HADRIAN

Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs

Improving the Driver Role for Automated Driving:
An Opportunity for advancing Human-Systems Integration

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25. Feb, 2022

www.hadrianproject.eu/

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AGENDA

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- A short introduction
- Automated driving as an opportunity for advancing Human-Systems Integration
- Presentation of the HADRIAN project
  - Start human limitations / problems to define technological solutions
  - Scenario based approach and mobility need identification as starting point to define technical opportunities
  - Using simulations as integration aid toward convergence among diverse partners
- Interactive part on Human-Systems Integration

AUTOMATED DRIVING

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SAE J3016™ LEVELS OF DRIVING AUTOMATION™

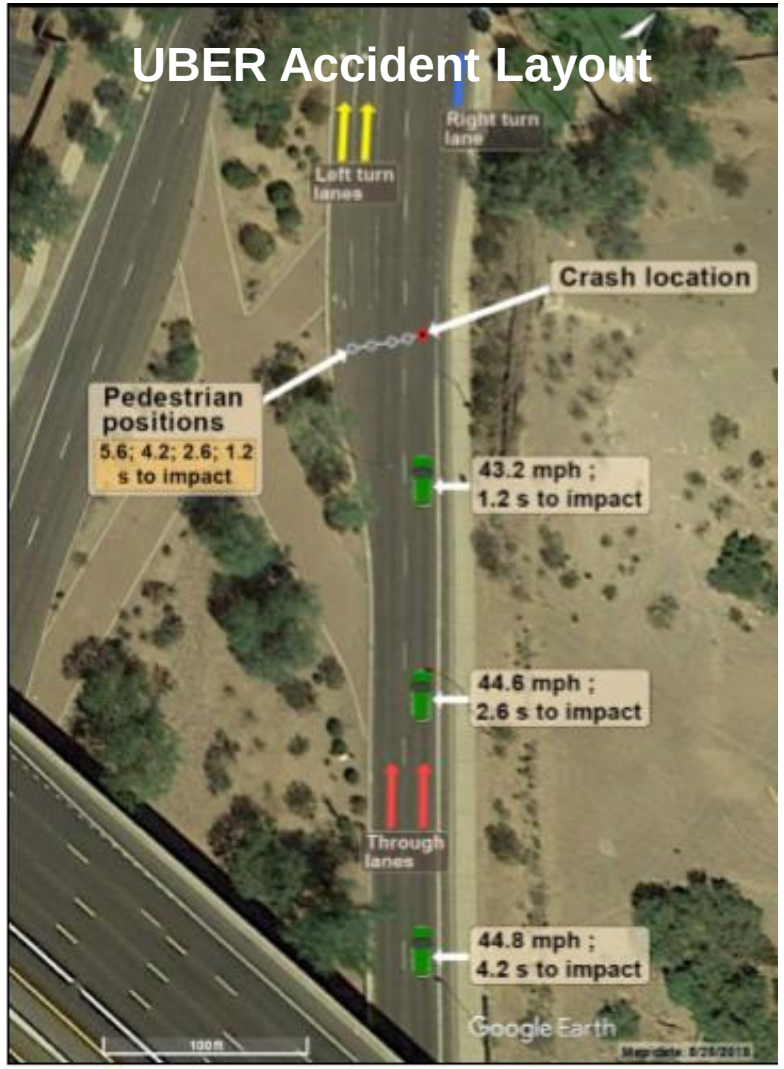
Learn more here: sae.org/standards/content/j3016_202104

	SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?	**You are driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			**You are not driving** when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			**These are automated driving features**		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering **OR** brake/ acceleration support to the driver	These features provide steering **AND** brake/ acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	• automatic emergency braking • blind spot warning • lane departure warning	• lane centering **OR** • adaptive cruise control	• lane centering **AND** • adaptive cruise control at the same time	• traffic jam chauffeur	• local driverless taxi • pedals/ steering wheel may or may not be installed	• same as level 4, but feature can drive everywhere in all conditions

MOTIVATION AND APPROACH

- Accident on March 18, 2018
  - Safety driver was unable to remain vigilant and monitor the vehicle and situation

- https://www.youtube.com/watch?v=RASBcc4yOOo



PROJECT

EU call for research and innovation:

"Solutions need to be developed **to ensure both a safe transfer between use cases with different automation levels and that drivers always have a very clear understanding** about the degree of automation enabled in each situation." (DT-ART-03 call text)

- **Duration**: 42 Months
- **Start**: Dec 2019
- **Funding**: 8 Mio EUR

virtual vehicle

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AVL

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National Technical University of Athens

tecnalia Inspiring Business

ASFINAG

IESTA

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UNIVERSITAS GRANATENSIS 1531

TU Delft

nervtech

UNIVERSIDAD DE GRANADA

VDI|VDE|IT

UNIVERSITY OF SURREY

FORD OTOSAN

FROM RESEARCH TO INDUSTRY ceatech

WHY IS FALLBACK READINESS DIFFICULT?

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➢ Watching somebody drive is harder than driving (!)

- Possible leading to fatigue, distraction (, or discomfort)
- Humans are (relatively) good controllers but usually bad monitors
- Building sufficient situation awareness for transition

➢ Predicting what is going to happen

- Difficult for the vehicle until it sees something
- Difficult for the “out-of-the-loop” human
- Unexpected events

➢ The Human Computer Interaction

- Non-professional drivers with diverse experiences
- Balance btw. complex functions and simple “attractive” interfaces
- Diversity of implementations and of automation levels

E

Enhance AD Predictability, Availability, & Continuity
• through road infrastructure integration

V

Vehicle

Fluid HCI’s
• observe the driver and adapt to the driver state and needs

Predictability
• of AD makes automation more manageable

D

Driver
• support the formation of driver competences to better use AD

HOLISTIC MODEL TO ADDRESS ADL 3 CHALLENGES

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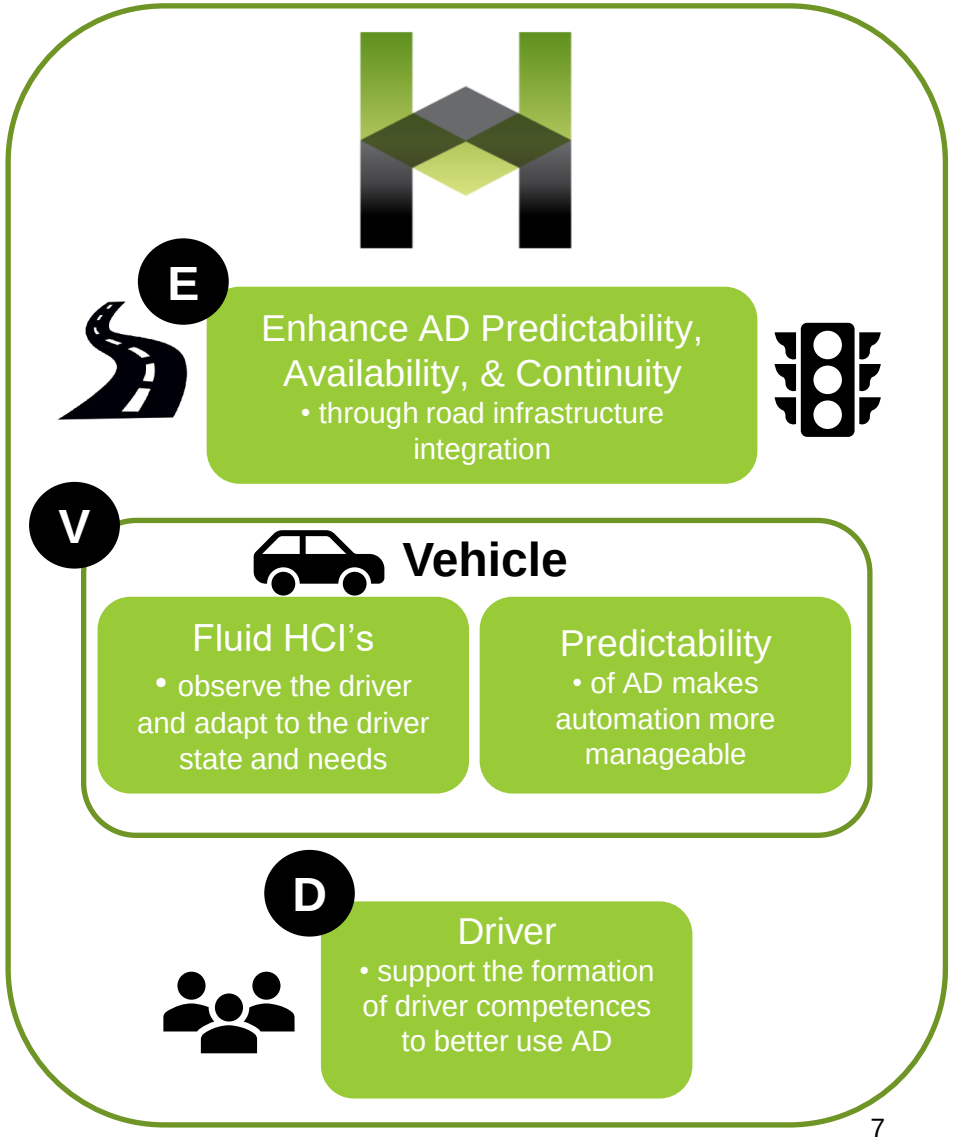
- Acceptable, safe AD driver role (E, V, D)
- Enhance AD Predictability
  - To facilitate getting driver back in the loop
  - Allow better planning for NDRA
  - Enhance availability of RI support for increase availability and continuity
- Improve the AD Vehicle
  - Add driver monitoring to warn driver in case of incompatible driver state
  - Enhance Human Computer Interactions
    - For predictable transitions and NDRA planning
    - Dynamic “fluid” interactions based on driver state/action
- Help the AD User / Driver
  - Strengthen competences for AD usage via tutoring
    - Before, during, and after drive
    - Active feedback in case of inconsistent actions
  - Increase understanding of vehicle for calibrated trust formation



VARIOUS ASPECTS OF PREDICTABILITY

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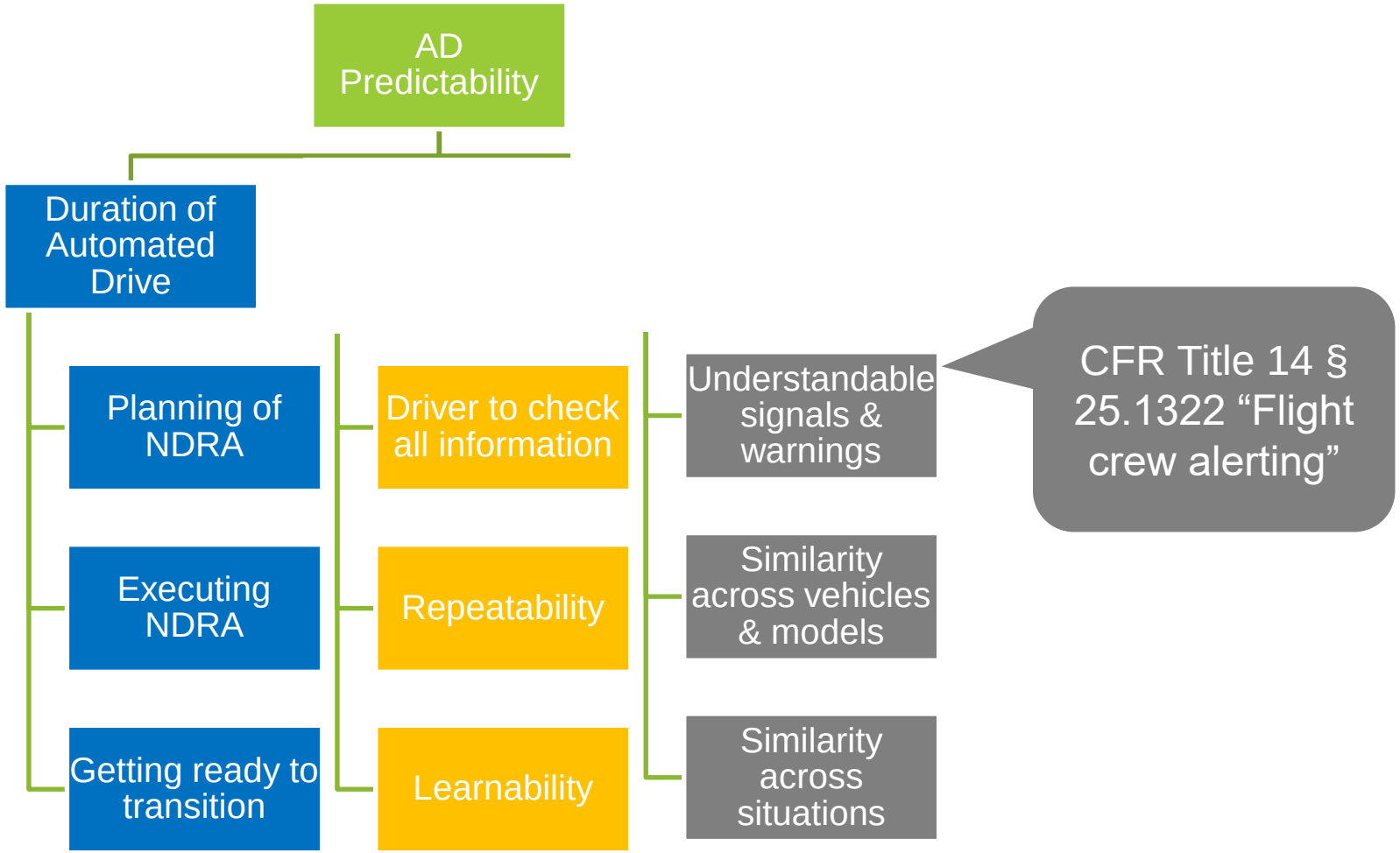

AMOUNT OF REENGAGEMENT TIME

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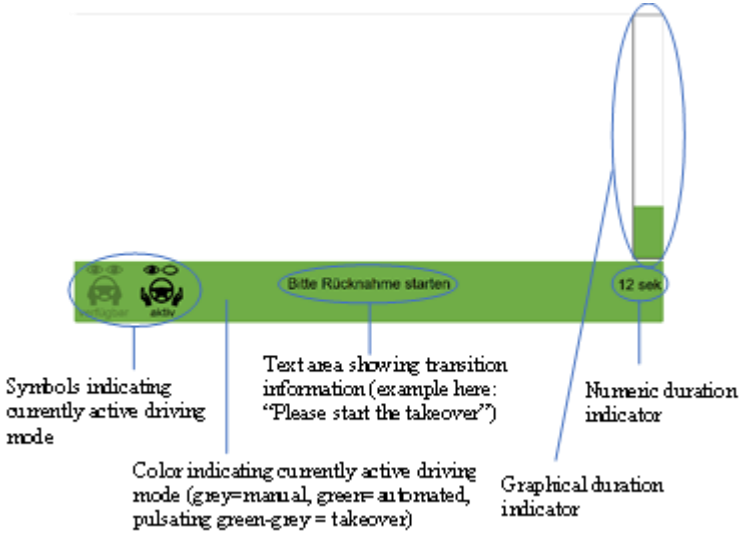
- Performed literature review to identify suitable reengement time for ADL 2
  - Among 33 mean re-engagement times obtained from 16 publications, a time budget of 5 seconds
- Performed a Wizard-of-Oz study to assess suitable reengagement times for ADL 3
  - On a test track
    - Drivers performed several NDRAs
      - playing Tetris,
      - reading & typing,
      - watching a documentary film
  - Results: all takeover times were below 15 sec.
    - Currently paper in review
- Form the basis for the design of the HADRIAN innovations

bast
Bundesanstalt für Straßenwesen

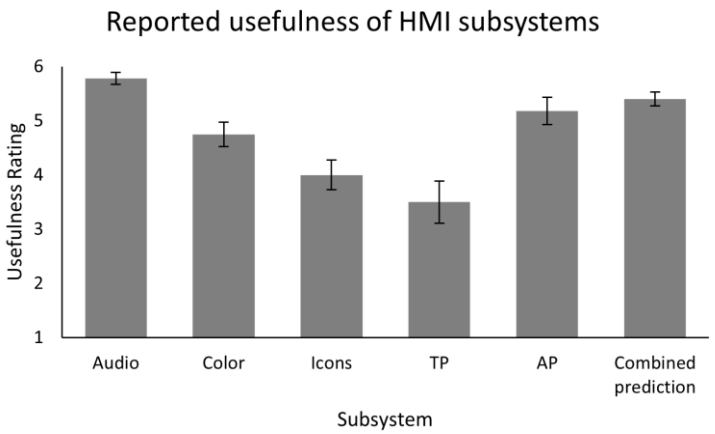
STUDY DESIGN

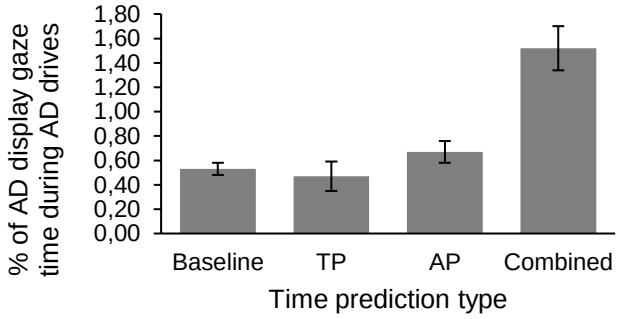
- Simulator study with 40 participants

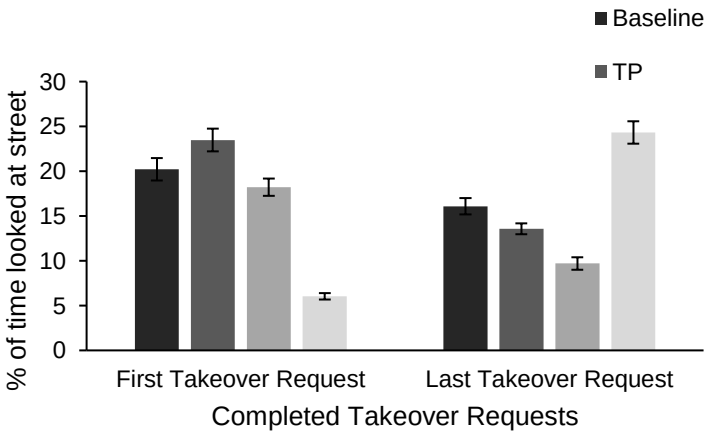
- Between-subjects design with 4 levels
  - No additional predictability information (baseline condition)
  - Predictability of duration of takeover maneuver
  - Predictability of duration of automated driving duration
  - Predictability of both, duration of takeover maneuver and automated driving duration



RESULTS


Reported usefulness of HMI subsystems
Usefulness Rating
6
5
4
3
2
1
Audio
Color
Icons
TP
AP
Combined prediction
Subsystem


% of AD display gaze time during AD drives
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
Baseline
TP
AP
Combined
Time prediction type


Baseline
TP
% of time looked at street
30
25
20
15
10
5
0
First Takeover Request
Last Takeover Request
Completed Takeover Requests

DESIGN AD TO ADDRESS EUROPEAN MOBILITY NEEDS

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More generally, in HADRIAN we investigate user mobility needs and how automoted driving can address them

- European mobility visions
- Held multiple workshops to identify specif ns

VDI | VDE | IT

Harold
is an elderly driver wanting
to stay mobile

Sven
is a truck driver within
the challenges of increasing
competitiveness

Florence
is a business women wanting
to keep up productivity
during transportation

DIFFERENT MODES OF AUTOMATED DRIVING TO ADDRESS MOBILITY NEEDS

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Manual Driving Aid for Elderlies

Guarding Angel

Innovation to ADL 2 Driving

Innovation to ADL 3 Driving

Innovation to ADL 3 Driving for Extended Disengagmt.

FROM USE SCENARIOS TO DRIVING SCENARIOS

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Harold on countryroads

Sven on motorways

Florence on urban roads

WP 3 FLUID HMI INNOVATIONS

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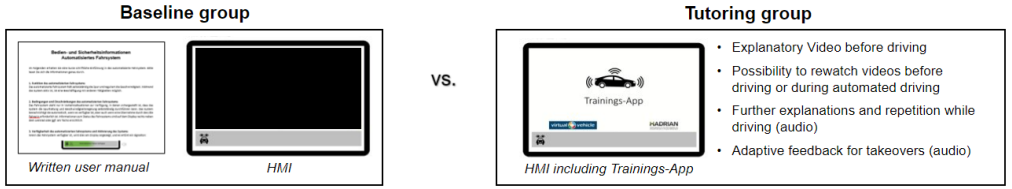
ADL Predictability

virtual vehicle

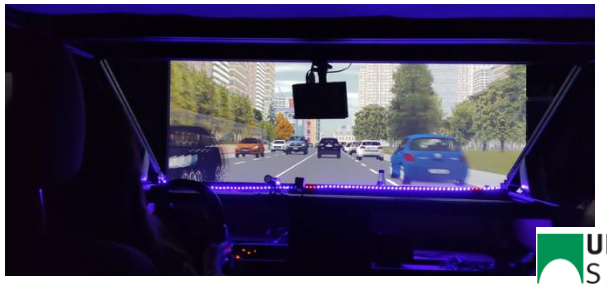
HUD

nervtech™



Driver Tutoring

virtual vehicle

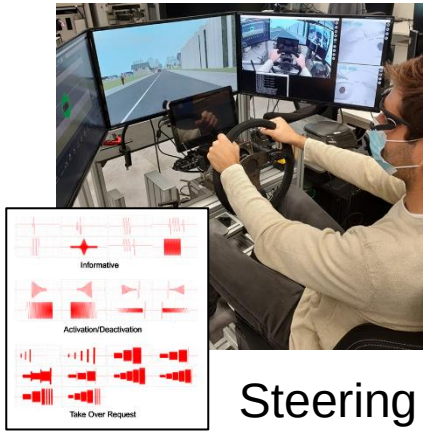


UNIVERSITÄT SALZBURG

LEDs

Turning Seat

ika | RWTH AACHEN UNIVERSITY



Steering Wheel

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Visual and auditory indications

TU Delft

WP 4 FIELD DEMONSTRATION

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► Turkey Field Demonstration

► Austria Field Demonstration

► Spain Field Demonstration

AUSTRIAN FIELD TEST

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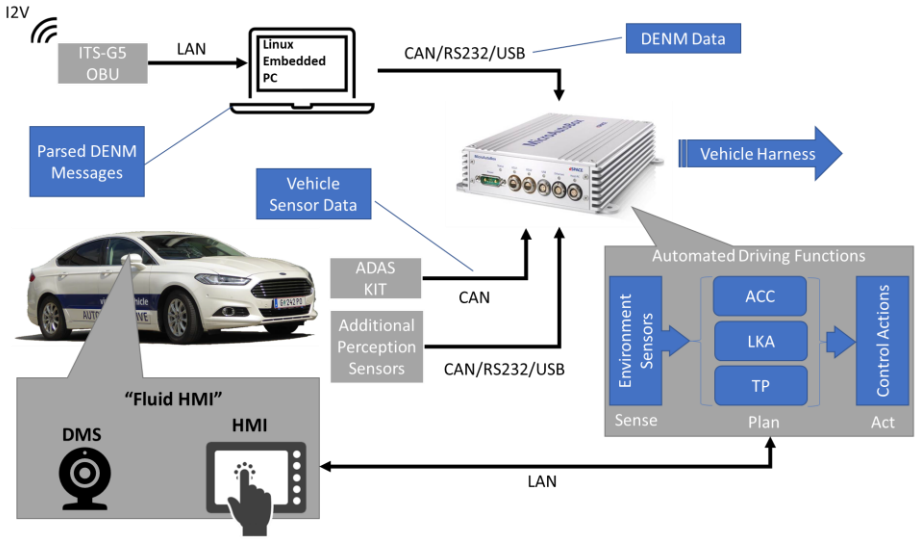
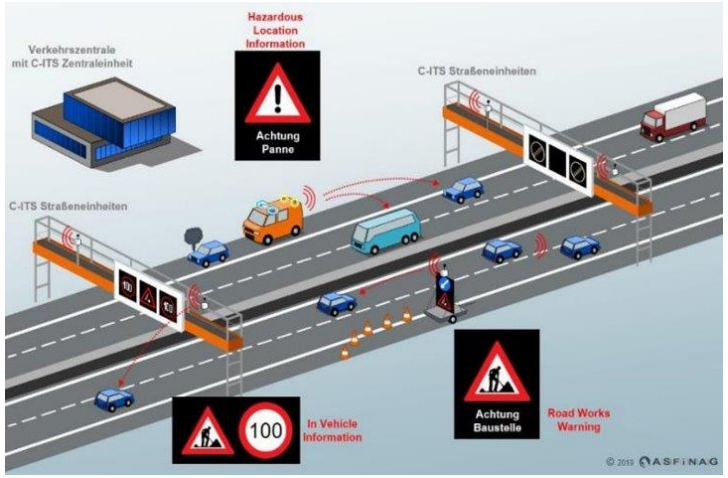
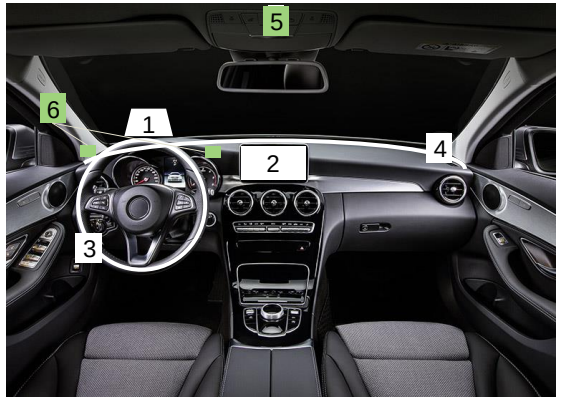
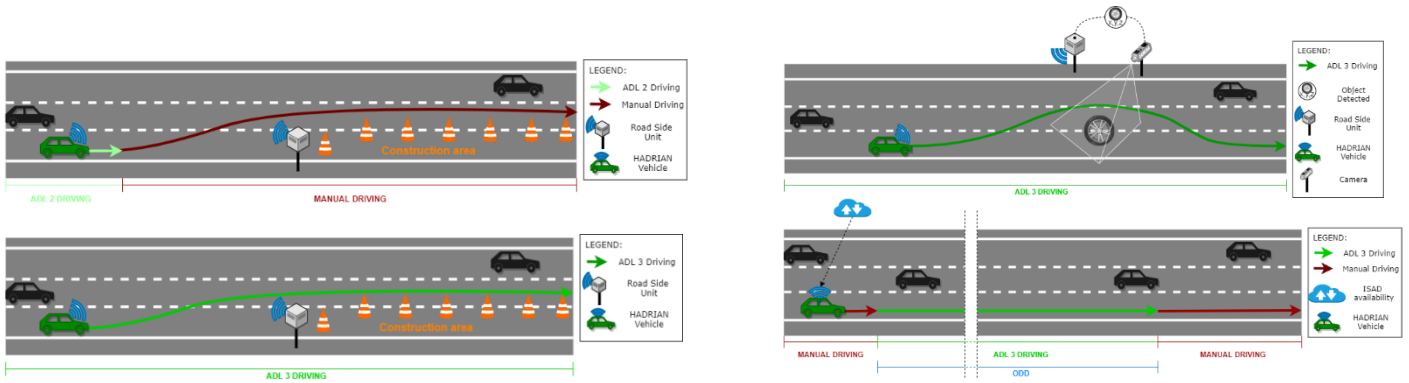




C-ITS Infrastructure
(ASFINAG)





HUMAN SYSTEMS INTEGRATION

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- Presented an approach to realize Human Systems Integration
  - Starting with the challenge to the human: driver fallback readiness
    - Identify holistic options (D,V,E), not just vehicle-based
  - Identify automated driving concepts for specific mobility needs
    - Not just adding automated driving to existing vehicles
  - Organizing technical implementations around these user concepts
    - Instead of the other way around
  - Presented methods to facilitate collaboration through use cases and matching simulation scenarios
    - Instead of developing the simulation scenarios are the end
- In the second (interactive) part, I would like to solicit your suggestions, feedback and lessons learned on successful human systems integration
  - Not just for automated driving, also e.g. increasingly AI applications seem to require approaches where the human concerns and requirements are taken into consideration before technology is being planned and built

INTERACTIVE PART: DISCUSSION ON HUMAN SYSTEMS INTEGRATION

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- Do you experience challenges concerning Human-Systems Integration?
- How would you suggest to address HSI challenges?
- What works best?
- What does not work?

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