Next Generation Integrated Mobility: Driving Smart Cities
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New ADAS Generation:
Connectivity and Data Privacy
Importance of the Driver

Still many years ahead with manual or semi-manual vehicles on the road

- **New ADAS Systems**
  Impact of the ADAS system on human driving behavior

- **Hand Over/Back**
  How to engage the driving to take decision in complex situations

- **Driver Training**
  Train the drivers individually based on the actions and reactions to maximize safety
User/Driver Perception and Acceptance on ADAS and Automation Functionalities

• 2 studies
  – Internet Forums Analysis
  – Specific Questionnaire

• Categories
  – Driving conditions: elements that are independent from the car or the driver (e.g. type of roads, traffic conditions, etc.)
  – Automated vehicle performance: reliability of the driving assistance systems (e.g. trajectories, detection of road markings, etc.)
  – Driver actions: actions taken by the driver to handle situations or because he is prompted to do so (e.g. emergency interventions, grabbing the wheel, etc.)
  – Cognition: cognitive processes showing how the driver feels and reacts in different situations (e.g. situation awareness, decision-making, etc.)
WEB ANALYSIS: Coding with MAXQDA

- **DRIVING CONDITIONS**
  - Construction zones
  - Curvy roads
  - Exit ramp
  - Heavy traffic
  - Intersections
  - Lane merge / split
  - Weather conditions

- **AUTOMATED VEHICLE PERFORMANCE**
  - Car trajectory
  - Road markings detection
  - Speed limits detection
  - Vehicles/obstacles detection

- **DRIVER ACTION**
  - Emergency intervention
  - Grab the wheel warning
  - Lane changing
  - Overtaking

- **COGNITION**
  - Decision making
  - Learning / Memory
  - Situation awareness
  - Stress / Relaxation
  - Trust in system

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56 The Autopilot did very well for most of the section, keeping the car in the middle of the lane between the lane barrier to the left and the line to the right.

56 A small concrete wall with yellow reflectors sticking out. The Tesla could clearly see the barrier all the time as shown by the side collision warnings (there were no audible warnings while the Autopilot was activated).

The barrier was of course very straight but the line was unfortunately not.

57 The accident happened when the lane got a bit wider (a few centimeters) and then shortly after got narrow again. Instead of driving on the line, the car swerved to the left and hit the reflectors on the barrier. I immediately deactivated the Autopilot and then the side collision warning sounds began.

There were no other cars, so there was no reason for Autopilot to prefer to hit the barrier instead of crossing the line a little bit.

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58 Passing big vehicles

Autosteer is great to stay in the middle of the lane. I noticed when I first started using it that Autosteer would drive a little further to the right that I would myself, but looking in the mirrors it turns out that Autosteer keeps you exactly in the middle while I think most human drivers would stay a little to the left of the center of the lane.

Normally, this is fine, but when overtaking a big lorry, I would feel much more comfortable if Autosteer would, like a human being, stay clear of the lorry and move to the left for more clearance. Only if there’s space on the left, of course.

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59 Road markings

There’s a number of different types of road markings and I get the feeling that Tesla doesn’t recognize them. Autosteer with assisted lane change will only recognize another lane if there’s an intermittent line on the lane. Continuous lines are not to be crossed.
## RESULTS

<table>
<thead>
<tr>
<th>Main codes</th>
<th>Sub-codes</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Driving conditions</strong></td>
<td>Construction zones</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Curvy roads</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Exit ramps</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Heavy traffic</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Intersections</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Lane merge / split</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Weather conditions</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Automated vehicle performance</strong></td>
<td>Car trajectory</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td>Road markings detection</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>Speed limits detection</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Vehicles/obstacles detection</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Driver action</strong></td>
<td>Emergency intervention</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>Grab the wheel warning</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Lane changing</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Overtaking</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Cognition</strong></td>
<td>Decision-making</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>Learning / memory</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Situation awareness</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>Stress / relaxation</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>Trust</td>
<td>14%</td>
</tr>
<tr>
<td>Driving conditions</td>
<td>Vehicle performance</td>
<td>Driver action</td>
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<td>Weather conditions</td>
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<td></td>
</tr>
</tbody>
</table>

- Driving conditions: Construction zones, Curvy roads, Exit ramps, Heavy traffic, Intersections, Lane merge / split, Weather conditions
- Vehicle performance: Car trajectory, Road marks detection, Speed limits detection, Vehicles detection
- Driver action: Emergency intervention, Grab the wheel warning, Lane changing, Overtaking, Decision making
- Cognition: Learning / Memory, Situation awareness, Stress / Relaxation, Trust in system
QUESTIONNAIRE: RESULTS

- 100 respondents
- Young drivers (75% of them younger than 40)
- Only 12% percent of the respondents are female

**How old are you?**
- 22 - 39: 3%
- 40 - 59: 72%
- 60 or more: 25%

**What is your gender?**
- Female: 1%
- Male: 87%
- Prefer not to answer: 12%
RESULTS: DRIVING HABITS

- Driving a car is fun
- Driving means freedom to me
- Using a car helps me save time
- Driving a car is relaxing
- Sitting in a car makes me feel safe

Bar chart showing percentages of appreciation of driving habits with categories:
- Strongly agree
- Agree
- Undecided
- Disagree
- Strongly disagree
RESULTS: SITUATIONS FOR AUTOMATED DRIVING / TRUST

How helpful do you think a driving assistance feature could be?

- Very unhelpful
- Unhelpful
- Neutral
- Helpful
- Very helpful

- Long distance highways
- Daily commute
- Parking
- Traffic waves
- Overtaking
- Roundabout
- Congested traffic
- Intersections
RESULTS: ACCEPTANCE OF AUTOMATED DRIVING

Acceptance of automated driving

- Strongly disagree
- Disagree
- Undecided
- Agree
- Strongly agree

I am sceptical about automated driving
I think an automated car will be reliable
I think an automated car will operate properly
I think automated driving will be useful for me
I think driving in an automated vehicle will be fun
I think it will require a lot of attention from my side
RESULTS: ACTIVITIES

What do you usually do while driving?

- Enjoy the landscape
- Listen to music
- Watch movies
- Browse the internet
- Use your smartphone
- Work
- Talk to other passengers

In an automated car, how much more likely would you be to do the following?

- Enjoy the landscape
- Listen to music
- Watch movies
- Browse the internet
- Use your smartphone
- Work
- Talk to other passengers
### RESULTS: USE CASES & TYPE OF FEEDBACK

<table>
<thead>
<tr>
<th>Situations</th>
<th>What feedback would you consider relevant in this situation?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="" /></td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td>Your car (yellow) is about to change lane to overtake the car in front of you (blue) but it slows down while another car (red) is approaching in your blind spot. Depending on the exact timing you should probably slow down rather than change lane. Your car gives you feedback so you are aware of the situation and you can take the right decision.</td>
<td><img src="image3" alt="Graph" /></td>
</tr>
<tr>
<td><img src="image4" alt="" /></td>
<td><img src="image5" alt="Graph" /></td>
</tr>
<tr>
<td>Your car is driving autonomously and approaches roadworks with yellow markings. White markings are still visible and your car detects both sets. Your car warns you about the complexity of the situation and prepares the upcoming maneuver.</td>
<td><img src="image6" alt="Graph" /></td>
</tr>
<tr>
<td><img src="image7" alt="" /></td>
<td><img src="image8" alt="Graph" /></td>
</tr>
<tr>
<td>Your car is driving in automated mode and therefore requires no action from you. It detects an accident (or obstacle) up ahead that you can’t see yet because you are not paying much attention. Your car’s system warns you about the incoming hazard and gives you feedback.</td>
<td><img src="image9" alt="Graph" /></td>
</tr>
</tbody>
</table>
RESULTS: CRITERIA WHEN BUYING A CAR

What criteria do you consider important when buying a new car?

- Cost
- Comfort
- Safety
- Eco-friendliness
- Manufacturer
- Social status
- Infotainment
- ADAS
- Original features

Not important
Slightly important
Fairly important
Important
Very important
High Definition Cartography Generation

Local Dynamic Maps Static + Non Static Elements

Scene Evolution Prediction and Control Algorithm

New Perception functionality design covering 360º

ALL POSSIBLE SITUATIONS

VALIDATION

10 X

OTHER VEHICLES

CLOUD SERVICES

CONTROL

Actuation

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inLane
Lane Navigation Technology

VALIDATION

CLOUD SERVICES

OTHER VEHICLES

AUTOPILOT

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New ADAS Functionalities

Data Generation **Outside Sensing**

- Lane Keeping
- Vehicle Position & Velocity
- Distance Keeping
- Blind Spot

**Services**

- Cooperative Services
- Personalised Services
- Maintenance Services
- Insurance Services

**OEM Data**

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New ADAS Functionalities

Data Generation **Outside Sensing**
Data Pre-Processing: Video Content Description

**Data Generation**

*Outside Sensing*

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A **VCD** is a **detailed description** of the Objects, Actions, Contexts and Relations of a recording. VCD entries can be stored in **document-oriented databases**.

```
"object": {
  "id": 0,
  "bbox": [31, 42, 610, 120],
  "type": "Car"
}

"object": {
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  "bbox": [31, 42, 610, 120],
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}

"object": {
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  "bbox": [37, 45, 625, 100],
  "type": "Car"
}
```
Privacy Masking
Data Generation Outside Sensing

**Person detection and tracking**
Detect persons in videos and identify their position, size and trajectory
The identity of the persons is not determined

**License Plate detection and tracking**
Detect License plate in video and identify their position, size and trajectory
The identity of the vehicle is not determined

**Implementation**
- Perspective calibration to determine the identify as persons moving elements in the scene
- Motion and appearance (faces, upper-body and/or full-body), time consistency
Privacy Masking Implementation

Data Generation Outside Sensing

- Privacy masking videos
  - Occlude / obfuscate regions holding privacy information (people, faces)
  - Allow for original video reconstruction upon valid authentication

- Workflow
  - Person Detection
  - ROI configuration (XML)
  - Extract ROIs
  - GStreamer multiplexer
  - Encryption keys
  - Output Video
  - Encrypt
New ADAS Functionalities

Data Generation Inside Sensing

- Blinking detection
- Gaze Estimation
- Head Pose
- Hands on wheel

Cooperative Services
Personalised Services
Maintenance Services
Insurance Services
OEM Data
New ADAS Functionalities
Data Generation Inside Sensing
Data Pre-Processing: Video Content Description

Data Generation Outside Sensing

A VCD is a detailed description of the Objects, Actions, Contexts and Relations of a recording. VCD entries can be stored in document-oriented databases.
Cloud Connection – Data Services

- Extract parameters and record driver status & maneuvers
- Analyse the driver behaviour
- Offer individual services
  - Training
  - Driver mode monitoring
  - Etc.
Cloud Connection

• Data Storage
• Big Data Analysis
• ADAS Services
THANK YOU!

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