



LECTURE

8

Intelligent vehicle,
Intelligent highway,
Smart cities

Lecture 8 - Overview

- Intelligent vehicle
- Intelligent highway
- Smart cities concept

Intelligent vehicle

Car systems available

- Anti-lock Braking System (ABS)
- Adaptive Cruise Control (ACC)
- Adaptive Headlights
- Lane Change Assistant / Blind Spot Detection
- Driver Drowsiness Monitoring and Warning
- Electronic Brake Assist System
- Electronic Stability Control (ESC)
- Gear Shift Indicator
- Lane Departure Warning
- Local Danger Warning
- Night Vision
- Obstacle and Collision Warning
- Pedestrian/ Vulnerable Road User Protection
- Speed Alert
- Tyre Pressure Monitoring System (TPMS)
- Wireless Local Danger Warning

Autonomous vehicle systems

- Forward vision system
 - Lane tracking
 - Object detection
 - Far IR capability
- Short range sensors
- Long range sensors
- Rear vision system
 - Object detection
 - Far IR capability
- Short range blind spot sensors

Autonomous vehicle technologies

- GNSS
- LIDAR providing sensory feedback
- Millimeter-wave radar
- Infrared and optical sensors placed at the front of, sides, and rear quarters
- Front-mounted stereo camera
- Ultrasonic sensors
- etc.

Autonomous vehicle domains

- Making a vehicle in which you can control the steering, the power delivery, and the breaking – all automatically.
- Technology that allows the vehicle to sense the environment around it
- The processing – what does that vehicle determine, what decisions does it make based on the sensing of what is going on around it
- The output – what actions does the vehicle make based on that processing

Companies developing autonomous vehicle

- Google
- Toyota
- General Motors
- Volkswagen
- Volvo
- Mercedes-Benz
- Audi
- Ford
- Nissan
- etc.

Legal environment

- „Vienna convention“
Article 8 of the 1968 Convention on Road Traffic:
"Every driver shall at all times be able to control his vehicle or to guide his animals."
- April 2014 amendment agreed by the U.N. Working Party on Road Traffic Safety (still needs to be approved):
it would allow a car to drive itself, as long as the system "can be overridden or switched off by the driver". A driver must be present and able to take the wheel at any time.
- States enabling autonomous vehicle testing on public communications
 - USA: Florida, California, Nevada, Michigan
 - Europe: Germany, Netherlands, Spain, UK , Sweden – Göteborg
 - Volvo testing

Legal issues

- Legal questions
 - Liability
 - Car manufacturer
 - Software developer
 - Driver
 - Responsible (obliged to intervene)
 - Morally responsible (no possibility of intervene)
 - » Shared responsibility
 - » Personal responsibility
- Moral questions

Slows down innovation

Intelligent highway

Intelligent highway

- Infrastructure improvements, vehicle control
- Several levels:
 - RLTC
 - Smart surface
 - Smart devices
 - Electromobility support
 - Vehicle control

Road line traffic control

- RLTC parts:
 - Information portals(variable message signs)
 - RLTC gantries(carrying variable message signs)
 - Variable message signs
 - information (e. g. About weather, traffic situation, road maintenance)
 - directive (dynamical assignment of traffic lines, speed limits, etc.)
 - meteostations, sensors, emergency call boxes,
 - Tunnels technologies



Zdroj: ŘSD

Road line traffic control principle

- Systems evaluates the on-line traffic data
- Goal – achieve stationary traffic, avoid congestions, achieve maximal throughput
- Available control options:
 - Limiting the speed in steps typically 20kmph.
Possibility to ban the trucks above certain weight in the left line, etc.
 - Possibility to warn the drivers of any dangers – slippery conditions, congestions, maintenance, etc.
- Usage:
 - When predefined traffic flow is reached and congestion is probable, traffic speed is decreased

Smart surface

- Glowing Lines



- Dynamic paint

Source: <http://www.smarthighway.net/>



Smart surface

- Frost protection and melting snow
- Structural health monitoring
- Photovoltaic pavement

Smart infrastructure

- Interactive light



- Wind Light

Source: <http://www.smarthighway.net/>



Source:
<http://www.smarthighway.net/>

Support of electromobility

- Electric Priority Lane with inductive charging



Source: <http://www.smarthighway.net/>

Intelligent highway projects

Virginia Smart Road – testing highway

- A 2.2-mile, controlled-access test track built to interstate standards
- Two paved lanes
- Three bridges, including the Smart Road Bridge (the tallest state-maintained bridge in Virginia)
- Full-time staff that coordinate all road activities
- 24/7 access control and oversight
- Centralized communications
- **Lighting and weather system controls**
- Safety assurance and surveillance
- Fourteen pavement sections, including an open-grade friction course
- **In-pavement sensors (e.g., moisture, temperature, strain, vibration, weigh-in-motion)**
- Zero-crown pavement section designed for flooded pavement testing
- An American Association of State Highway and Transportation Officials (AASHTO)-designated surface friction testing facility
- Seventy-five weather-making towers accessible on crowned and zero-crown pavement sections
- Artificial snow production of up to four inches per hour (based on suitable weather conditions)
- Production of differing intensities of rain with varying droplet sizes
- Fog production
- Two weather stations with official National Oceanic and Atmospheric Administration (NOAA) weather available within one mile
- Variable pole spacing designed to replicate 95 percent of national highway systems
- Multiple luminaire heads, including light-emitting diode (LED) modules
- A wireless mesh network variable control (i.e., luminaire dimming)
- **A high-bandwidth fiber network**
- A differential GPS base station
- Complete signal phase and timing (SPaT) using remote controls
- Wide shoulders for safe maneuvering during experimental testing

Intelligent highway projects

Netherlands

- 500m stretch of the N329 highway in the Netherlands, approximately 100km south east of Amsterdam.
- Glow in the dark road markings
- Once the paint has absorbed daylight it can glow for up to eight hours in the dark.
- Installed April 2014



Source: <http://www.bbc.com/news/technology-27021291>

Intelligent highway - platooning

- Connecting cars into groups („trains“) following the lead vehicle
- Possibilities
 - lead vehicle driven by human driver
 - All autonomous vehicles
- Tests with platoon groups of ca 10 vehicles enabling usage in today's traffic
- E.g. SARTRE project (2009-2012) (with Volvo)

Smart cities

Smart cities

- Smart citizenship
- Smart commerce
- Smart economy
- Smart energy and water management
- Smart environment
- Smart entertainment
- Smart governance
- Smart health
- Smart infrastructure
- Smart living
- **Smart mobility**
- Smart people
- Smart security and emergencies

Smart cities principles

- applied **innovation**
- better **planning**
- more **participatory approach**
- higher **energy efficiency**
- better **transport** solutions
- intelligent use of Information and Communication Technologies (**ICT**)
- etc.

European support in the HORIZON 2020

- **Smart, Green and Integrated Transport**
 - resource efficient transport that respects the environment
 - better mobility, less congestion, more safety and security
 - global leadership for the European transport industry
 - a socio-economic and behavioural research and forward looking activities for policy making

Thank you for your attention



References

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