REGULATORY APPROVAL OF AN AI-BASED AUTONOMOUS VEHICLE

Alex Haag
Munich, 10.10.2017
Launched 03/2017 with AUDI as a sole investor,

1. Volkswagen’s center of competence for autonomous driving in urban environments

2. Visit us at: aid-driving.eu

“We see potential for highly automated driving also in the city, where traffic is highly complex; this is the ultimate test for us”

Prof. Rupert Stadler,
Chairman of the Board of Management of AUDI AG
Speech at the Annual Press Conference, March 15, 2017
AID IS LEAPFROGGING TO LEVEL 4+ DIRECTLY

Continual withdrawal of the driver from the task of driving

ASSIST

Continually growing automation of driving tasks

PILOT

AID serves in first step as enabler of on-demand mobility services on a global scale for the VW Group

FOCUS AID

LEVEL 0 Manual

LEVEL 1 Assisted

LEVEL 2 Semi-automated

LEVEL 3 Highly-automated

LEVEL 4 Fully-automated

LEVEL 5 Autonomous

AUTOMATION LEVELS PER SAE

A6 (model year 1999)

Q7 (MY 2015)
with adaptive cruise control
Audi active lane assist

A8 next gen.

» Initially focused on urban environment and mobility services, our software is also designed to get integrated in ownership cars of the Volkswagen Group
MISSION STATEMENT

By 2021, enable mobility services to drive fully autonomously in urban environments. In the future, enable everyone – shared and owned cars – to drive fully autonomously.

WHAT WE DO

We develop the full software and data service stack together with a hardware specification to enable autonomous driving.

OUR COMPANY VALUES

Act fast
Be safe – take risk
Show passion
Succeed as a team
TO MASTER AUTONOMOUS DRIVING IN URBAN AREAS, AI TECHNOLOGY AND DATA-DRIVEN CONTINUOUS IMPROVEMENT WILL BE CRITICAL
HOMOLOGATION PROCESS IN THE CAR INDUSTRY

PARTIES:
» Car Manufacturers, Suppliers
» Engineering Services like TUV
» Approval agencies like KBA, RDW...

LAWS / REGULATIONS / STANDARDS:
» Vienna convention
» European laws / directives
» ISO 26262 standard

» We, all parties, need to come together to define a safety goal and create a new high-level process that allows innovation and guarantees safety to all road users
THERE WILL BE NO COMPROMISE ON SAFETY – WHAT DOES THAT MEAN FOR THE PERFORMANCE? HOW TO APPROVE AUTONOMOUS CARS?

GOALS

SAFETY
- # of Crashes
- Types of accidents

PERFORMANCE
- Drive time
- Smoothness of ride

Touch / Injury / Fatality
- AD specific or not
- At fault or not
- Remote control rate
- Speed of vehicle
- Areas "accessible"
ACCEPTABLE GOAL

We’re after all very tolerant today with road safety

Can it be rational?

The trip to and from the airport is way more dangerous than the flight itself

The good news: The race for Autonomous Driving is injecting 10’s of Billions of $$ in technologies that will improve safety
2015 GERMAN ROAD USER FATALITIES

<table>
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<tr>
<th>PASSENGER CAR</th>
<th>POWERED-2-WHEELER</th>
<th>BICYCLE</th>
<th>PEDESTRIAN</th>
<th>OTHERS</th>
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Source: Federal Statistical Office (Destatis), 2015
SOME COMMON MISCONCEPTIONS

“Grandma vs kiddy” is not our biggest problem

We may not need 8B km to prove the system is safe

- Fatality rate: ~150M km
- Injury rate: ~3M km
- Accident rate: ~0.5M km (~0.15M km in urban areas)
- Driving error rate: 1,000 km??

→ So 100M of km for validation may be enough

Human Intuition is poor at evaluating Probability of very rare events

- needs to be much more data-driven

Human Driving code is not always the safest for AD (following distances, drive on the right...)

The best way to solve the problem is not always to do it like a human

- New sensors, different architecture, infrastructure

Committed, talented and trusted software engineering teams remains the best guaranty for high-quality software
SOME LIMITATIONS OF CURRENT SAFETY METHODS (1/2)

REDUNDANCY

» Redundancy is not a goal, it’s a mean (no redundancy against loosing a wheel, for example)
» Goal is FIT rate (Failures In Time, number of failures per billion hours)
» How to decide which path is correct?
» Must be seen as Fusion. Otherwise increase of False Positives
SOME LIMITATIONS OF CURRENT SAFETY METHODS 2/2

**MONITOR**

» The hard part is detecting that there is an issue. If you detect it, you can manage it for most of the cases.

» Makes sense for hardware failure (incl. bit flip), but not for algorithm failure

**Fallback**

» When and how to transition?

» How to know fallback is better?

» How to make sure fallback gets enough testing? (Nasa)

**Prediction ...**

» ... is the hard part and cannot be done with a simple system
DEFENSIVE SAFETY

- Track risk and uncertainty in algorithm and lower speed accordingly
- Driver Assistance System for AI: necessary but probably not sufficient (prediction)