



EU-Project HEIDI Research Activities on Human-Machine-Interfaces

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HEIDI has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101069538.



A decorative graphic consisting of two intersecting diagonal lines that form an 'X' shape. A vertical line is positioned to the left of the intersection point. The word 'Introduction' is written in a light blue font to the right of the vertical line.

Introduction

HEIDI

Holistic and adaptive Interface Design for human-technology Interactions



- Funded project of the European commission
- Development and evaluation of internal, external and cooperative HMI
- 09/2022 → 08/2025,
- 3 years duration



External
HMI

International Partners:

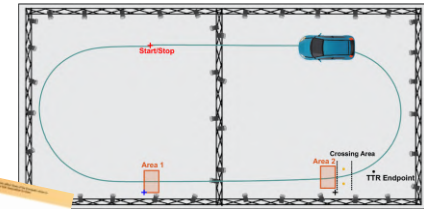
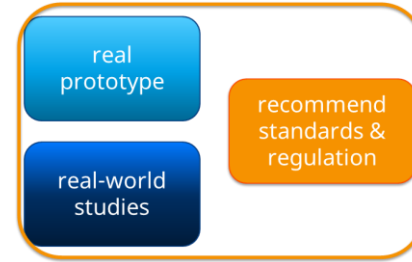
- BMW, Germany
- Reutlingen University, Germany
- Honda Research Institute, Germany
- Marelli Germany GmbH,
- NiSys, Germany
- VTI, Sweden
- Tree Technology, Spain
- Universidad de Alcalá, Spain
- Virtual Vehicle, Austria



Focus eHMI

Goal w/ Industry Perspective

- Create a „**realistic**“ communication display
 - form follows function
 - adaptable to **entry** level and **high** level cars
 - demonstrate **efficacy** in **near-real-world scenario**
 - clear scenario, high number of interactions
 - **measured data** + questionnaires
 - create proposal for **regulatory framework**
- ➔ Enable a „new“ light function in mid-term-future

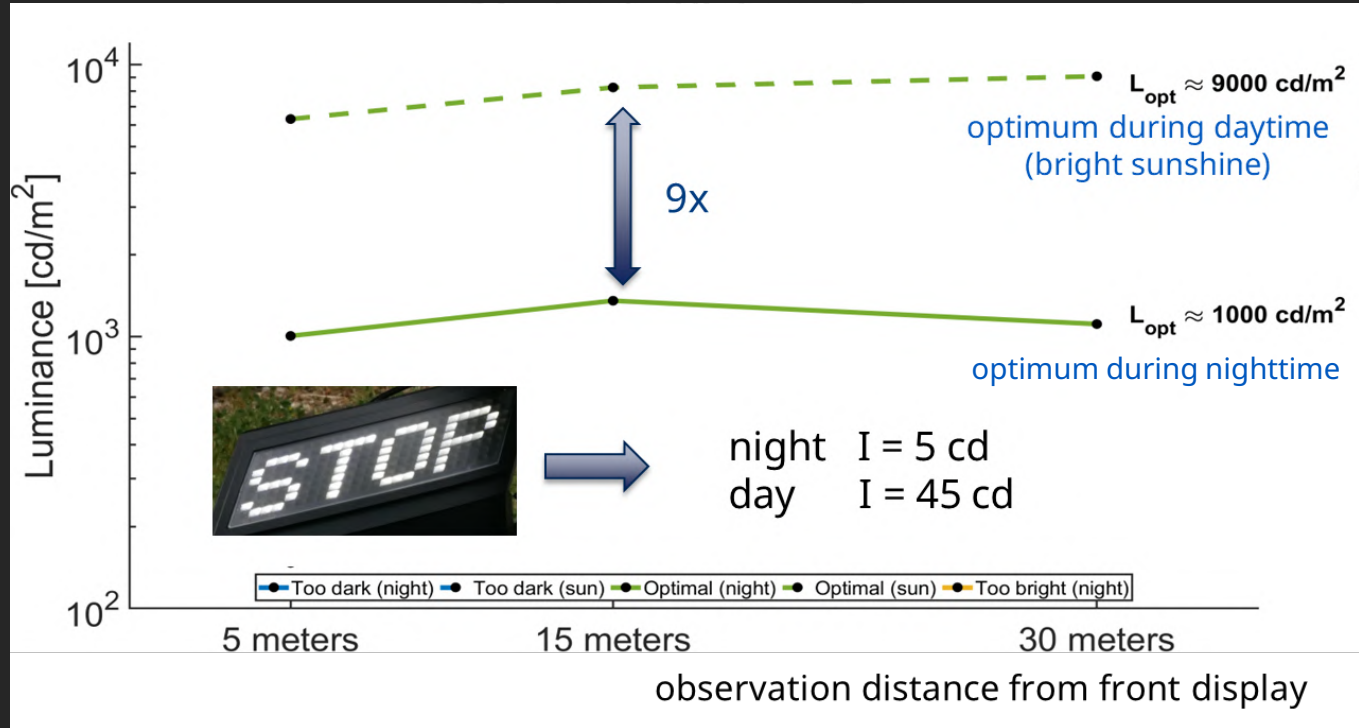


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Basic Lighting Parameters

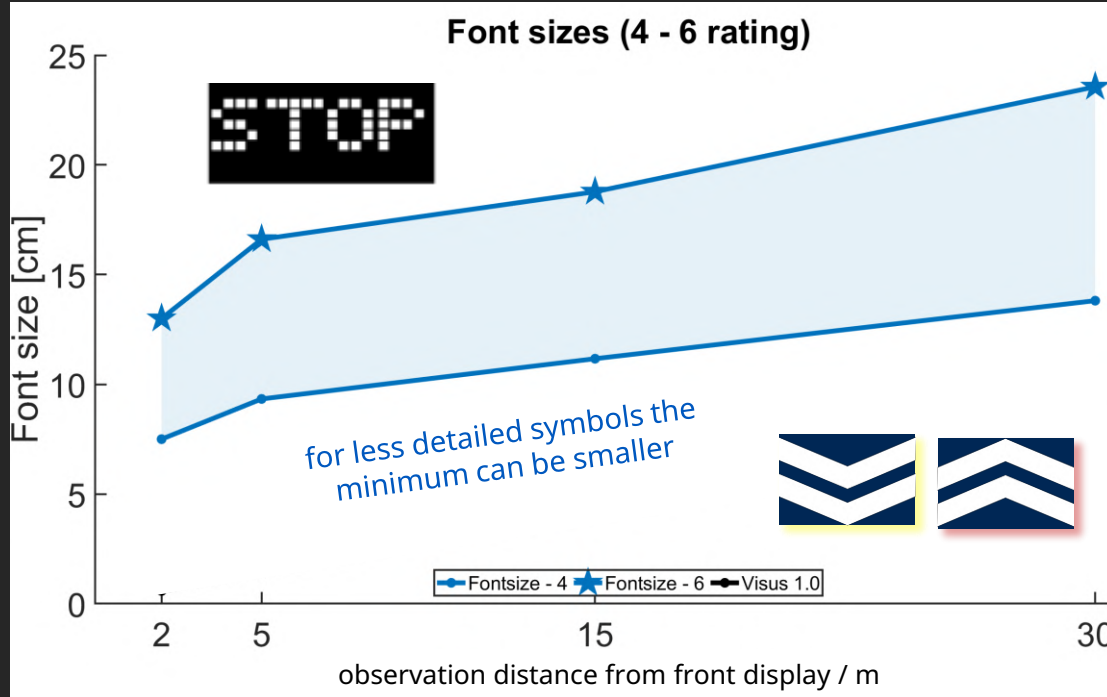
Real World Experiment on Signal Matrix

Results out of the Test Runs: Luminance Needs



Future Signal Matrix Applications

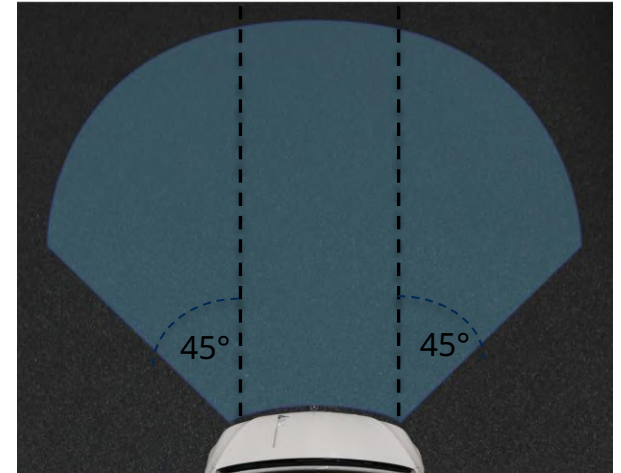
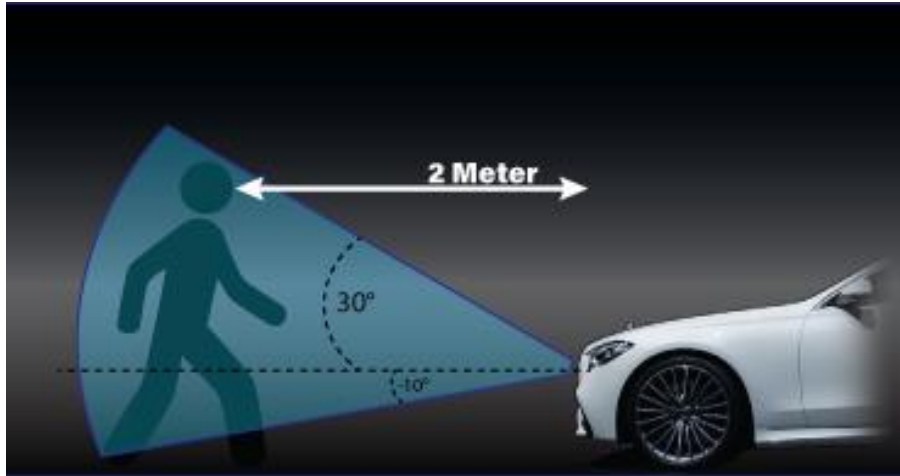
Results: Font Size evaluation (4 – 6 rating) Readability



Future Signal Matrix Applications

Guideline for Lighting Parameters for Frontlighting Display Communication:

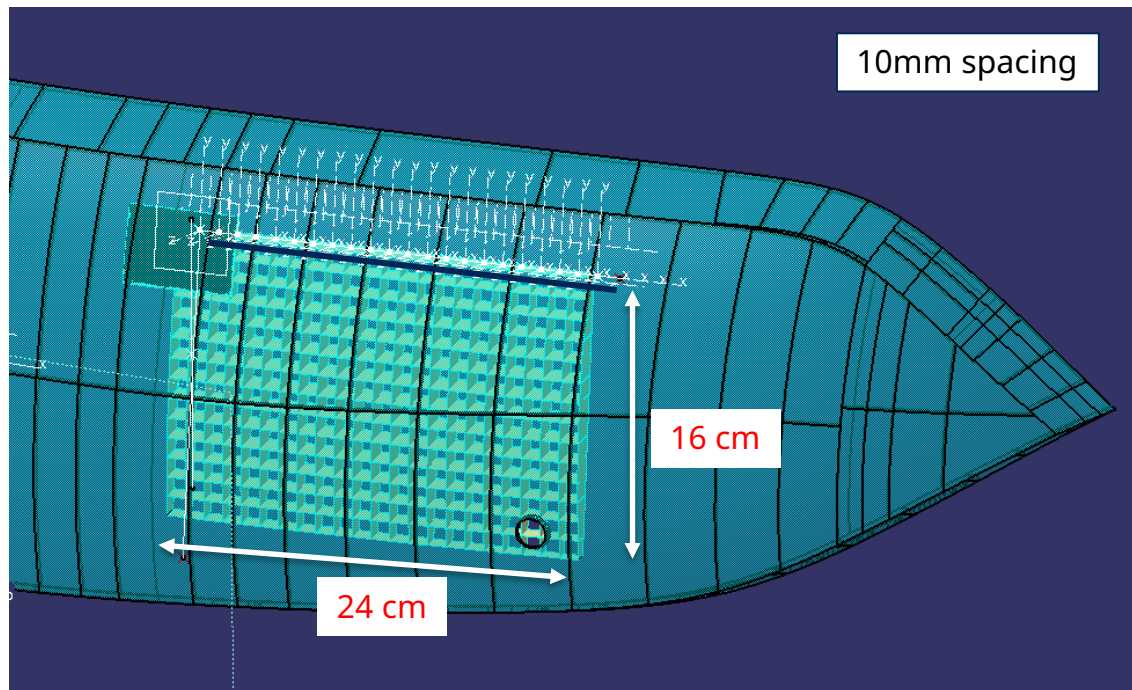
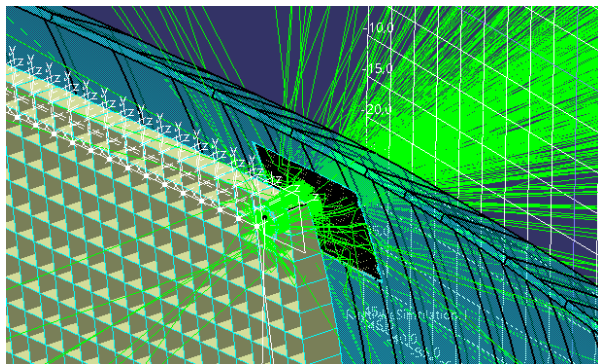
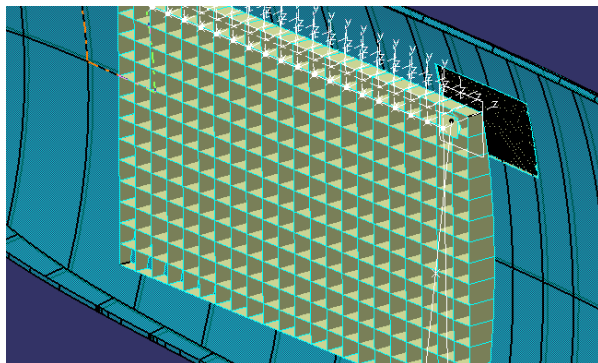
„Active“ sector size:



2

Prototype

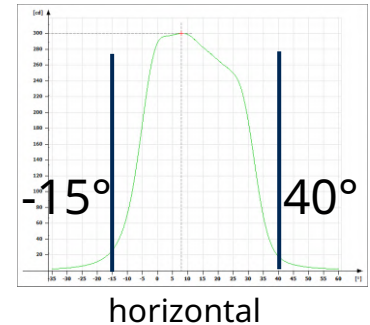
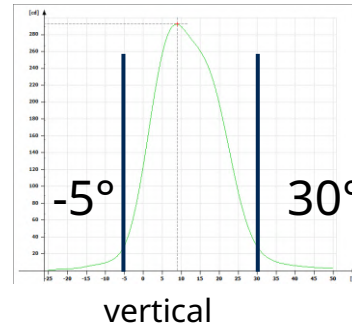
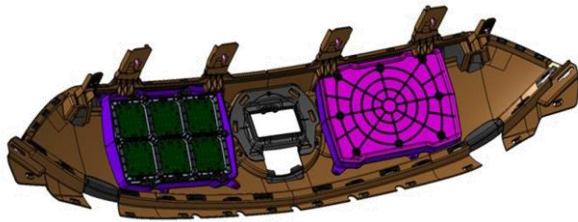
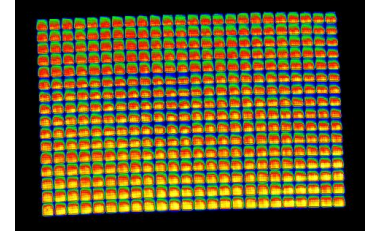
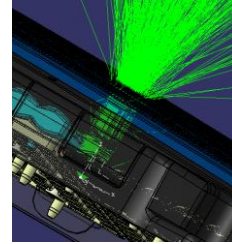
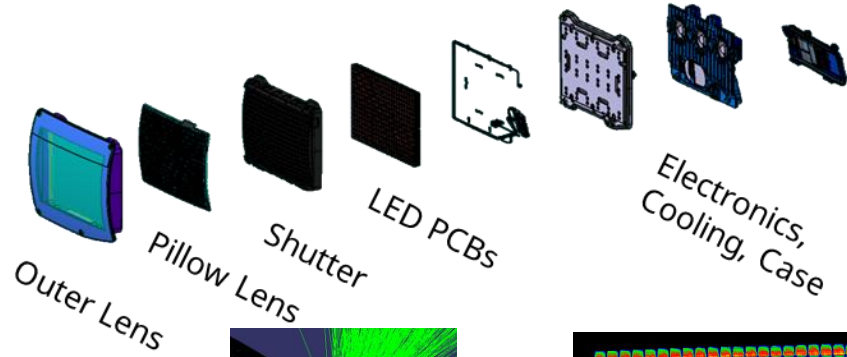
Heidi optical design



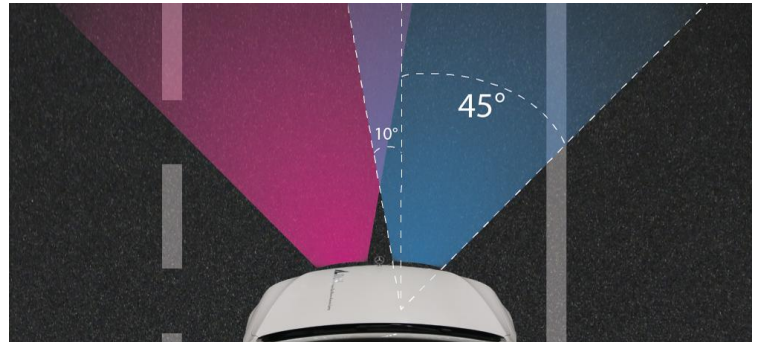
eHMI Prototype Concept



- 24x16 pixels, 10 mm pitch
- 384 Osram iRGB LEDs
- 9000 nits (cd/m²) (adjustable)
- asymmetric viewing angles
- integrated to panel



EU Funded Project: HEIDI Displays on Test Vehicle

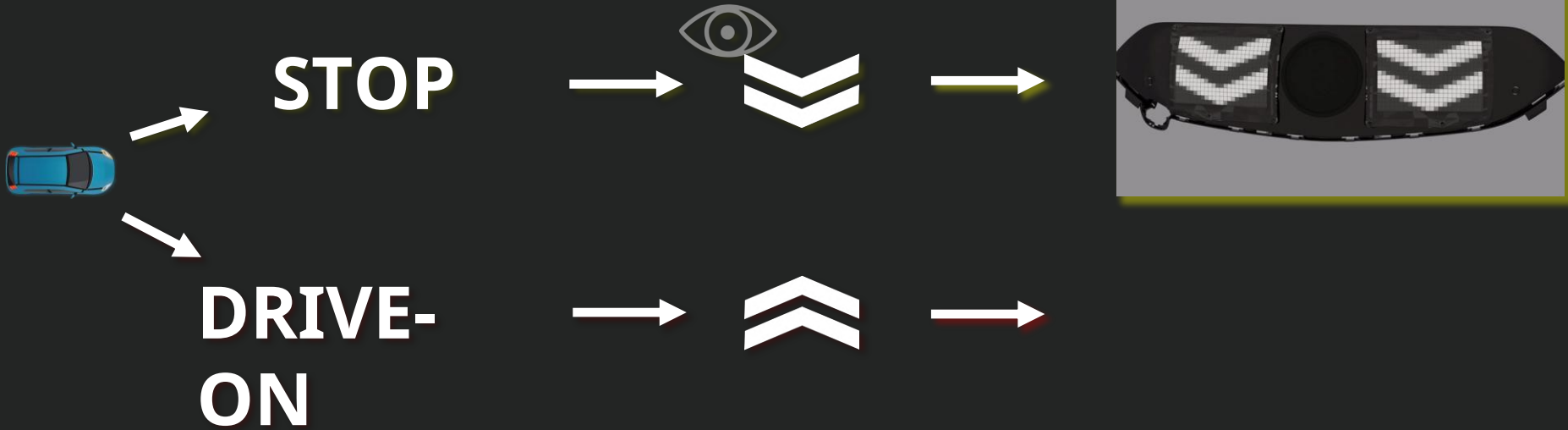




Evaluation Setup

eHMI Display

- 16 x 24 RGB Pixels

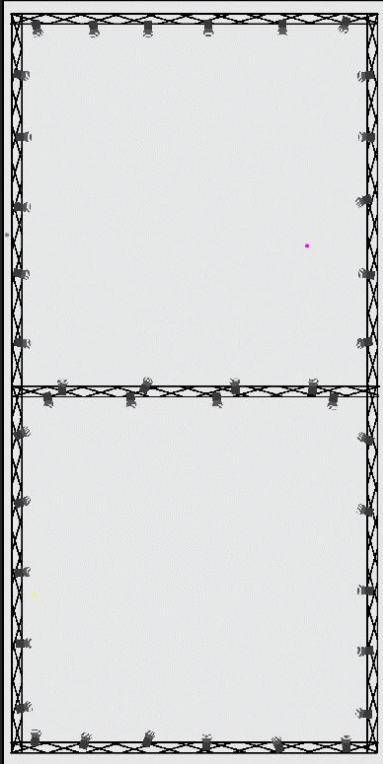


3D Motion Tracking

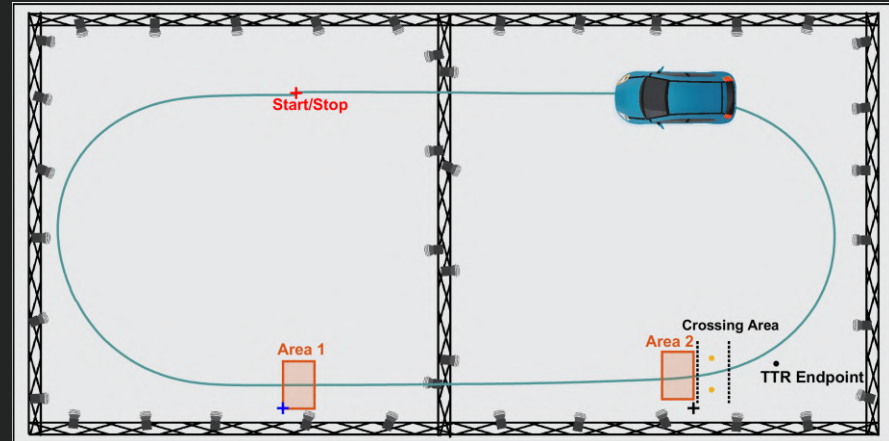


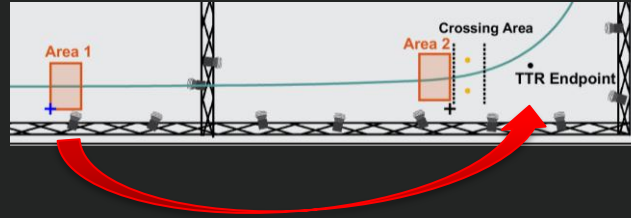
- 60 m x 30 m „Trackable“ Area
- 38 IR-Motion Tracking Cameras
- Multi-Object Tracking
 - Simultaneous Tracking of Car and Pedestrian



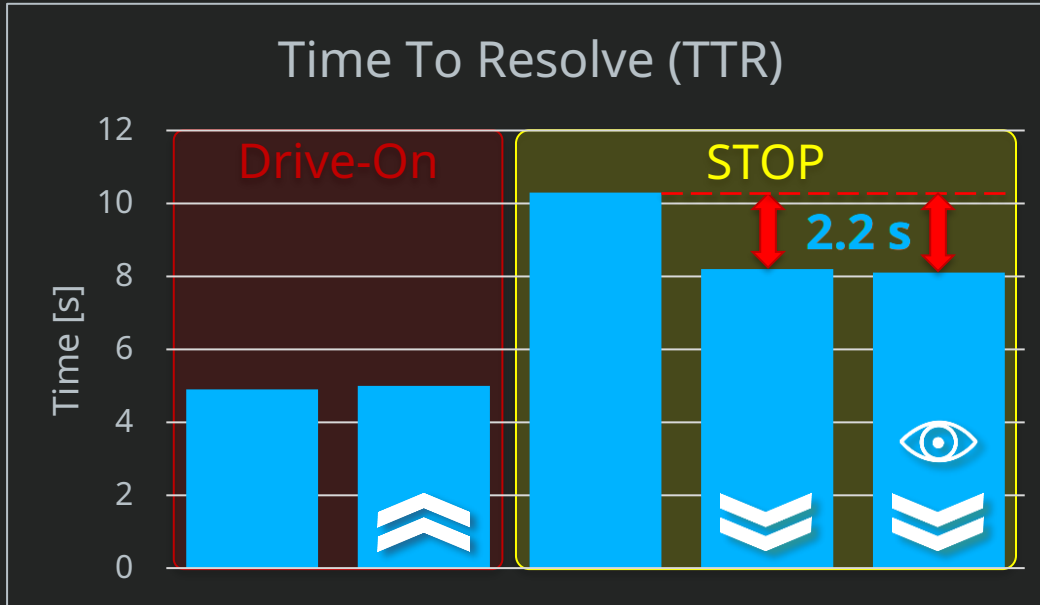


- 27 Participants (7 female)
- 1050+ Interactions
- Several Parameters calculated
 - Velocities, distances, time to collision
 - **Time to resolve (TTR)**





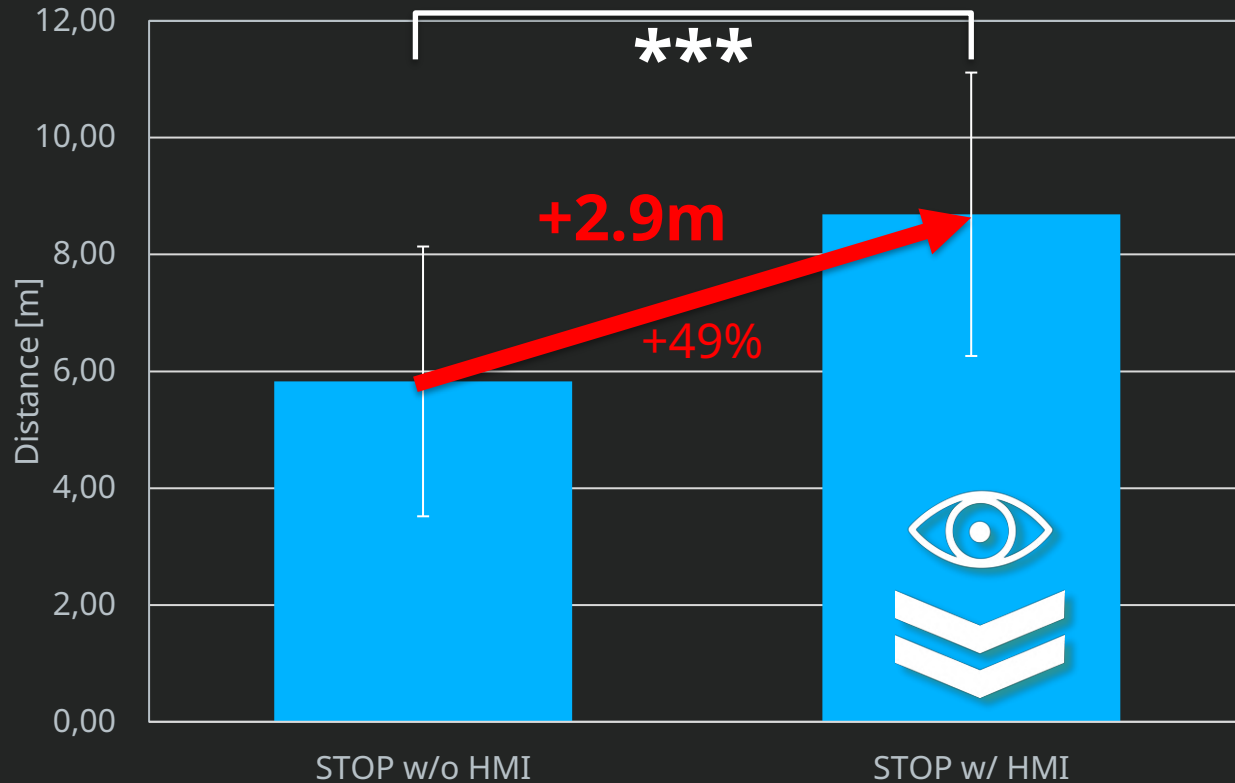
- Time To Resolve (TTR)



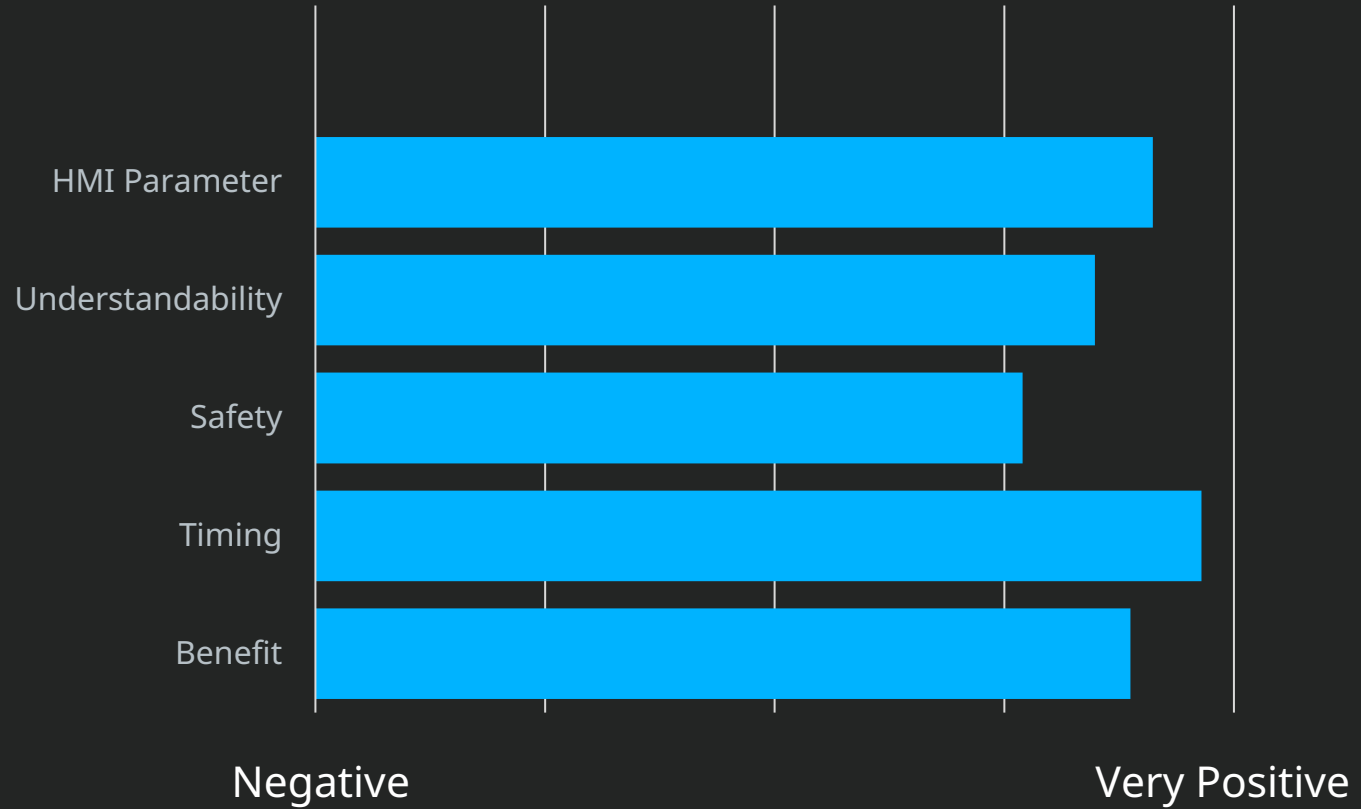
w/o HMI

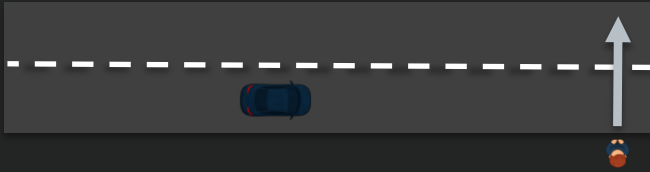
HMI

Distance: Car - Pedestrian



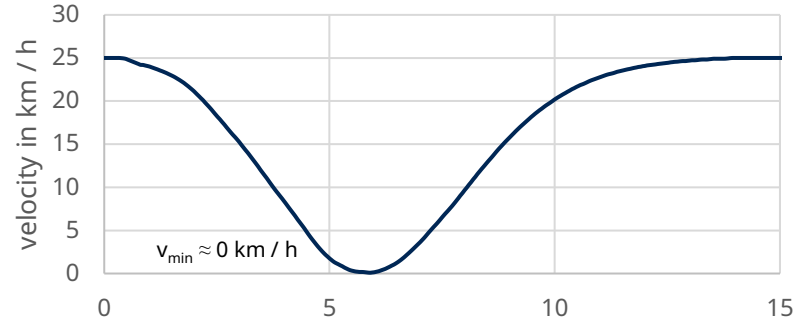
Results Questionnaire



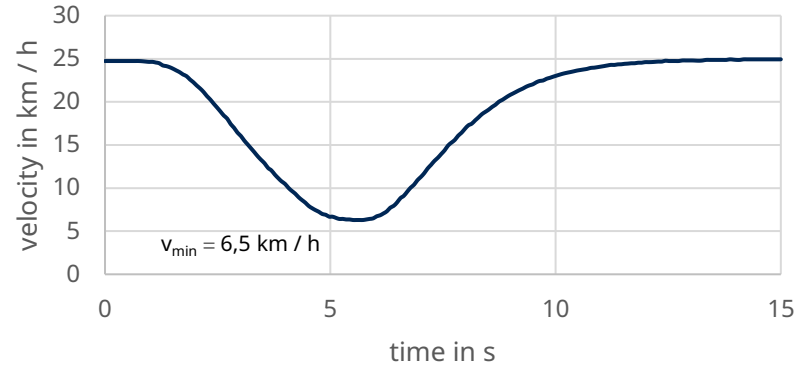


Traffic flow: speed

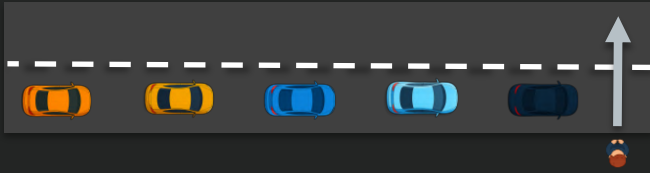
w/o external Display



w/ external Display



Traffic Flow Simulation

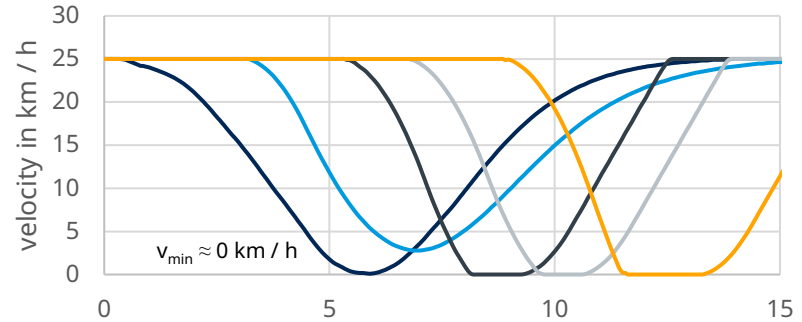


Simulation:

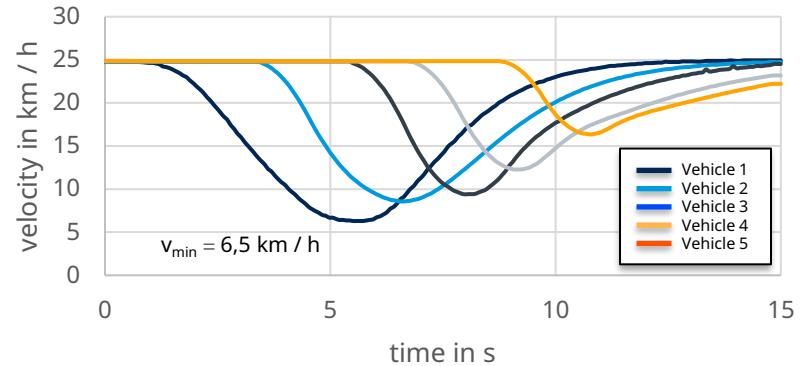
- 5 vehicles
- Distance between cars 18 m
- Velocity at start: 25 km / h

Traffic flow: speed

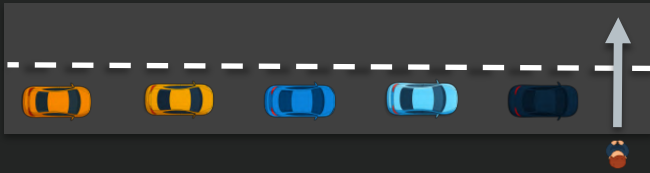
w/o external Display



w/ external Display



Traffic Flow Simulation

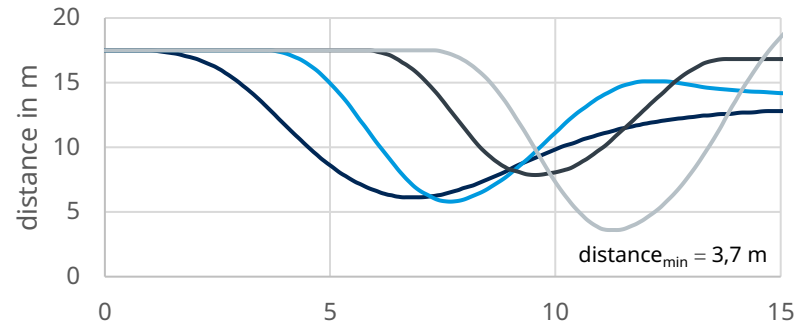


Simulation:

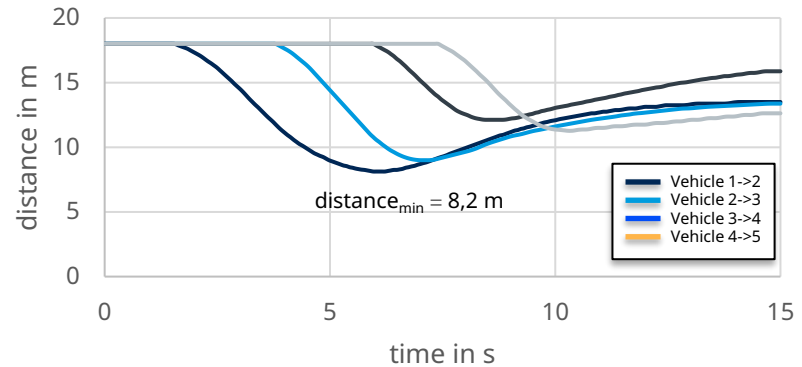
- 5 vehicles
- Distance between cars 18 m
- Velocity at start: 25 km / h

Traffic flow: distance V2V

w/o external Display



w/ external Display





Recommendations for Legal Regulation

Proposal for ECE-Regulation



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Finalised recommendations for legislation proposal and standardisation

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Finalised recommendations for legislation proposal and standardisation



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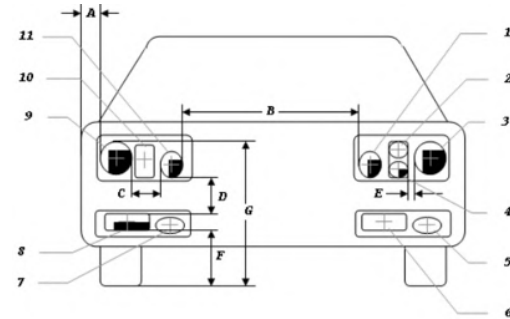
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Proposal for Regulation

Key aspects – position & size

- Placement below windshield & inside POS
- Either single eHMI or one per side of vehicle
- center placement optional
- No requirement on size of eHMI
→ size of pattern/symbol
min: 100 cm², max 800 cm²

HEIDI display ~400 cm²



Proposal for Regulation

Key aspects – brightness & colour

- **adaptive** brightness
 - 700 – 1500 cd/m² → night
 - >3000 cd/m² → cloudy day
 - >9000 cd/m² → bright day
 - adapt to environment (rain, fog, etc.)
- **mandatory** colour for messaging **white**
 - cyan optional
 - amber optional in connection to emergency brake etc.



Proposal for Regulation

Key aspects – messages & patterns

- **Three Messages**
 - Vulnerable Road User (VRU) **detected**
 - Vehicle will **decelerate / stop**
 - Vehicle stays **at speed / accelerates**
- **Pattern requirements**
 - recognizable at distance
 - dynamic (either moving or segmented)

Flashing permitted

No conflicting patterns at same time



Proposal for Regulation

Key aspects – vehicle requirements & limitations

- **Vehicle requirements**

- ADAS level 3 or higher
- reliably detect VRUs at distances of 30 m
- recognize VRU intention
- calculate time to collision and similar metrics


- **Limitations**

- only active at speed <55 km/h
- Fail State = OFF



LIDAR
CAMERA 
EYE-TRACKING



RADAR 
LIDAR
CAMERA (VIS, IR)
V2X COMMUNICATION
(LIFI)



Thanks!