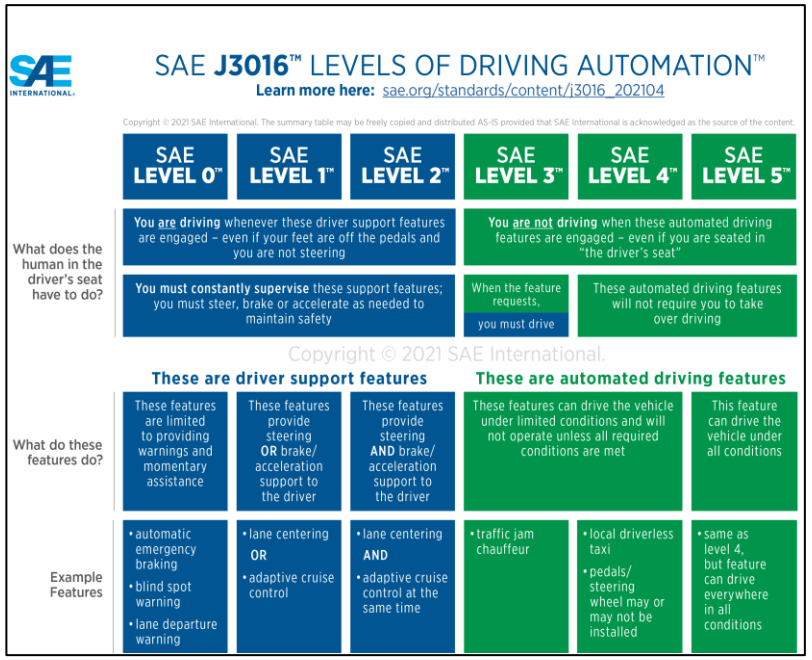
TRA
TRANSPORT RESEARCH ARENA
LISBON 2022

Facilitating the driver role for automated driving in Europe: Perspectives from the HADRIAN Project

Peter Moertl, Virtual Vehicle Research

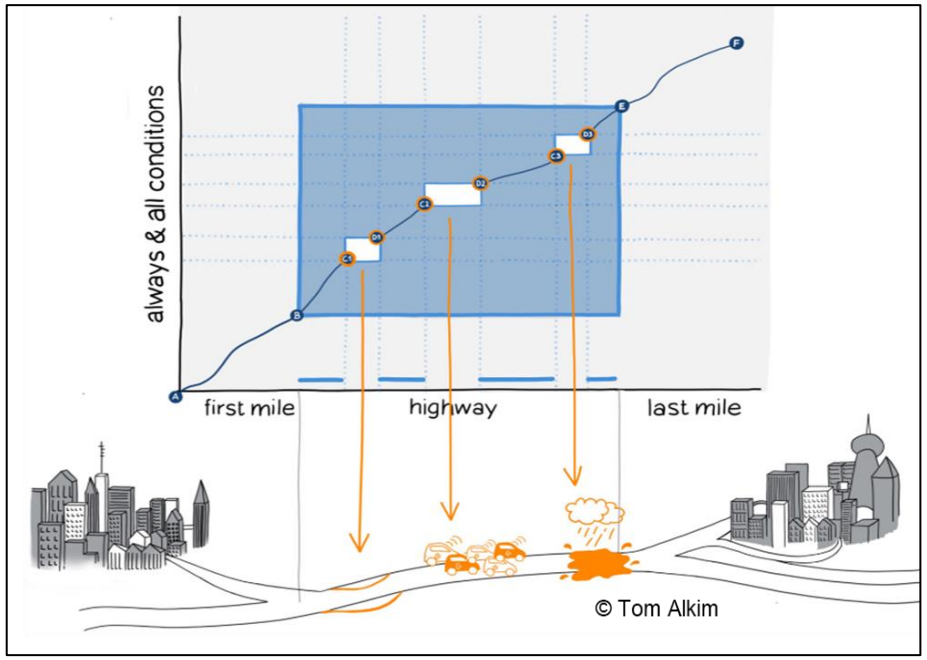
PROJECT GOAL AND OBJECTIVES



SAE J3016™ LEVELS OF DRIVING AUTOMATION™

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

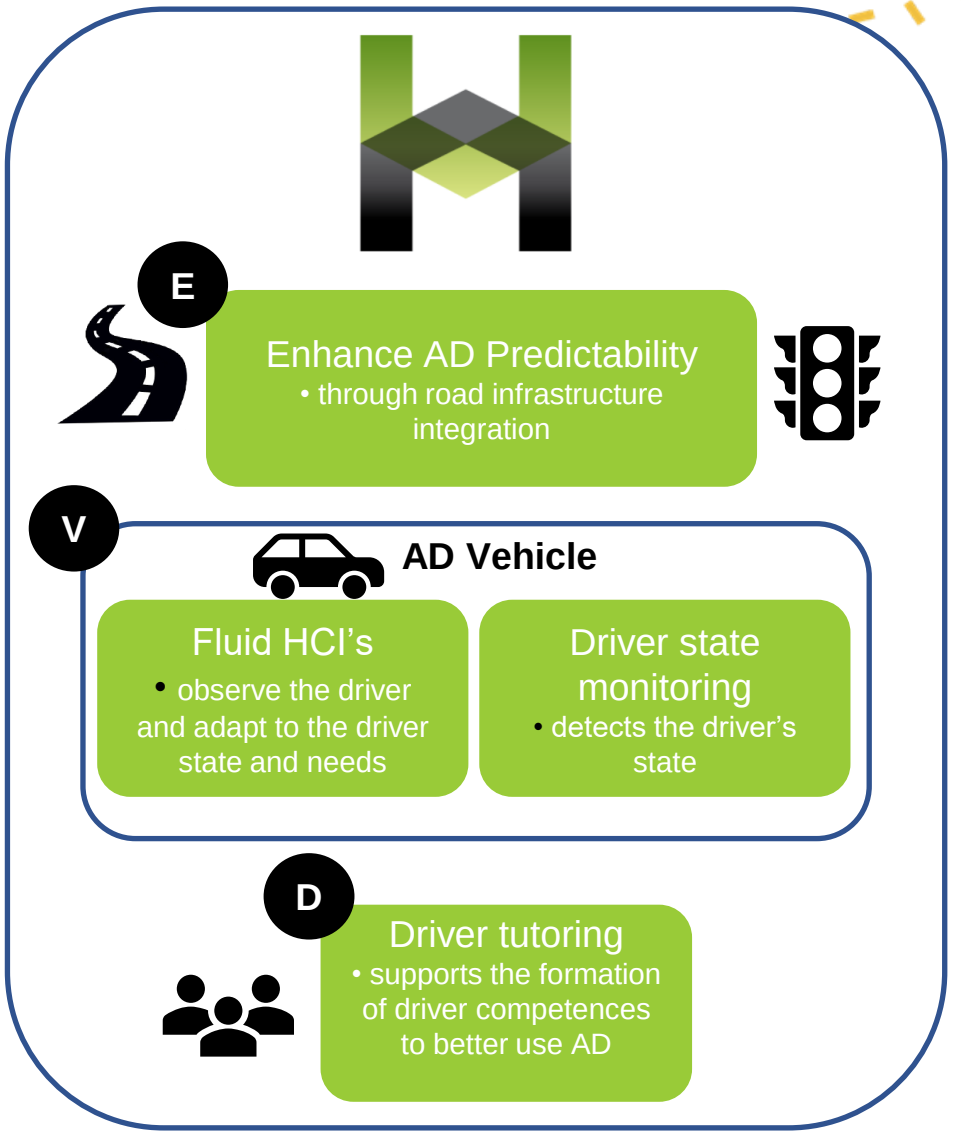
	SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?	**You are driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			**You are not driving** when these 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



"Solutions need to be developed and they have 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." (EU H2020 DT-ART-03 call text)

HOLISTIC APPROACH FOR SAFE AND ACCEPTABLE DRIVER ROLE

- Enhance AD through road infrastructure integration
  - To facilitate getting driver back in the loop
  - Allow better planning for NDRA
  - Increase availability and continuity
- Improve the AD Vehicle
  - Driver monitoring
    - Driver state during SAE L2, SAE L3 versus manual driving
  - Mutual adaptive “fluid” Human Computer Interactions
    - Reduce complexity and required knowledge for the driver
    - **Warn or Help** only when and how needed
- Strengthen competences of the AD User / Driver
  - Onboard tutoring provides
    - Lessons before and reminders during and after the drive
    - Active feedback in case of inconsistent actions



CONSORTIUM PARTNERS

TRA TRANSPORT RESEARCH ARENA LISBON 2022

virtual vehicle

Coordinator

ASFINAG

AVL

tecnalia Inspiring Business

ika | RWTH AACHEN UNIVERSITY

bast

University of Ljubljana

UNIVERSITÄT SALZBURG

TU Delft

IESTA

UNIVERSIDAD DE GRANADA

National Technical University of Athens

VDI | VDE | IT

FROM RESEARCH TO INDUSTRY ceatech

FORD OTOSAN

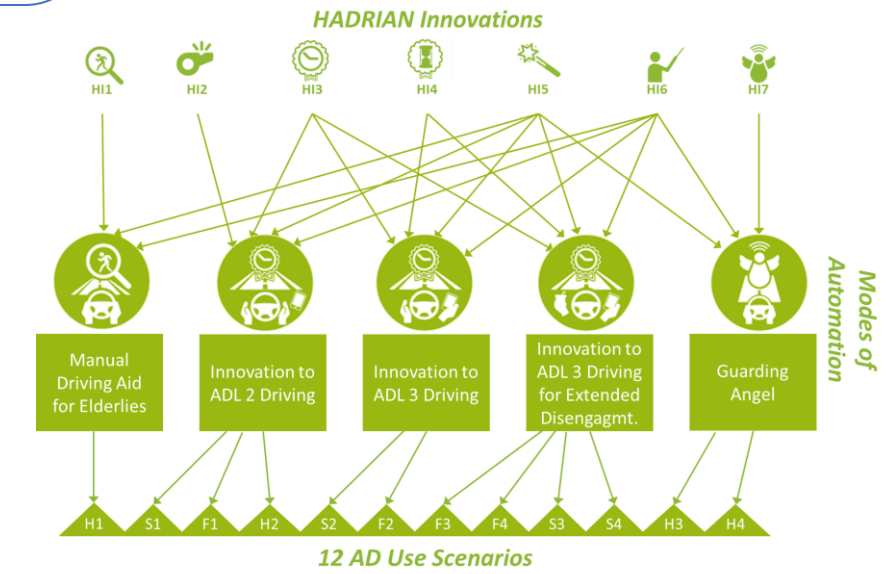
UNIVERSITY OF SURREY

OPPORTUNITIES FOR AUTOMATED DRIVING VEHICLES TO SUPPORT MOBILITY NEEDS: DEFINITION OF USE SCENARIOS

Florence, an business owner

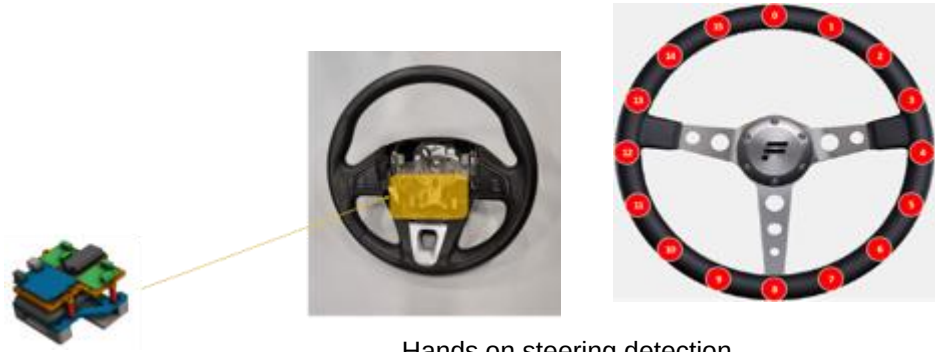
Harold, an elderly driver

Sven, the truck driver

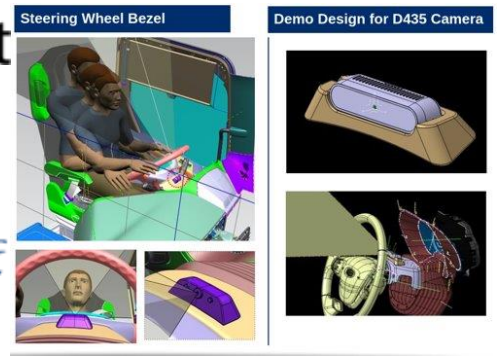


Results: Driver Status Monitoring

- Driver status monitoring
  - Driver state assessment studies with 235 participants covering various age groups, experience, and gender
  - Manual categorizations
  - Will be made available as dataset
- Developed 6 distinct sub-models for prediction of:
  - Fatigue
  - Hands on steering wheel
  - Visual distraction
  - Engagement in secondary task
  - Drowsiness
  - Facial Expression
- Developed integrated sensors on steering wheel for reliable hands-on-wheel detection
  - Use in field-demonstrations
- Applied to trucks

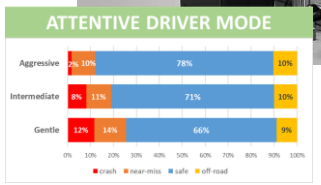


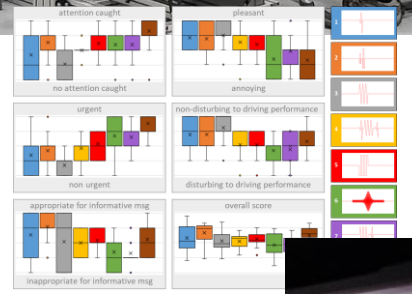
Hands on steering detection



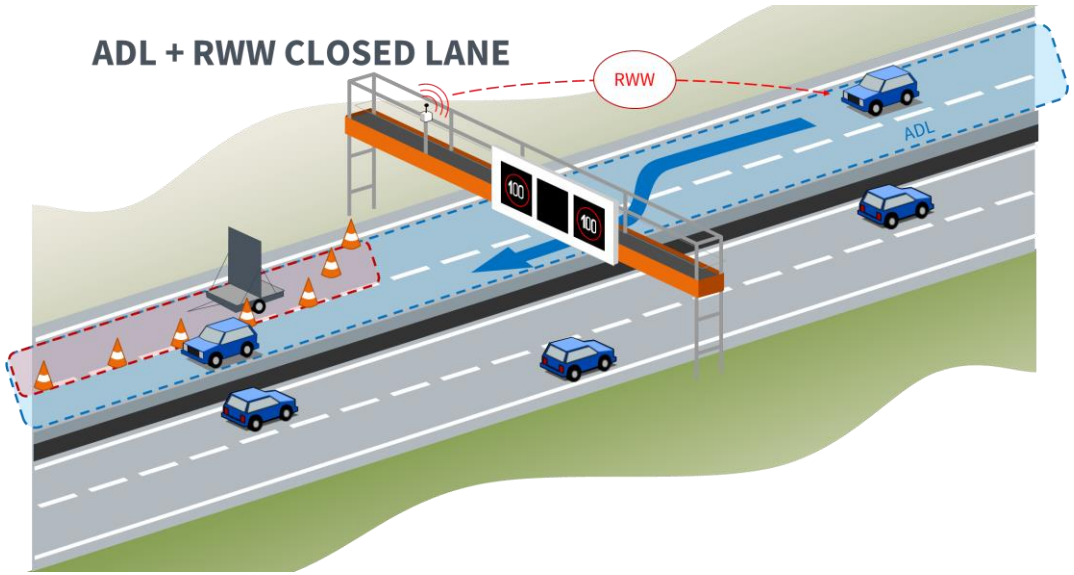
Results: HMI

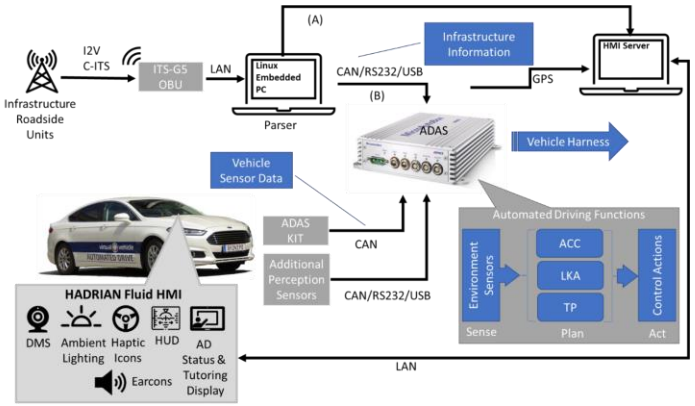
- Increasing the predictability of the automated drive
  - What AD predictability time horizons would be needed to be helpful?
  - How helpful is ADL 3 predictability to improve the takeover?
- How could ambient lighting in the vehicle facilitate ADL mode awareness?
- How can a tutoring application help drivers learn to interact with the AD functions
  - Driver state dependent feedback to build competences and mental model
- Under what conditions can a guarding angel support the safety of manual driving?
- Developed optimized AD sound designs
  - Develop standardizable automation driving alerting framework
  - Measured effectivity of a turning seat to increase AD mode awareness
- Developing a human reliability calculator





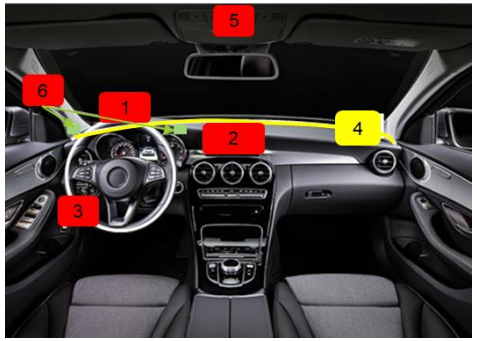
Road Information Infrastructure – Vehicle -



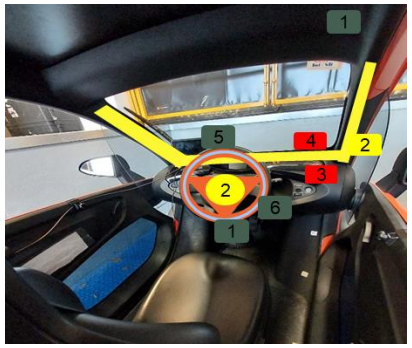


Display of AD predictability
and guarantee transition duration

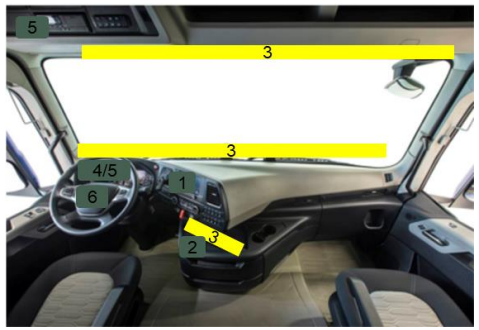
HADRIAN Demonstrators



1. Head-Up display (HUD) with critical timing information for transition
2. HADRIAN predictability and tutoring for automated driving (AD) on a tablet
3. Steering wheel feedback
4. Ambient lighting
5. Hands-on-wheel driver monitoring system (DMS) camera
6. Eye-gaze DMS cameras
7. Auditory cues



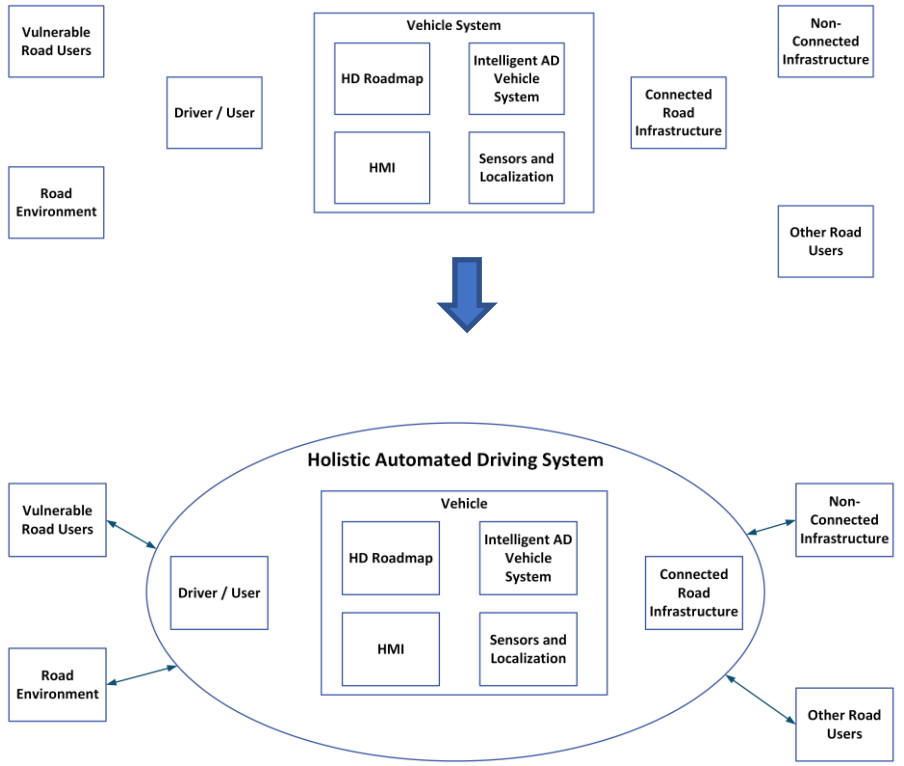
1. Hands-on-wheel DMS camera
2. Ambient lighting
3. HADRIAN AD Display
4. Auditory cues
5. HUD
6. Haptic steering wheel feedback



1. Human-Centered fluid-Human-Machine Interface
2. Auditory Cues
3. Ambient lighting
4. Truck Driver Monitoring System
5. Basic Fit2drive App
6. Haptic steering wheel feedback

Recommendations from the HADRIAN Perspective

- Create organizational structures for joint development of automated driving systems that include vehicles, road infrastructure, and drivers
  - Harmonizing AD functionality across brands (engage, disengage, availability,..)
  - Enabling the possibility for common education and training drivers across multiple brands
  - Enabling the vehicle to rely on road infrastructure to reliably extend the vehicles sensor horizon
    - Sensors, messages, networks
  - Allow for prediction of automated driving availability and display to the driver
  - Allow for guaranteed minimum durations of transition duration from automated to manual driving



Thank you!

Traconference

Transport Research Arena (TRA)

@TRA_Conference

traconference2022

TRAconference

traconference.eu

HOSTED AND ORGANISED BY:

AGÊNCIA NACIONAL DE INOVAÇÃO

CO-ORGANISED BY

European Commission

IN COOPERATION WITH:

INSTITUTO DA MOBILIDADE E DOS TRANSPORTES, I.P.

CONSÓRCIO DE ESCOLAS DE engenharia
FEUP • FCTUC • IST • EEUM • UA • FCTNOVA

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

magellan
European Affairs Consultancy

TOGETHER WITH:

ACARE

alice Alliance for Logistics Innovation through Collaboration in Europe

CEDR Conférence Européenne des Directeurs des Routes
Conference of European Directors of Roads

ECTP INNOVATIVE BUILT ENVIRONMENT

ERTRAC

ERRAC The European Rail Research Advisory Council

ETRA European Transport Research Alliance

WATERBORNE