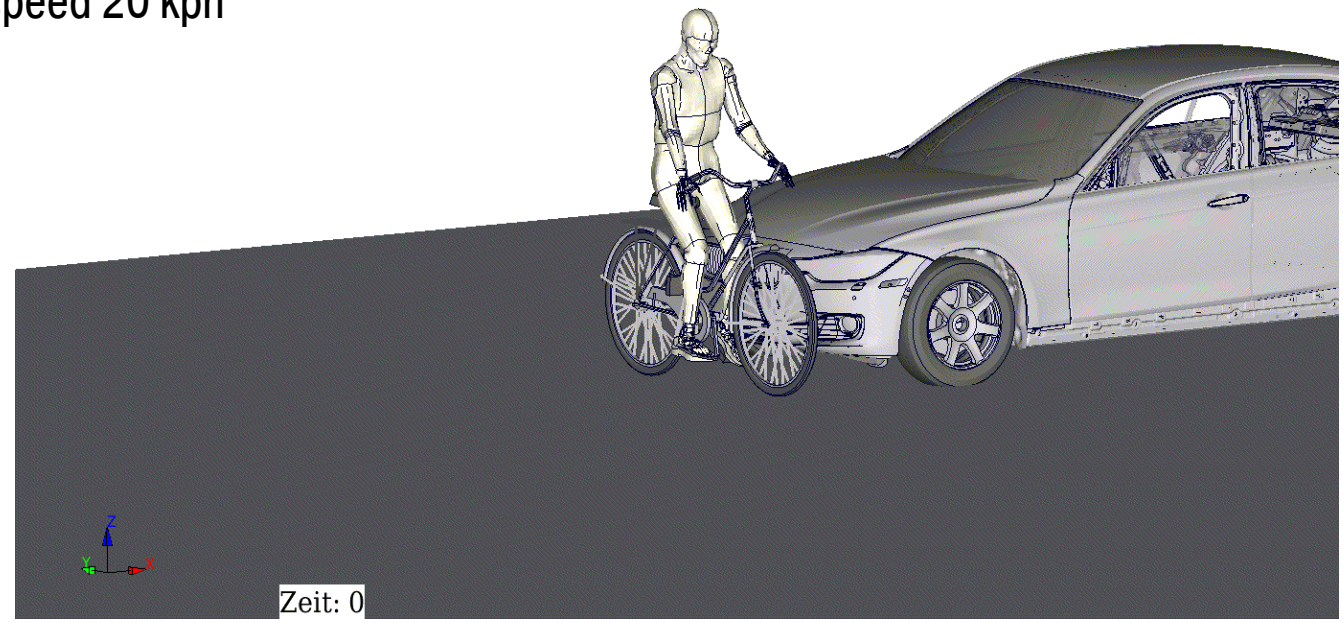
- no head impact on the vehicle
- in comparable scenarios a lot of cyclists will not have a head impact on the vehicle

→ Passive safety systems would have a rather low effect!

ACTIVE SAFTEY 3.0 – SIMULATION OF ACCIDENT BETWEEN CAR AND CYCLIST.

High overlap scenario with AEB-system:

- car is driving straight, cyclist is crossing from near side
- **impact position / overlap 50 %**
- vehicle speed 40 kph, **braking before impact → impact speed 20 kph**
- bicycle speed 20 kph



- no head impact on the vehicle
- in comparable scenarios a lot of cyclists will not have a head impact on the vehicle

→ Limited effect of passive safety, speed reduction has positive effect!

THANK YOU FOR YOUR ATTENTION.