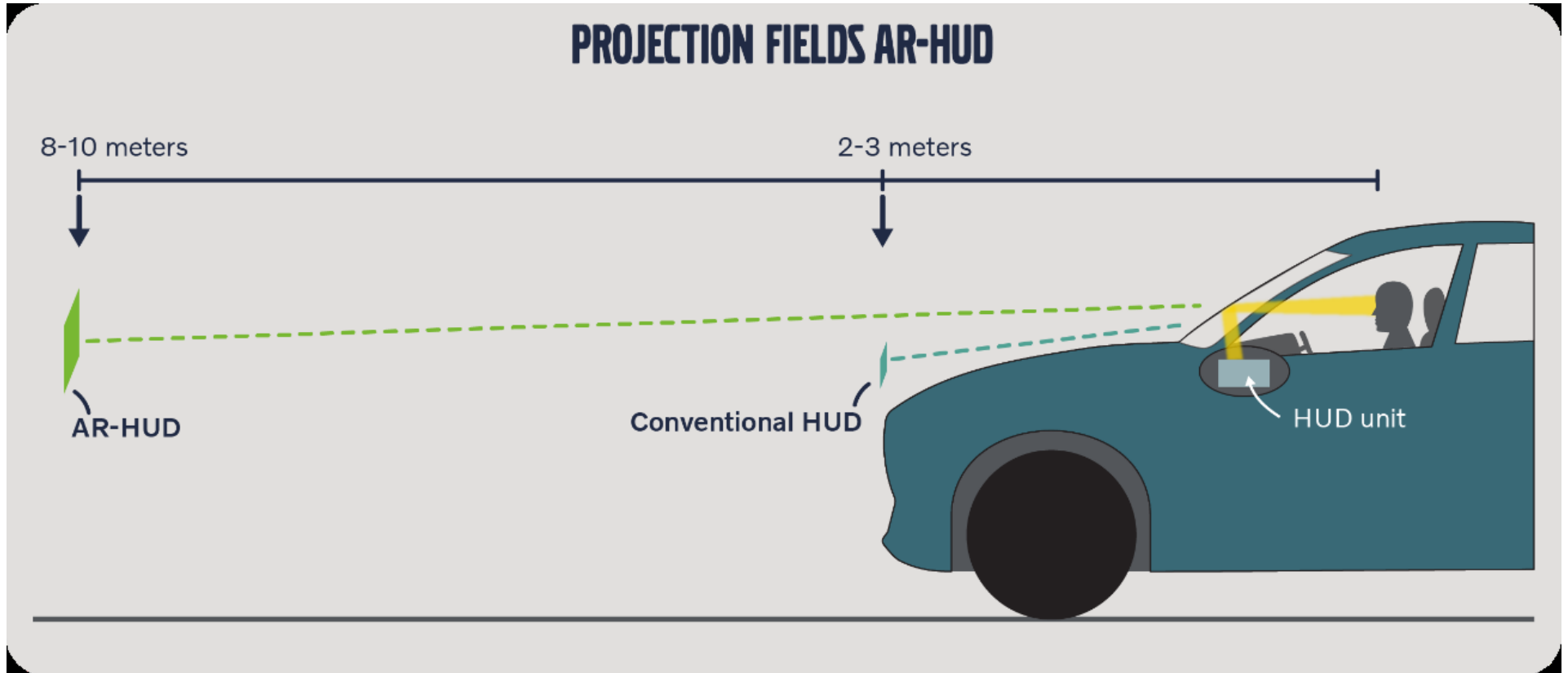


SCREENS

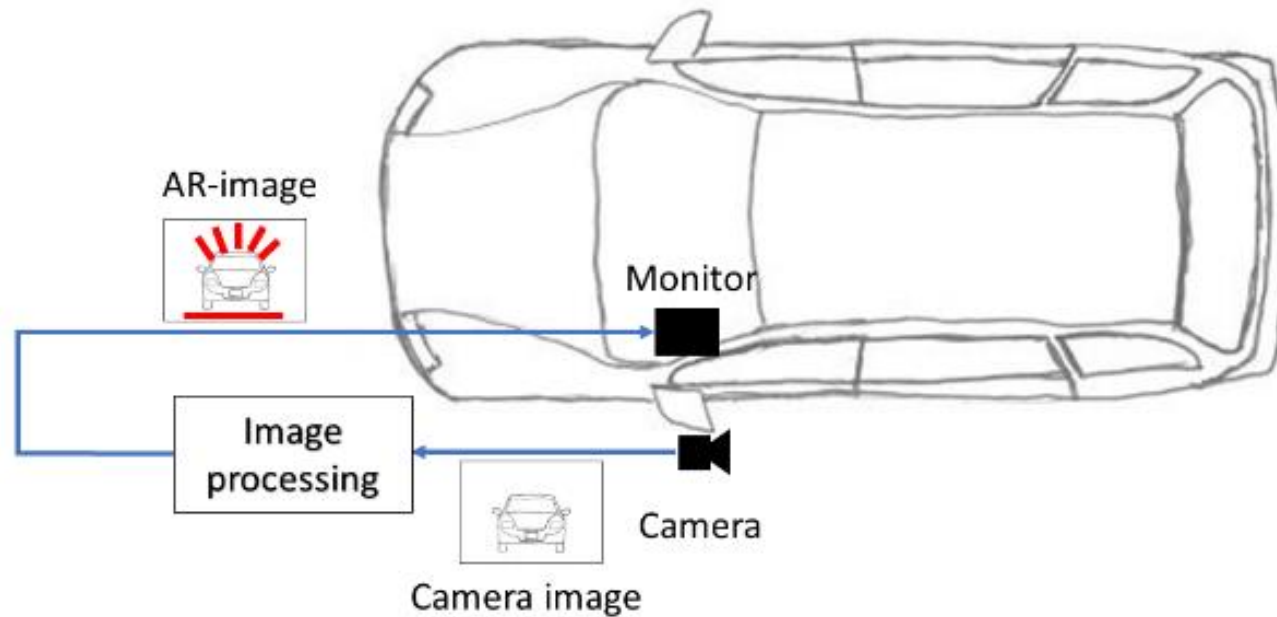
Safe Car Driving with Head Up Displays
and Camera Monitor Systems



Augmented Reality Head-Up Display (AR-HUD)



Camera Monitor System (CMS)



Project organization and budget

- Volvo Cars
- RISE Research Institutes of Sweden AB
- **Budget:** 6 722 067 SEK (från Vinnova 3 329 566 SEK).
- **Duration:** Start 1st April 2021 and end 31st March 2023

Project goals

Five goals have guided the work:

Objective 1: Methods for performing camera-based measurements on in-car HUDs and CMSs

Objective 2: A practical and verified end-to-end latency measurement method for CMS.

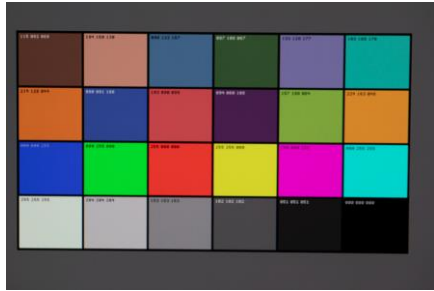
Objective 3: Recommendations on placing extra information in AR-HUD compared to the currently used conventional HUDs.

Objective 4: Recommendations with potential use of extended information on how to minimize distance judgment and decision-making error in CMS compared to a traditional analog mirror

Objective 5: Find a perceptual range for the impact on the visibility of moving objects caused by low temperatures in a CMS, compared to a screen at 20 degrees Celsius.

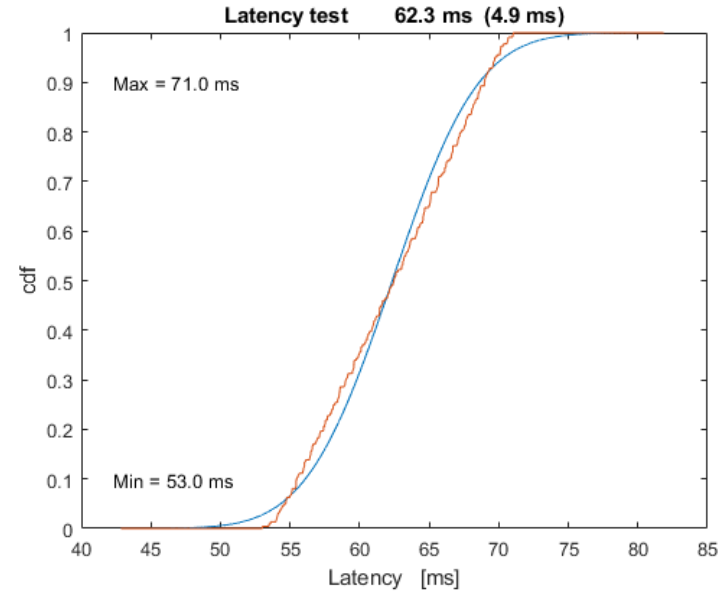
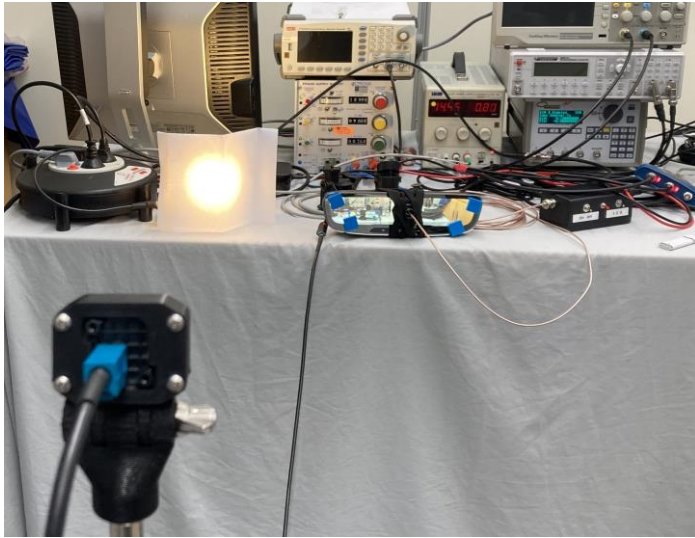
Project results: Camera-based measurements

High-quality standard digital cameras can replace more expensive and heavier measuring instruments for measurements in vehicles in the field. Here, however, more work is needed to develop a practical calibration method for the digital cameras.



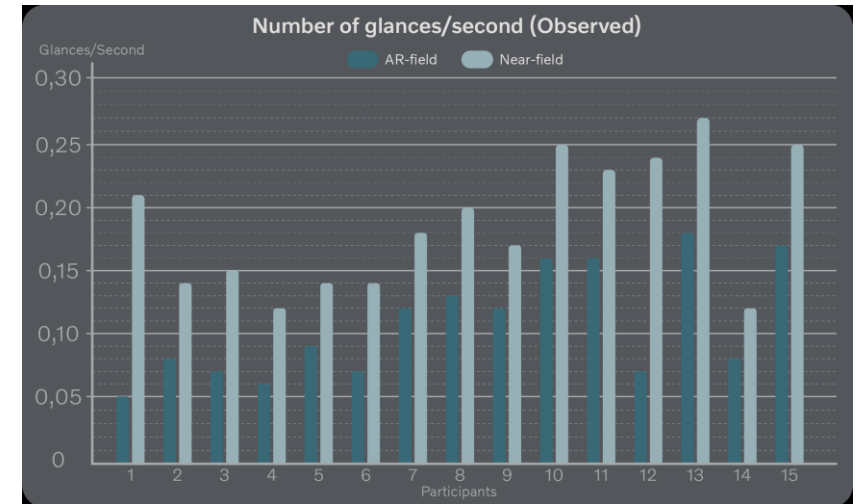
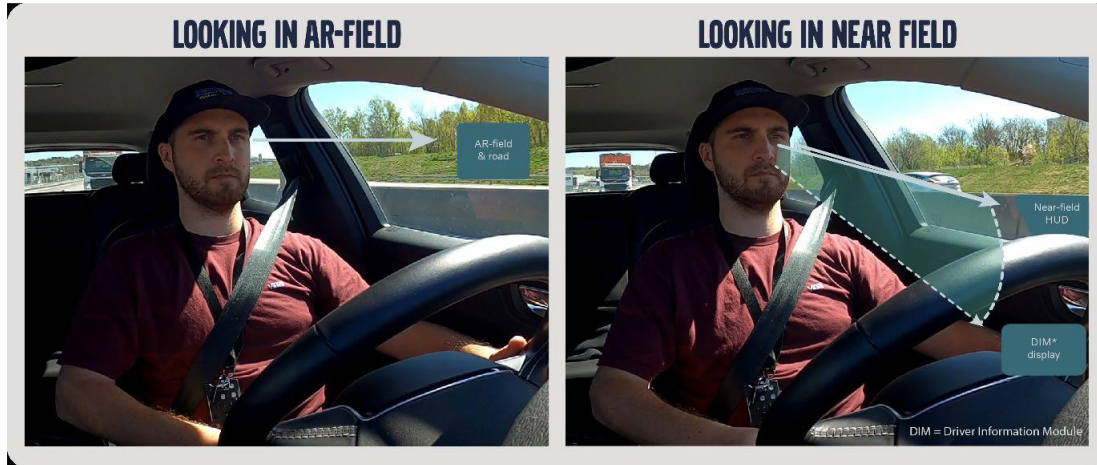
Project results: Latency

Method to measure glass-to-glass latency developed in the project works and gives stable results.



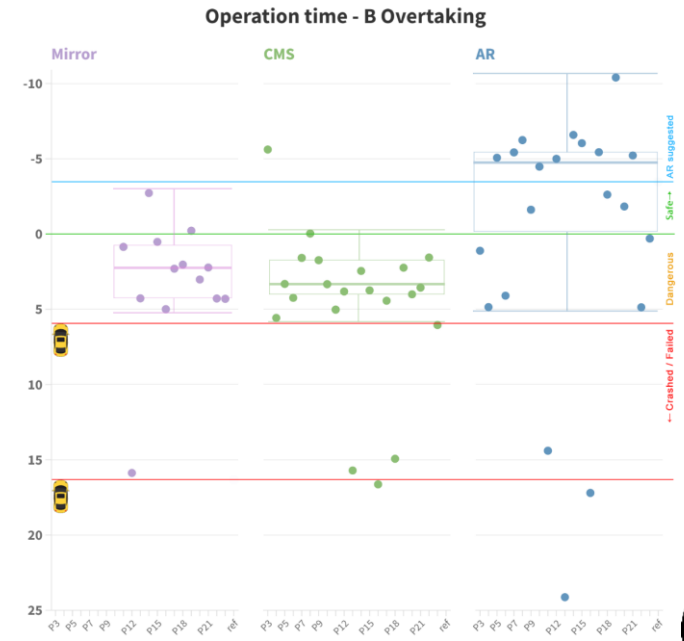
Project results: AR-HUD

AR-HUD provides positive effects on safety as the drivers keeps their eyes on the road more frequently with AR-HUD compared to conventional HUD.



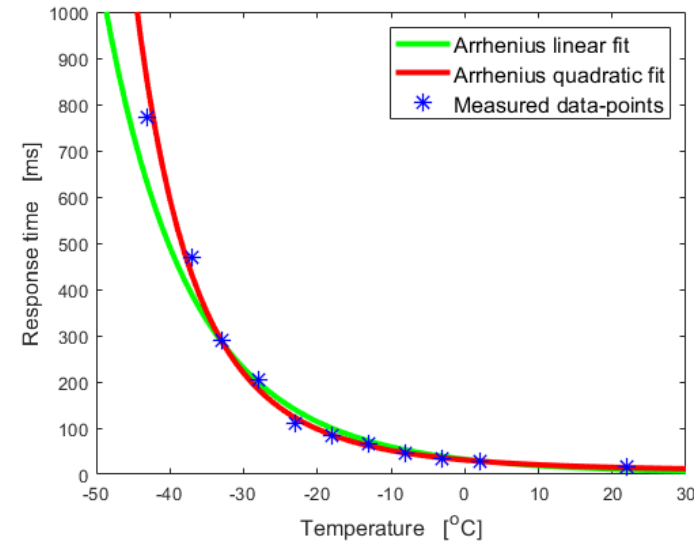
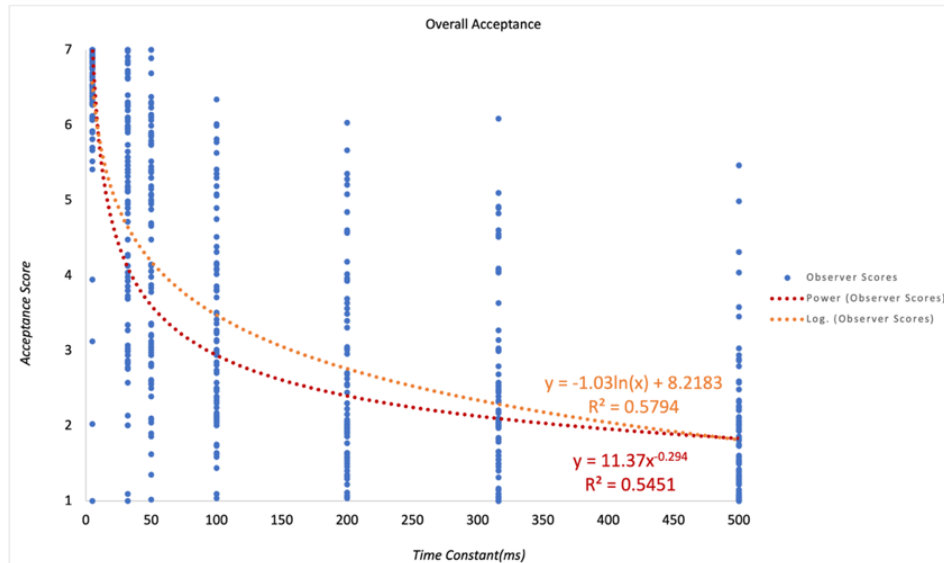
Project results: CMS

CMS with AR increased driver performances and experiences compared to traditional analogue mirrors and CMS without AR. In contrast, a CMS without AR degraded driving performance compared to traditional analogue mirrors.



Project results: Cold screens

A relationship between behavioural results and simulated temperature-induced image degradation exists. On the basis of this, recommendations for handling screens in cold temperatures in vehicles have been developed.



SCREENS conclusions

- High-quality digital cameras can substitute pricier, bulkier measuring devices for vehicle field measurements.
- Project-developed glass-to-glass latency measurement method yields stable results.
- AR-HUD enhances safety by promoting increased driver focus on the road compared to conventional HUDs.
- AR-enhanced CMS improves driver performance and experience over traditional analogue mirrors and non-AR CMS, whereas non-AR CMS reduces driving performance compared to traditional mirrors.
- A correlation exists between behavioral outcomes and simulated temperature-induced image degradation. Understanding of critical temperatures obtained.



SCREEN II: Overview

- Safe ChauffeuRs in safe and hEalthy multimodal drivEr information eNvironmentS (SCREENS II)
- Successor of SCREENS which finished March 2023 (RISE and Volvo Cars)
- Overall goal: To develop methods, tools and guidelines as well as knowledge and understanding in creating road-safe and healthy digital information environments for the drivers.
- Three-year project, from 1 Sept. 2023 to 31 Aug. 2026
- Coordinator: RISE
- Partners: Volvo Cars, AB Volvo, Scania, Smart Eye och Optea
- Budget in total 32.6 MSEK and 16.3 MSEK from Vinnova FFI Traffic-safe automation - FFI - spring 2023



Thank you