Panel on Vehicular Challenges

Topic: New Vehicular Technologies and Urban Requirements

Moderator
Yoshitoshi Murata, Iwate Prefectural University, Japan

Panelists
Felipe Jimenez, Universidad Politecnica de Madrid, España
Akimasa Suzuki, Iwate Prefectural University, Japan
Jeevan Visvesha, ANI Technologies Private Limited, India
Urban Requirements

- Problems especially for developing countries
  - Hard traffic congestions
  - Air pollutions
  - Traffic accidents (by old persons)

**How to solve these problems?**

- Existing transportation system
  - Road
  - Road + Metro/Tram
  - Road + Metro + Tram

**Can these system solve above problems?**
Technical Challenges for Vehicles

- MaaS: Mobility as a Service
- CASE
  - C: Connected car
  - A: Autonomous car
  - S: Sharing cars
  - E: Electric car

Others?
Vehicles in animation

Mobile Suit **Gundam**

**Flying Nimbus**
Dragon Ball/ Son Goku

**Motor skate board**
Detective Conan

???
Topics of panelist

- **Felipe Jimenez**

- **Akimasa Suzuki**
  - Solution of the notification for drivers on future connected vehicles.

- **Jeevan Visvesha**
  - Novel transportation systems suited for urban area and challenging technologies to realize them.
Needs for autonomous vehicles

Perception and scenario comprehension

Decision making

Reliability

Cooperation V2X

Infrastructure

Ethical / legal issues (responsability)

Cyber.security
Which transportation system suits for urban area, the autonomous and connected car, manned drone, or others?
What kinds of technologies are needed for the urban area transportation system?
Notification Methods for Near-future Vehicles

Akimasa Suzuki
Connected car and automatic driving levels

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No Automation&lt;br&gt;Zero autonomy; the driver performs all driving tasks.</td>
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<tr>
<td>1</td>
<td>Driver Assistance&lt;br&gt;Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.</td>
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<td>2</td>
<td>Partial Automation&lt;br&gt;Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.</td>
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<td>3</td>
<td>Conditional Automation&lt;br&gt;Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.</td>
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<tr>
<td>4</td>
<td>High Automation&lt;br&gt;The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation&lt;br&gt;The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.</td>
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Assisted by “connection”
Difficulties on automatic vehicle with Level 5

- Accident: Kanazawa seaside line
  - Monorail: easier operation than car.
  - Reverse run at end-loading platform and crash.
  - ATO (Automatic Train Operation)
  - Operated without driver

- Monitoring operator may be still required.
  - Who has responsibility (System developer won’t)
  - We have to solve many problem for realizing level 5
Notification method for vehicle

- We should watch outside, navigation system, speed meter, and mirrors.
- Many sound alert would be occurred.
- Connected car:
  Mach information is required to tell for drivers.
- Conventional method: confusion to other information
- Car Sharing: we don’t know individual systems
Case: Airplane

- Sound: words
- Indicator on display
- Stick shaker (Stall)
- Professional pilot
- Less traffic than cars
- Less real-time response than car driving
Notifying for human sensors

- Any else effective method??

- Sound (Abnormal noise)
- (Oil leak)
- Indicator Viewers
- Shaker Vibrator (Tire burst)
Lilium JET
Needs for autonomous vehicles

FELIPE JIMÉNEZ ALONSO

Head of Intelligent Systems Unit of INSIA
Email: felipe.jimenez@upm.es
Surroundings perception with onboard sensors

Complete and reliable representation of the vehicle surroundings that guarantee that no false positive or negative alarms occur.

Sensors with different capabilities

Appropriate for some purposes and scenarios but useless in others

Sensor fusion
OPEN ISSUES

Positioning as a secondary sensor

POSITIONING

• ACCURACY (in-the-lane accuracy)

DIGITAL MAPS

• ACCURACY
• DETAIL
• UPDATENESS

FUSION

• Positioning
• Information sources
• Map-matching
Toma de decisiones

WHAT SHOULD ONBOARD INTELLIGENCE PROVIDE?

- RELIABILITY
- FLEXIBILITY
- HUMAN BEHAVIOUR
- Rules observation
- Responsibility
Integration in non-structured scenarios
The autonomous vehicle is not capable of managing chaos; humans do.

Efficient shared space management
OPEN ISSUES

Infrastructure integration

• Correct conditions of horizontal and vertical signaling

• Acquisition, processing and dissemination of information
Driver interaction

- Driver role in autonomous vehicles
- Autonomous – manual driving transition
OPEN ISSUES

Other technical aspects

- Shared environment with other users
- Hackers threat
- High reability of the systems
OPEN ISSUES

FROM ASSISTED DRIVING TO COMPLETELY AUTOMATED DRIVING

• Driver interaction
• Other users interaction
• Reliable surroundings detection
• Cheaper technologies
• Legal issues
• Ethical issues
• “Predictable” behavior
• Information and communication management
• …
Is necessary a transport model change?

- Other ways of mobility (mobility as a service)
- Is going to change the vehicle propriety model?
- If manufacturers assume responsibility, what should insurance companies do?
- Who is responsible in case of an accident?
- What should driving schools do?
- How connected and automated vehicles can interact with conventional ones?
Which would be the impact on the transport mode choice?

Autonomous vehicles combine some advantages of public transport and traditional private vehicles.

Why would be the impact on commercial vehicles operation?

- More efficient operations
- Operation during low traffic schedules
¿AUTONOMOUS DRIVING OR AUTOMATION ON CERTAIN CIRCUMSTANCES TO IMPROVE SAFETY AND EFFICIENCY?

IS AUTONOMOUS DRIVING POSSIBLE WITHOUT COOPERATIVE DRIVING?
Needs for autonomous vehicles

FELIPE JIMÉNEZ ALONSO

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Novel transportation systems suited for urban area and challenging technologies to realize them.

JEEVAN VISVESHA
Hardware and Automotive Security Engineer
ANI Technologies Private Limited
Agenda

- Novel transportation system
- Existing transport mode
- Future technologies for short distance and long distance transportation
- Challenges to realize
- Conclusion
Novel Transportation system

Over the past few decades, due to increase in human capacity, congestion and emission. Few countries are moving towards enhancing the public transportation with advanced technologies.
<table>
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<tr>
<th>Current Societal needs</th>
<th>Current Transportation system</th>
<th>Future and Emerging transportation system</th>
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<td>Existing systems provide high levels of mobility and convenience but at high cost and with notable limitations.</td>
<td>Future systems would need to be cheaper, safer, faster, more comfortable, and more convenient than is the current set of transportation options.</td>
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| Future and emerging Societal needs | Current modes may not be able to adapt to future needs or societal changes. | Future systems would be developed to respond to new and emerging needs (e.g., for independent mobility for growing elderly population). |

**Example**
- United States collectively spends approximately $800 billion per year on motor vehicles, fuels, and related items.
- According to the National Highway Traffic Safety Administration report, 30,057 fatalities and just under 1.6 million non-fatal injuries resulted from traffic crashes in 2013.

Source: The Exploratory Advanced Research Program on Novel Surface Transportation Modes
Existing Transport models

- Personal mobility vehicles
- Infrastructure based Vehicle charging
- Self driving vehicles
- Shared fleet of On-Demand self driving
- Train
- Bus
- Cab service
Future Technologies

What is the advantage of inventing some enhanced surface mobility ???

- Innovation
- Private Sector
- Passenger Comfort
- Safety
- Security
- Current traffic congestion
- Challenges In travel pattern
Future Technologies for short range

**Straddling bus**
Also known as an elevated bus. This bus travels on top of all vehicles while allowing the vehicles to travel underneath and bus also can make frequent stop without creating congestion for other vehicles.

**Advantages**
- Solves huge traffic congestion
- The transport as a system is too fast.
- Comparatively inexpensive model as this is the second story of bus travel

**Disadvantages**
- Tracks required relatively straight road, thereby making it difficult to maneuver for changing lanes
- Expensive infrastructure change development
Future Technologies for short range

**Levitation Car**
A magnetic levitating vehicle (MagLev) is a vehicle that uses a strong electromagnetic field to resist gravity and keep the vehicle floating out of the ground.

**Advantages**
- Solve traffic Congestion as it can rotate easily (having more degrees of freedom)
- Fuel efficient as there is no road friction

**Disadvantages**
- Entire road needs to be magnetic bed
- Huge infrastructure cost
Future Technologies for short range

Autonomous vehicles for cab service

Advantages

- Lesser waiting time
- Rush hour will get a lot more pleasant
- Most of the space needed for parking is set free

Disadvantages

- Safety concern
- Security breach resulting in a Vehicle take over
- Unemployment
Future Technologies for short range

**Flying taxi**

**Advantages**
- Traffic Congestion reduces to maximum extent
- Lesser time for travel as it can take relatively straight path for the destination

**Disadvantages**
- Safety (Massive safety concern)
- Security breach resulting in a Vehicle take over (Massive destruction)
- Unemployment
- Huge infrastructure change required for the vehicles to stop for passenger to get off
- Huge parking space
- 3D Dimensional routing
- Lesser flight time restriction on battery
Future Technologies for long range

Tube-rail

Advantages
- Fastest Surface transport (neatly twice the airspeed)
- Low power consumption.
- Less cost in the long run
- Immune to bad weather

Disadvantages
- Initial cost for infrastructure requires huge investment
- High risk to life when something happens
- The installation requires cutting of large number of trees, which causes environmental loss
- Might cause dizziness due to high speed
Future Technologies for long range

Never ending train

Train stopping at each station and waiting for new people to get in is a time consuming.

This works on a concept where a Small cabin car will get detached from the top of train. A new cabin car will get attached to the train from the train station.

The locomotive underneath never stops

Advantages

- Very less waiting time at the train station
- Quick way of passenger entering and leaving the train

Disadvantages

- Safety concern if the cabin car doesn't attach or detach properly
- An infrastructure change required
Conclusion

Although there are lot of advanced and enhanced surface technologies invented, still it faces significant issues with expenditure, infrastructure, Safety and Security.

Is it really wise to invent these things ??

Debating topic