interACT

Designing cooperative interaction of automated vehicles with other road users in mixed traffic environments

Virtual Final Event

Integration and technical Testing of the interACT demonstrator vehicles

Fabio Tango

Centro Ricerche Fiat (CRF)

interACT Final Event, 19 June 2020

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3 Demos Description – BMW Vehicle

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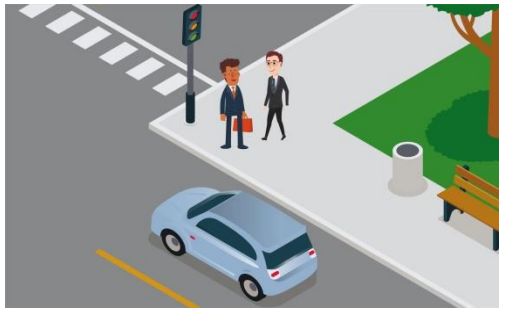
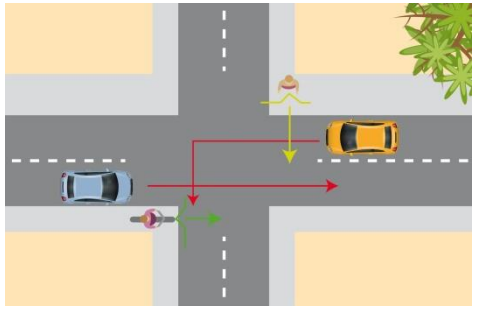
5th Objective
Methodology for assessing the quality of interaction

The challenge

1st Objective
Psychological models

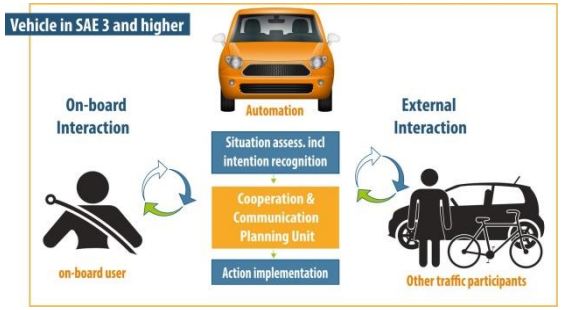


4th Objective
Novel HMI elements



2nd Objective
Intention recognition & behavioural predictions

3rd Objective
CCPU & safety layer



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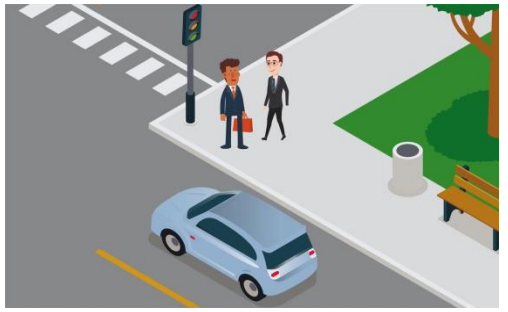

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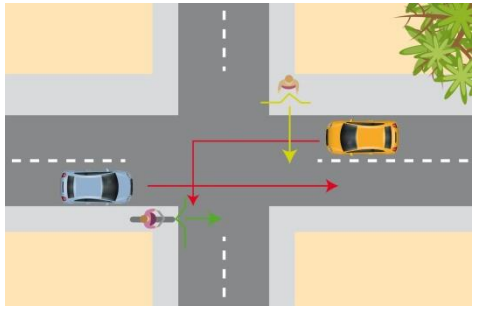

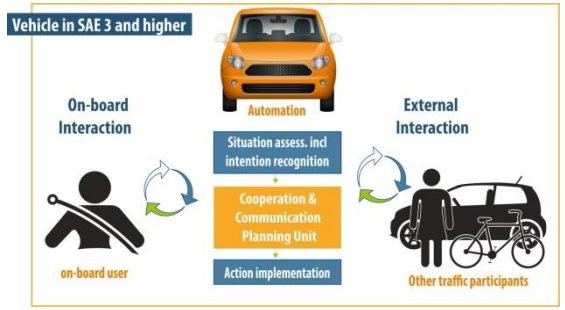

3rd Objective
CCPU & safety layer

2nd Objective
Intention recognition & behavioural predictions

Introduction

Context

- A basic challenge, when introducing AVs into a mixed traffic environment, is the extension of the traditional two-way human-to-human cooperation into a three-way cooperation.
- The interACT project developed specific solutions that have been integrated in two demonstrator cars: one from BMW and the other one from CRF

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Overview

Objectives

- This activity has been carried out inside the WP5 of interACT project.
- Its main goals are to:
  - Implement and integrate the system components (enablers) as designed and developed in the other WPs of the project
  - Integration testing of components and technical evaluation of the whole system
- The two demonstrations will focus on different scenarios and use-cases

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Features of Demonstrators

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	CRF	BMW
CCPU	Fully integrated and functional CCPU	No CCPU (just parts of it for eHMI control)
Sensors	Completely integrated sensors	No additional sensors
eHMI	eHMI elements (LED stripe)	Fully integrated and functional eHMI – LED stripe and directed single lamp
Demo Use Case	Use cases on parking lot	Use case on urban intersection
Evaluation	Evaluation on test track	Wizard of Oz evaluation in real traffic
Main responsible evaluation partner	ITS	TUM

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Overview of BMW Demonstrator

- Basis for prototype is a **BMW i3s** series car
- BMW demonstrator is focusing on the **interaction between the vehicle and other traffic participants**
- Vehicle is equipped with **fully integrated eHMI components**
- Demonstrator received a **special permit for real world testing** of the eHMI components

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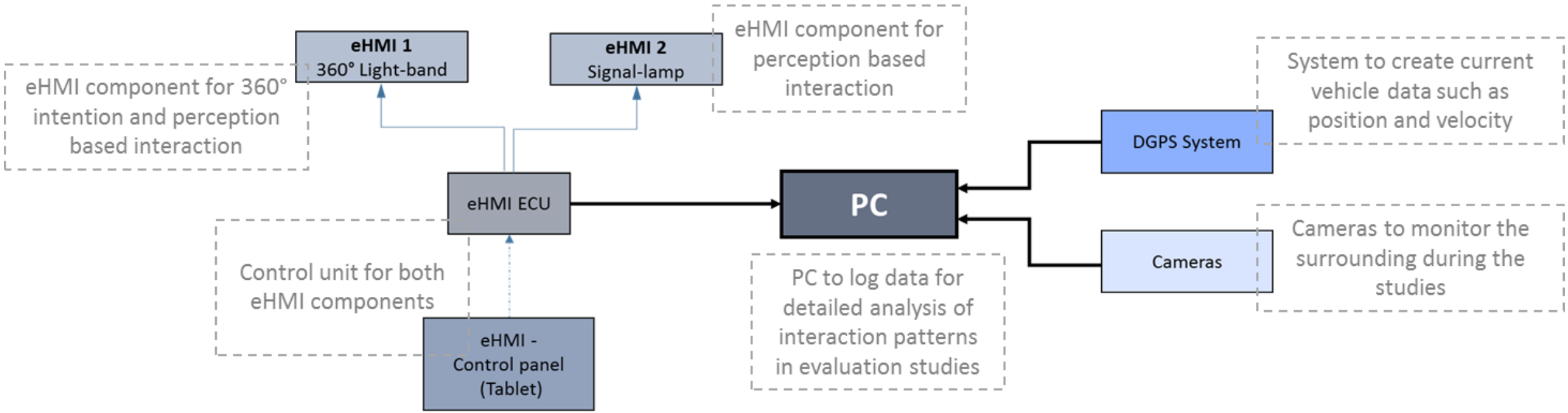
Main components in the BMW demonstrator



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Integration process of all components

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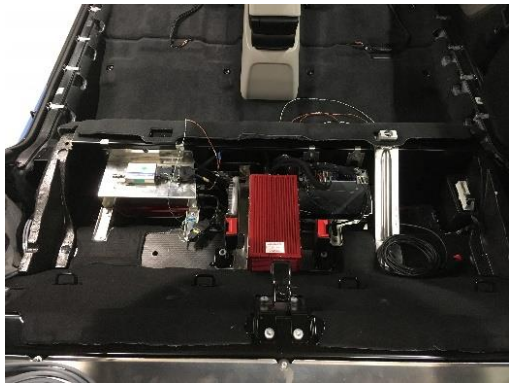
Process steps

Preparation of the series car for eHMI Integration

Integration WS at BMW and start of the eHMI integration

Integration of DGPS system under back seat



Installation trials with first sample parts

Final Integration of eHMI comp., cameras & PC

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Integration process

Final demonstrator (exterior)

Front view (360° light band & signal lamp)

Side view (360° light band)

Rear view (360° light band)

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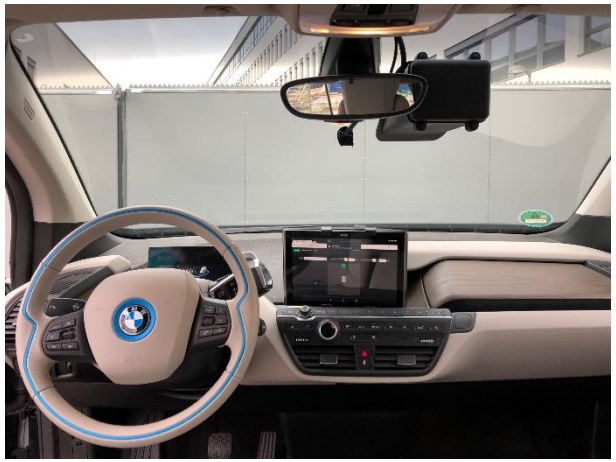
Integration process

Final demonstrator (interior)

Trunk lid

(eHMI ECU, PC, camera unit)



Passenger compartment

(eHMI control panel, signal lamp, front camera)

Under back seat

(DGPS System)

Seat cover

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Testing process

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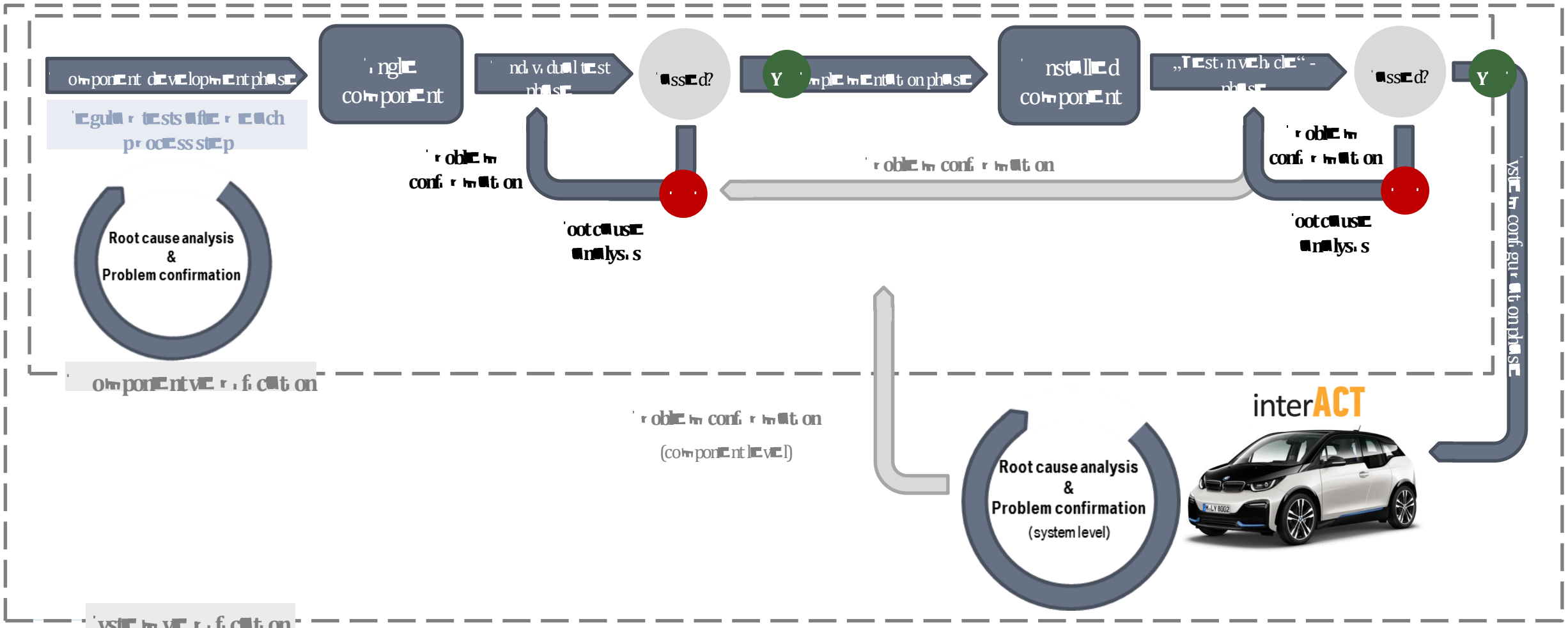

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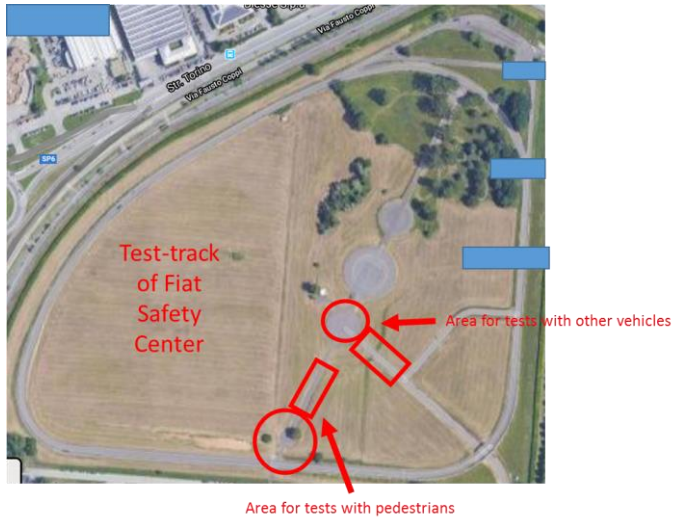
Overview of CRF demonstrator

- Basis for prototype is a “**Jeep Renegade**” series car
- CRF demonstrator is focusing on the **interaction between the vehicle and other traffic participants** in parking scenarios
- Vehicle is equipped with the following components, fully integrated:
  - The Perception Platform
  - The Cooperation and Communication Platform Unit (CCPU) developed by the interACT consortium
  - A basic implementation of the eHMI
- Demonstrator has been evaluated in private FCA test-track



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Main components in the CRF demonstrator

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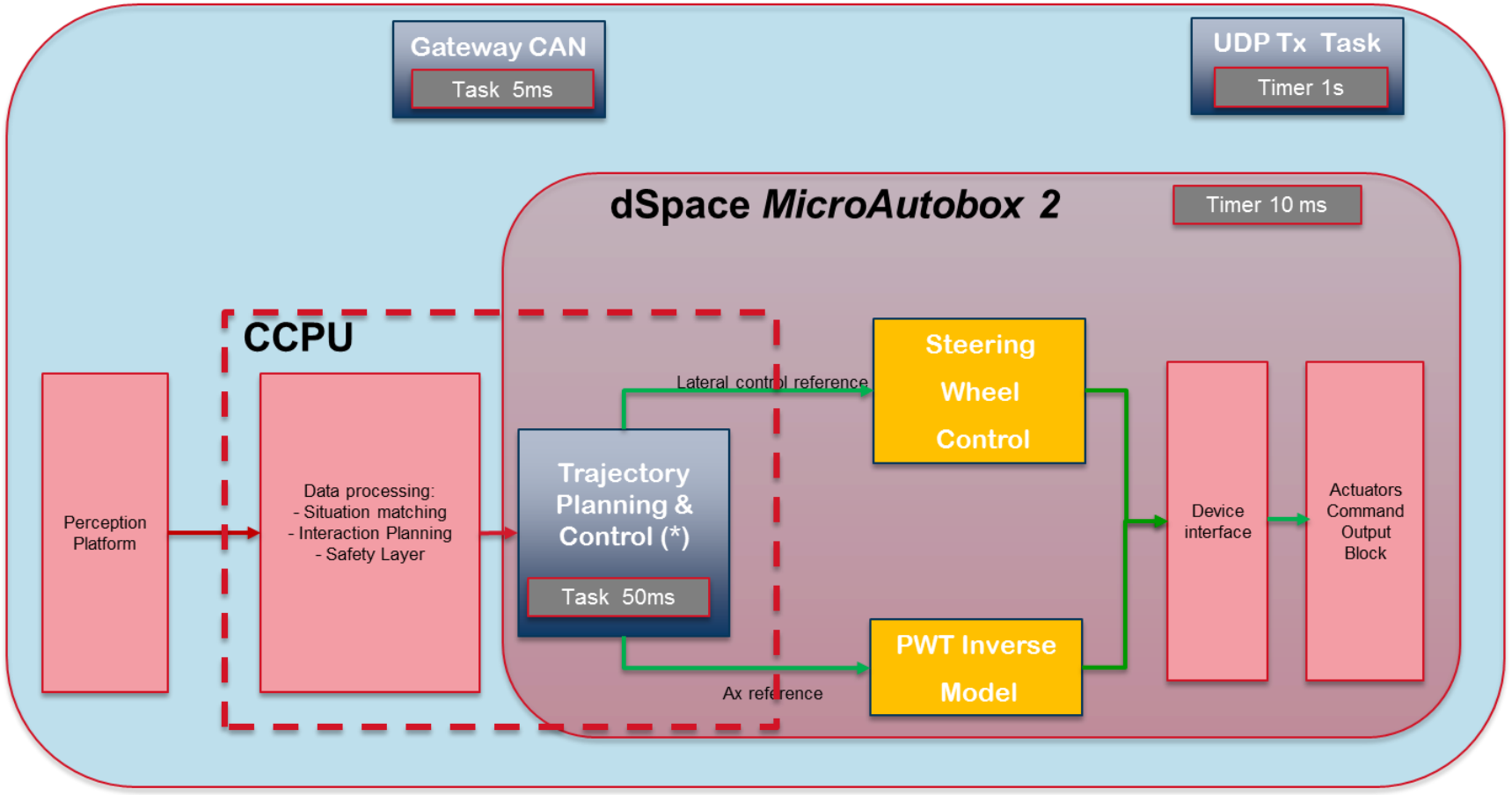

(*) MPC components

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Integration process of all components

Final demo – external integration

Three frontal Laser-scanner sensors

Three rear Laser-scanner sensors

eHMI solution

Antenna for DGPS

External camera

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Integration process of all components

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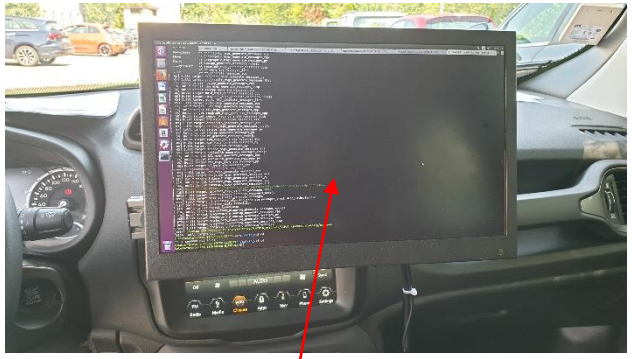
Final demo – internal integration

Trunk of CRF vehicle (including Lidar ECU, CCPU and E/E components)



Internal Display (for data monitoring and for on-board iHMI)

People at work during one the integration workshops

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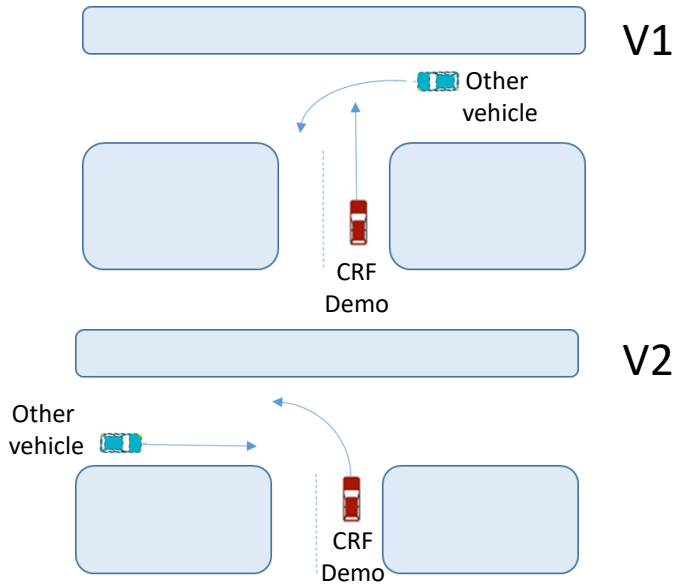
Testing Process

- Scenario: parking area, interacting with pedestrians and other vehicles.
- Private FCA test-track.
- Tests with PP and CCPU fully integrated



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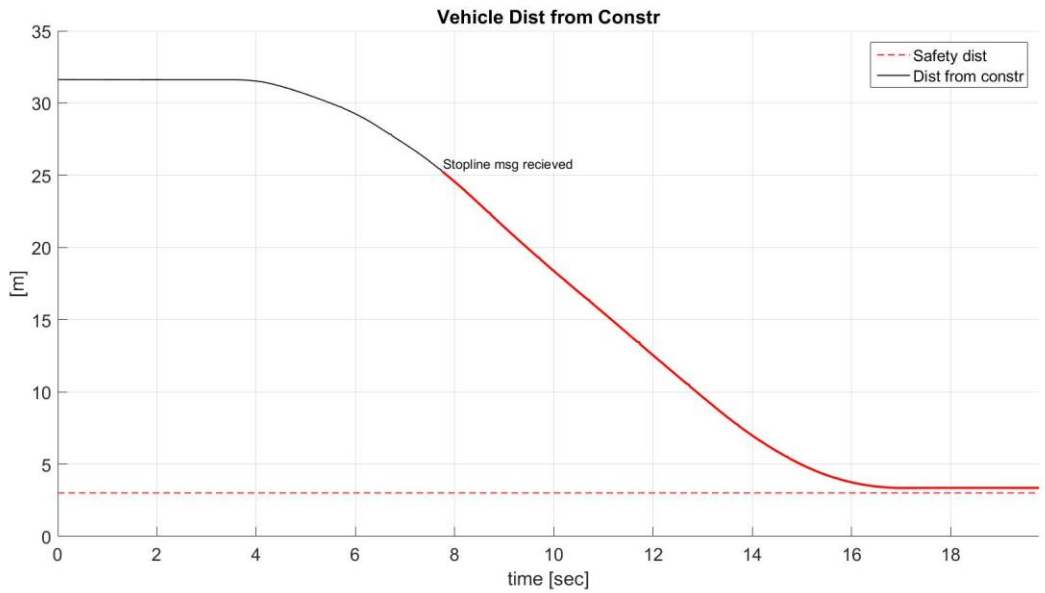
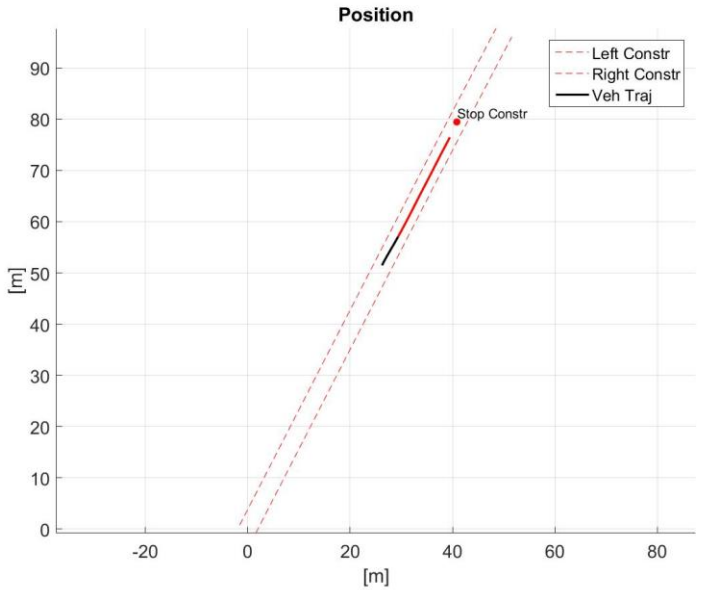
Testing Results (scenario V1)

- interACT vehicle straight on
- Other vehicle turning on the left

- interACT vehicle able to stop within the constraints (in terms of distance and deceleration), provided by CCPU





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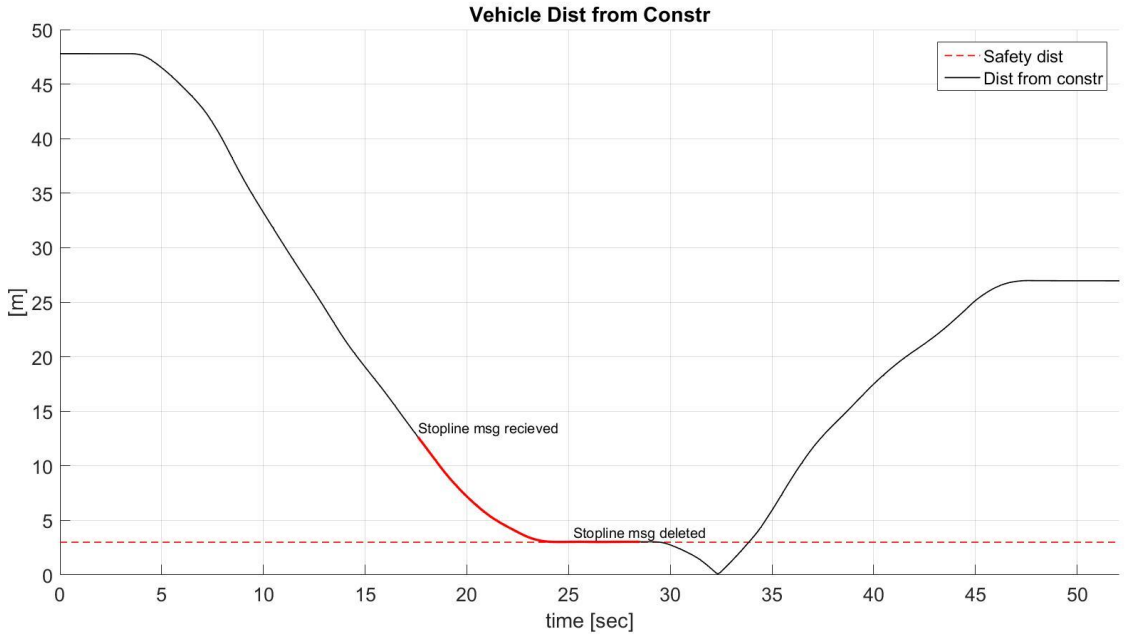
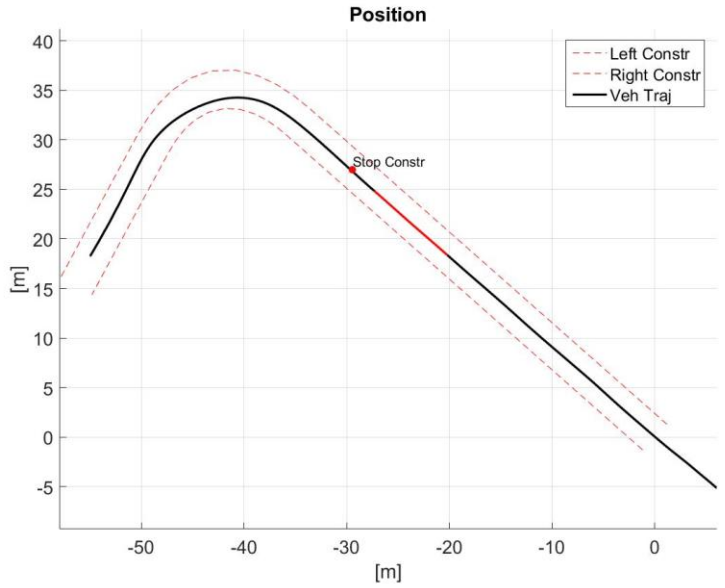
Testing Results (scenario V2)

- interACT vehicle turning on the left
- Other vehicle straight on



- interACT vehicle able to stop within the constraints, giving priority
- interACT vehicle can then start again (to complete the maneuver)



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Summary and Lessons Learnt

The main results of this integration activities were:

- interACT demonstrators ready for evaluation
- interACT solutions evaluated and demonstrated

Some key-points have to be taken into account:

- Needs of high-precision digital maps and positioning (for trajectory planning in particular).
- Needs for 360° surrounding view for detecting dynamic/static obstacles.
- Carefull design to take into account the integration of the sensorial system and eHMI components.

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Read more

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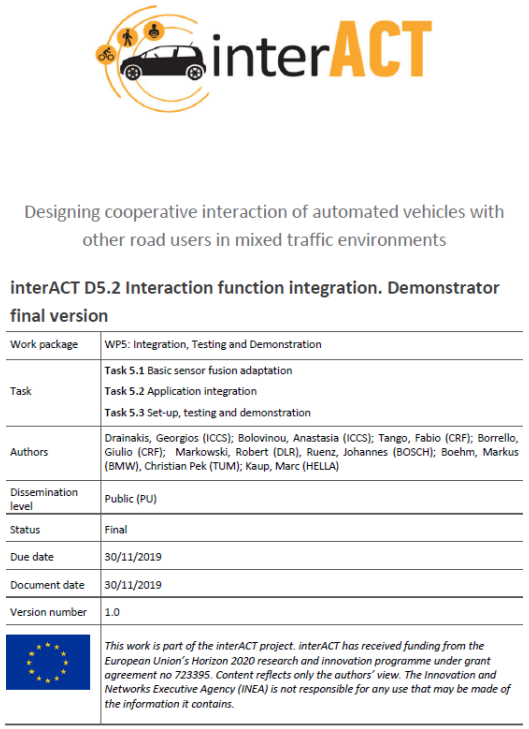
Drainakis G. et al., "interACT D5.2: Interaction function integration. Demonstrator final version“, 2019.



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interACT D5.2 Interaction function integration. Demonstrator final version

Work package	WP5: Integration, Testing and Demonstration
Task	**Task 5.1** Basic sensor fusion adaptation **Task 5.2** Application integration **Task 5.3** Set-up, testing and demonstration
Authors	Drainakis, Georgios (ICCS); Bolovinou, Anastasia (ICCS); Tango, Fabio (CRF); Borrello, Giulio (CRF); Markowski, Robert (DLR), Ruenz, Johannes (BOSCH); Boehm, Markus (BMW), Christian Pek (TUM); Kaup, Marc (HELLA)
Dissemination level	Public (PU)
Status	Final
Due date	30/11/2019
Document date	30/11/2019
Version number	1.0
	This work is part of the interACT project. interACT has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 723395. Content reflects only the authors' view. The Innovation and Networks Executive Agency (INEA) is not responsible for any use that may be made of the information it contains.

Tango F. et al., "interACT D5.3: Technical verification plans and Outcomes“, 2020.

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interACT D5.3 Technical verification plans and Outcomes

Work package	WP5: Integration, Testing and Demonstration
Task	**Task 5.2** Application integration **Task 5.3** Set-up, testing and demonstration
Authors	F. Tango (CRF); J. Ruenz (BOSCH); G. Drainakis (ICCS); R. Markowski (DLR); C. Pek (TUM)
Dissemination level	Public (PU)
Status	Draft
Due date	30/04/2020
Document date	30/04/2020
Version number	0.4
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Thank you!

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