Augmented Reality in Cars
Requirements and Constraints

Dr. Klaus Bengler
Robert Passaro

BMW Group
Forschung und Technik

That‘s the Face behind the Name ->

Augmented Reality in Cars

Driving task - Basics and Constraints

A simple Model of the Driving Task.
Levels and Subtasks.

Stabilisation

Manouvering

Navigation

Driving Situation - Driving Task.
Cognitive Processes.

Control of Speed

Control of Distance

Steering

Observe other vehicles

Figure out what they will probably do

Observe lanes, deciding which to take

Handle the actuators

Detect traffic signs

Remember traffic signs

Observe traffic rules

Watch various displays

Route planning and navigation

Listen to radio traffic messages

...

Future Applications
Infrared – Night Vision

Visual Night Scenery

FIR Night Vision

„Augmented“

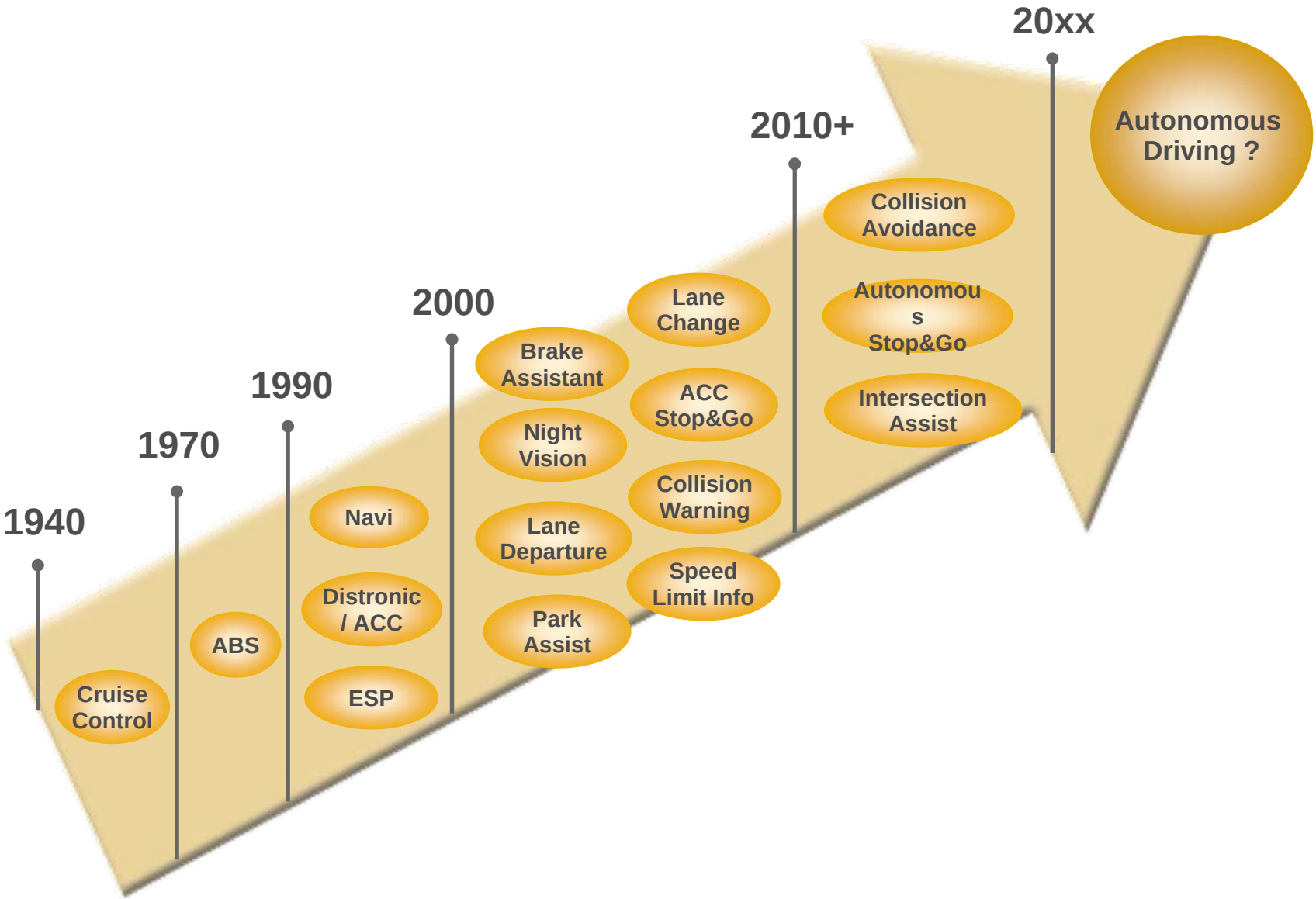
Future Applications
Driver Assistance.

Car to Car Communication

Lane Change Assistance

Advanced Driver Assistance Systems.

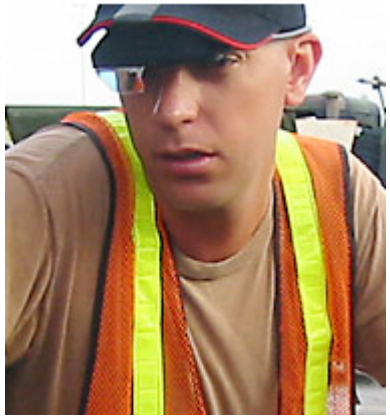
ADAS Evolution.



Augmented Reality in Cars

State of the art

Augmented Reality Applications

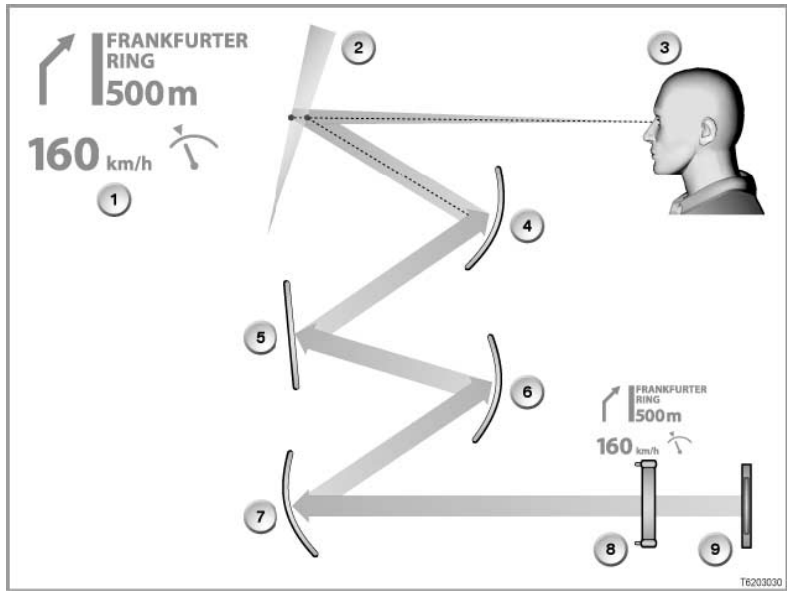


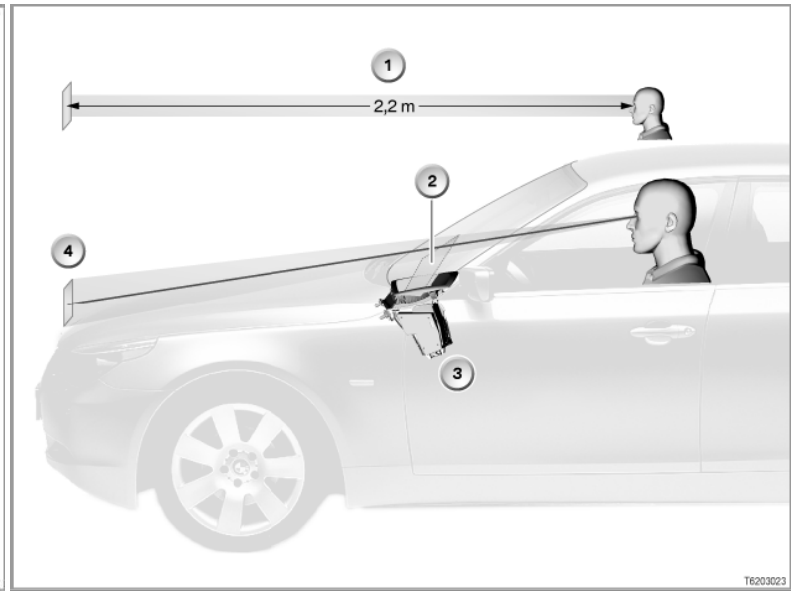
Information Presentation.
An Expert‘s Workplace.

Human - Machine – Interaction in Vehicles.
“Get virtual“.

State of the Art.

BMW Head-Up-Display-System.





Principle: Projection of contents onto the frontscreen

- Adaptation of display to visual properties
  - viewing angle
  - brightness
  - image distance

- Traffic scenery stays in field of vision
- Enthusiasm by innovative technology

Head-Up-Display.

Augmentation or Additional Information.

Head-Up-Display.
In Vehicle Requirements.

In vehicle augmented reality means

existing systems are already highly optimized
„optimization on a high level“

to introduce AR relative to moving objects (external) in a
moving object (own vehicle)
higher dynamic compared to aviation
more mobility compared to medicine, industry

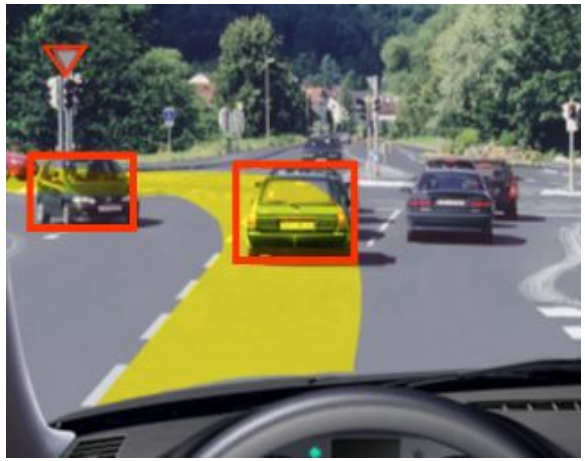
Augmented Reality in Cars

Requirements

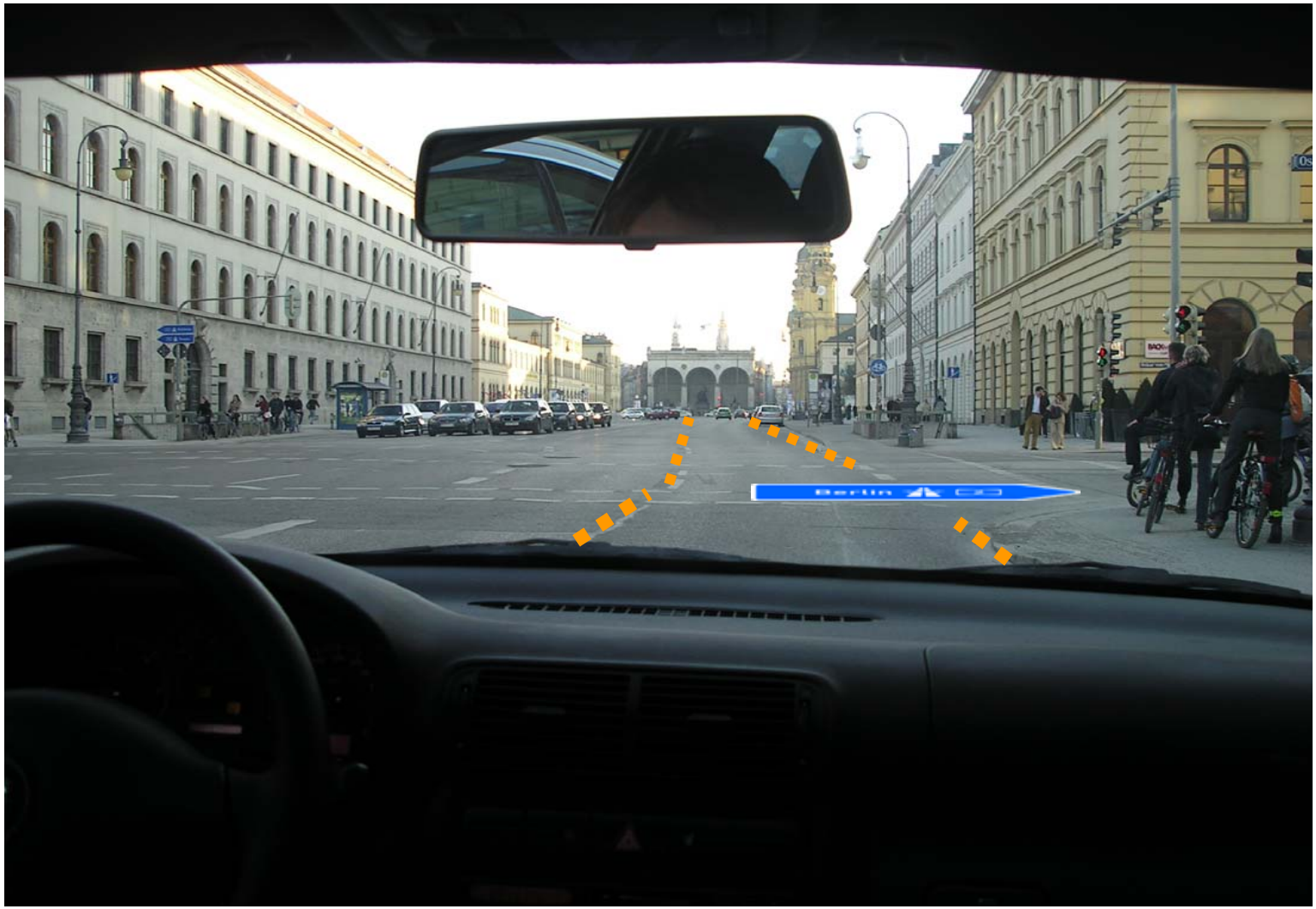
Examples for Augmentation.
Should AR Go this Far ?








Examples for Augmentation.
Readability or Obstruction ?



Examples for Augmentation.
Time Horizon vs. Clutter

Far Distance
No Clutter

Far Distance
Including Clutter

Questions

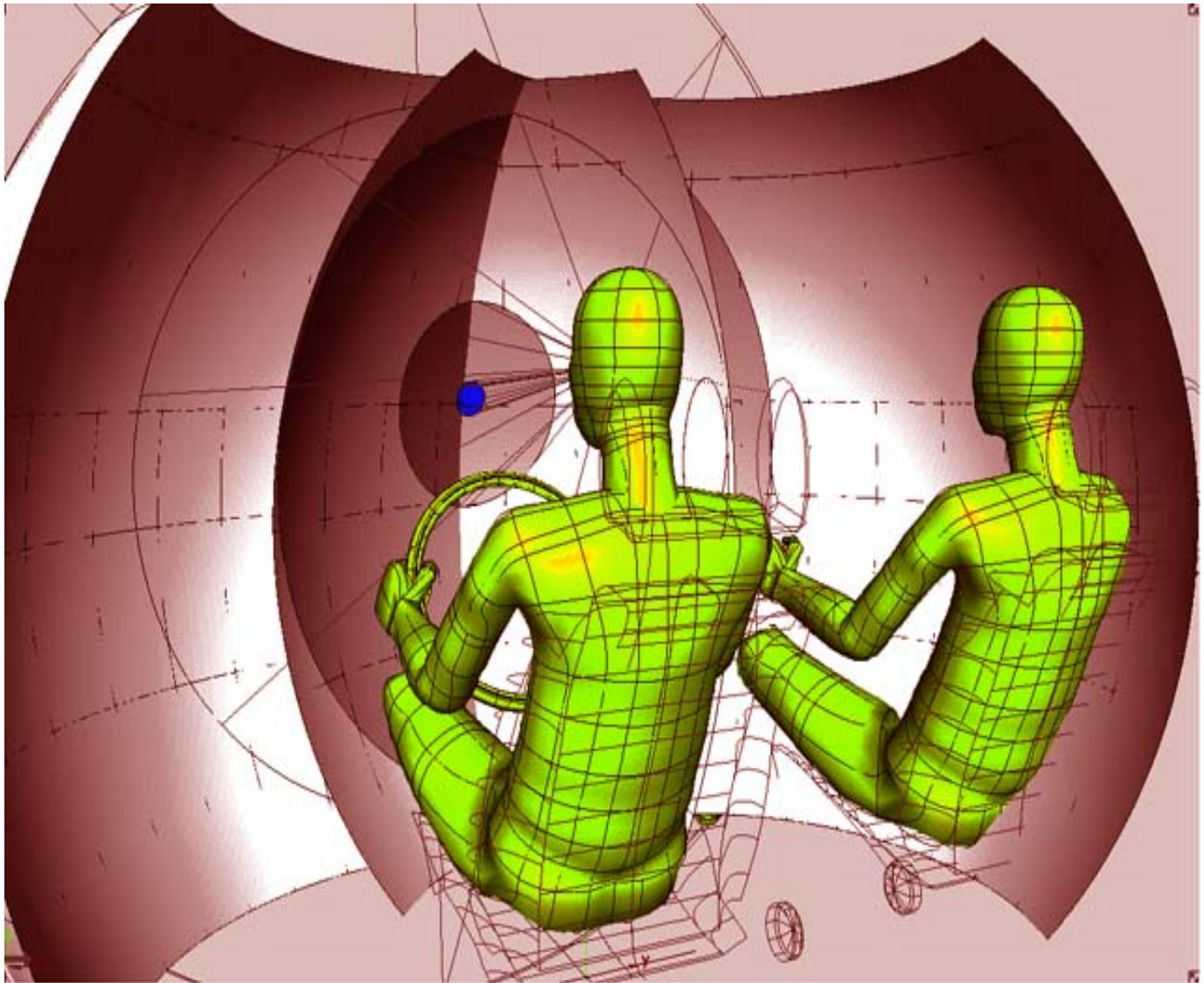
- Is it possible to use one augmentation principle (e.g. overlay of additional information)
  in any traffic situation / for any application ?

- Is it possible to avoid obstructions and driver distraction using reasonable AR-methods ?

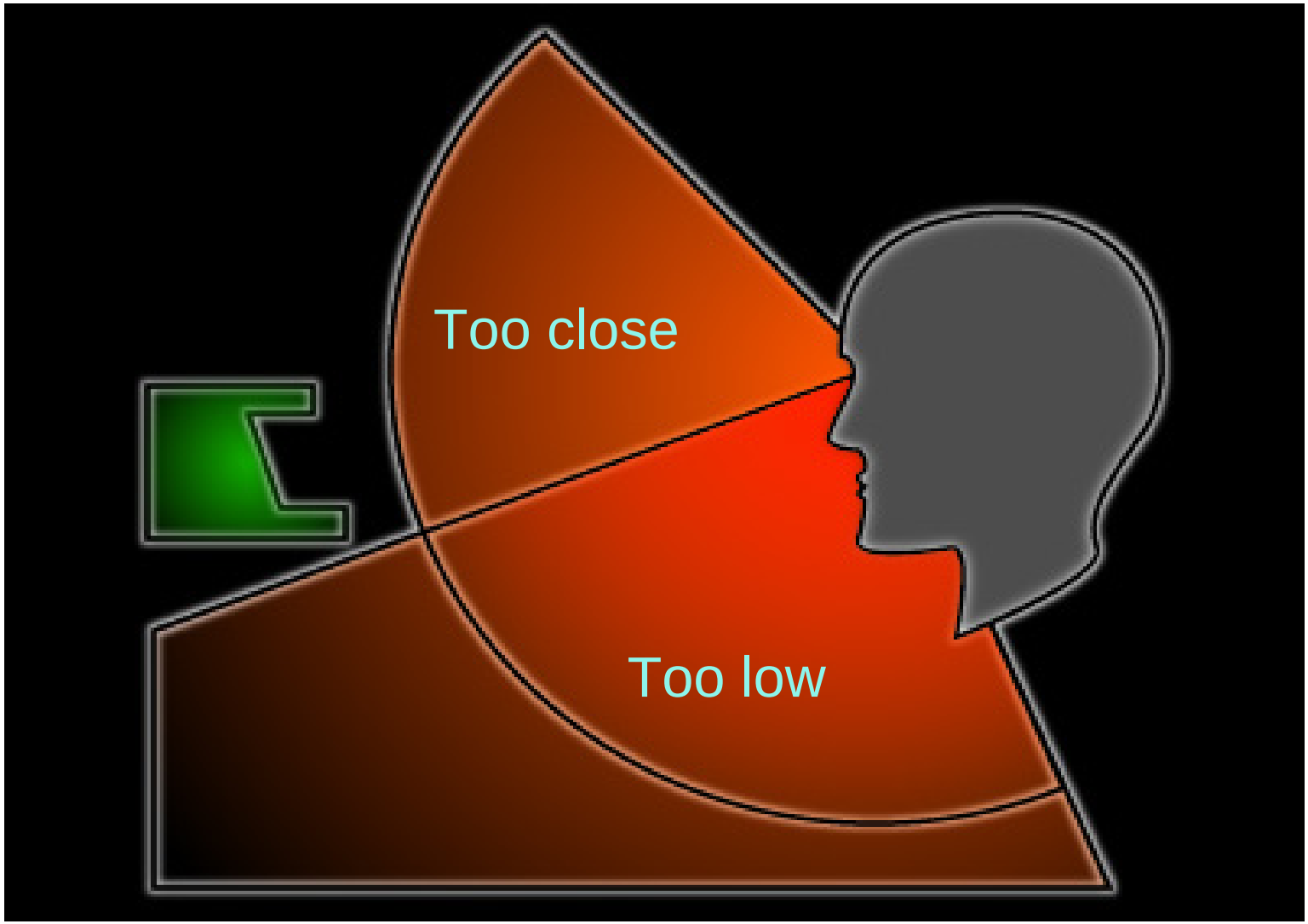
Augmented Reality in Cars

Constraints

Driver Workplace.
External Visual Information.



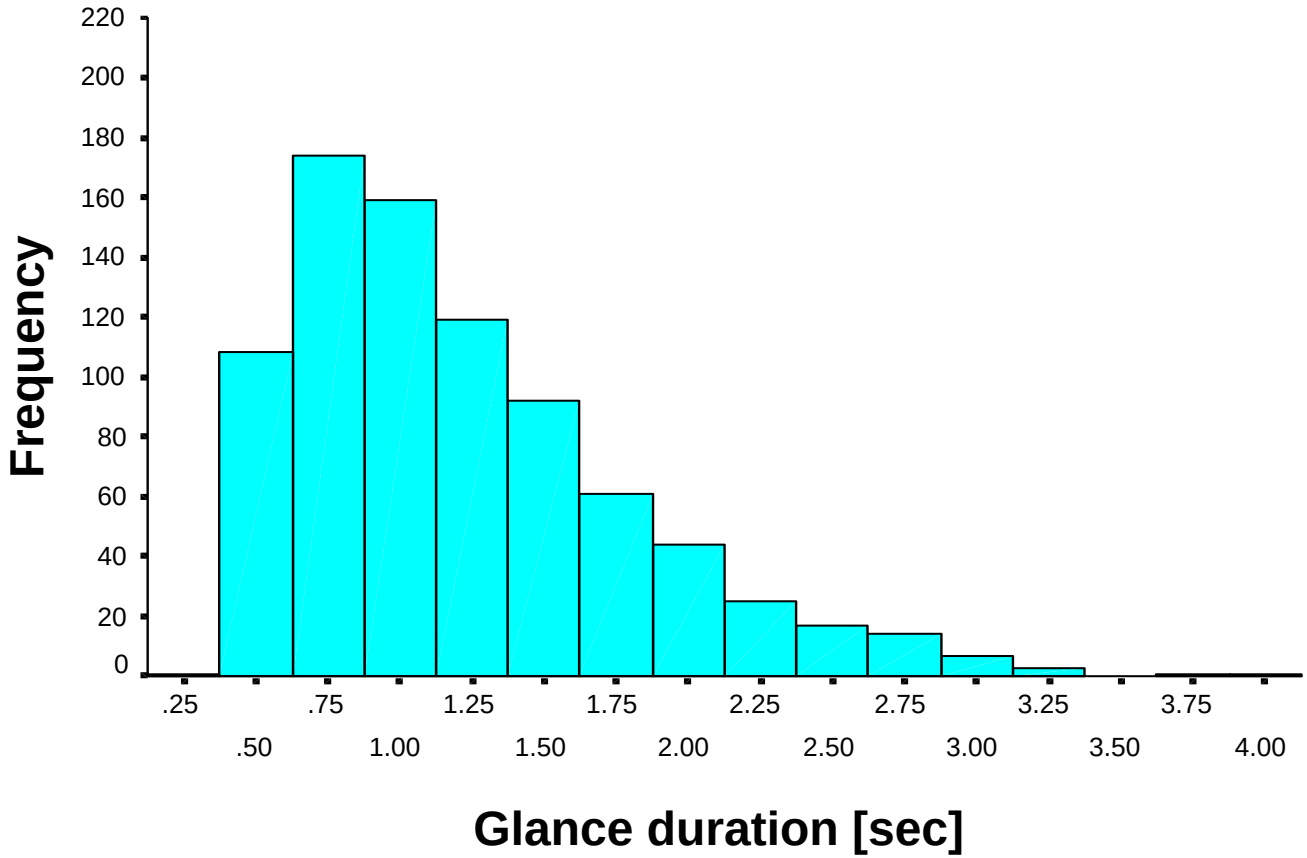
Driver Workplace.
Internal Visual Information.



Evaluation Tools.
Eye Tracking.

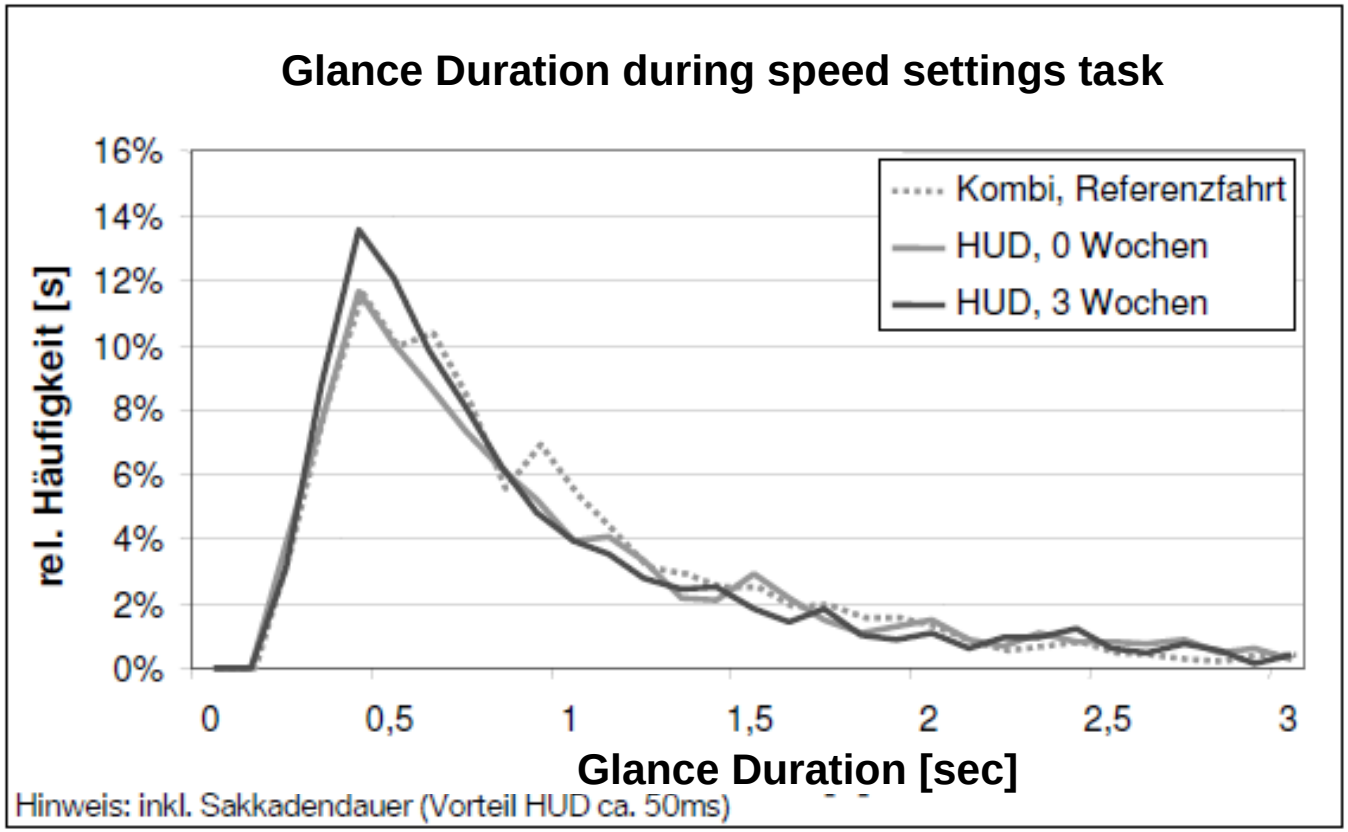
Eye movement behavior.

Typical Glance durations.



Visual Behavior.

Head up vs. Head down.



Ergonomic Requirements.
Cognitive Effects.

Avoid Information Overload
Large amounts available information
High rate of new information
Contradictions in available information,
Low signal-to-noise ratio
Inefficient methods for comparing and processing of information

Avoid Cognitive capture
situation where the driver may be totally ”lost in thought,”
could impair situational awareness.

Induced by
high emotional content
Instruments that require cognitive involvement

Avoid Perceptual Tunneling
Originally comes from aviation

Individual becomes focused on one stimulus (cf. flashing warning signal; neglects to attend to other important tasks/information)

Ergonomic Requirements.
Driving Performance.

Evaluation of solutions using

Visual behavior

Lane keeping behavior – lateral performance

Speed regulation – longitudinal performance

Object and Event Detection in the scenery

Augmented Reality in Cars
Guidelines

- Especially augmented reality in cars must be oriented to the requirements of the driving task.
- Non-conformal moving images are not allowed. Overlay images shall not lead to obstructions
- Improved driving performance is **the** indicator whether additional information is reasonable
- Side effects (Cognitive Capture, Tunnel Vision, ..) have to be avoided
- In general creativity has to be balanced with carefulness if additional visual information is introduced to the car Whether additional information is a potencial distractor depends on the driver needs and driving situation
- Compared to other environments a solution has to be of outstanding quality, be „non intrusive“ and non disturbing

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