AUTONOMOUS CAR FUTURE
Transportation progress and issues
- Automation Levels in transportation
- Autonomous Systems
  – Companies: Waymo, Uber, Tesla, Cruise/GM
  - Technologies: Lidar / Cameras / Radar
- Exception handling – Uber, Nissan, Tesla
- Future of Transportation
  – Parking, Communication, Awareness, Ride-sharing
- New way of transportation
  – Hyperloop, Tunnels, Air-Taxi
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Automation</td>
<td>Human driver monitor</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance - hands on</td>
<td>Automated driving system</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation - hands off</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Conditional Automation – eyes off</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>High Automation – mind off</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Full Automation – steering wheel opt</td>
<td></td>
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</tbody>
</table>

www.sae.org/autodrive
Levels of Automation for On-Road Vehicles - J3016:

- **Level 0**: No Automation
- **Level 1**: Driver Assistance - hands on
- **Level 2**: Partial Automation - hands off
- **Level 3**: Conditional Automation - eyes off
- **Level 4**: High Automation - mind off
- **Level 5**: Full Automation - steering wheel optional

Learn more about SAE J3016 or purchase the standard document: [www.sae.org/autodrive](http://www.sae.org/autodrive)
Waymo has run self-driving cars over **5 million road miles** in 25 cities and done billions of miles in computer simulation.

- Collisions: three over more than 350k miles
- Lowest rate of disengagement
- Commercial operation in Phoenix, TX
- Operating in pre-mapped environment
- Using expensive Lidar
GM / CRUISE

- Cost ~ 200k USD an autonomous Bolt version
- Cost ~ 35k USD an electric Bolt version
- Cruise had 22 of the 27 accidents in the state involving driverless cars
- Trying to use cheaper Lidar’s
- Collisions: 22 over 132k miles
- Drive speed limited to 25 miles/hour
• Building ride sharing platform Tesla Network
• Uses mainly Cameras for Driving
• Uses Radar for long distance view
• Level 4 expected in 2020
• Fatal accident March 2018 – Killed pedestrian
• In 2016 Uber bought Self-driving trucking startup Otto
• Focusing on ride-sharing

https://www.bloomberg.com/hyperdrive
EXCEPTION HANDLING

• Nissan Automated Driving
  • Stop in case of parked car in street
  • https://youtu.be/cfRqNAhAe6c?t=519

• Tesla crashes
  • Environment aware of automation
  • https://youtu.be/P8CQ6pShc0I?t=240
  • https://youtu.be/--xITOqIBCM

• Uber accident
  • https://youtu.be/0Za_L_fbg2w
• Emergency braking
  • https://youtu.be/QJQOFS4YIfw?t=3 – fail to brake

• Emergency vehicles – right to go
  • https://youtu.be/R88hpUA6SI?t=106

• ACC with Line assistant issues
  • https://youtu.be/qQkx-4pFjus - crash
  • https://youtu.be/eB7fr2s_l9M?t=305 – cannot stay in the line
FUTURE – PARKING

• With automation you do not need to spend time to search for parking space and park close to your place where go
• Car will drop you off and continue with driving
• You can call car to pick you up.
• Big parking lots in Malls or Stadiums might not be needed
• Saving Time and Money. The car can be utilized by anyone else.
• Less traffic in the urban areas
FUTURE - AUTOMATED DRIVING

• Automated driving increase the flow of the traffic by reducing reactions of accelerating and distance between cars

• Intersection management – more intelligent car network cause less traffic and eliminate congestion time

• Shorter commute time - no congestion
FUTURE - AWARENESS

• Cars will communicate to each other
• Obstacle or Accident will be reported to other cars to adjust the route
• Reduce stress on the driver and potential accident due to lack of concentration
• When cars will be automated people can actively spend time during commuting.
• No accidents - More convenient commuting
FUTURE – RIDE SHARING

• Due to constraints it will be suggested to use ride sharing
• New ways of ridesharing – better planning, choose company you like to ride with
• Separated sections within car for privacy
• Owning car will be expensive and you will pay extra for parking

• Less cars on the road – Cheaper Transportation
FUTURE – NEW TRANSPORTS

• Hyperloop – fast intercity train
• 3D Tunnel network – more layers of roads
• Air-Traffic – Air-Taxi, Airbus, Gyrocopter /Gyroplane, Rocket Travel
  • https://youtu.be/zqE-ultsWt0
  • Lilium
    • https://youtu.be/BXyewsk-7aQ?t=23
  • Airbus
    • https://youtu.be/BXyewsk-7aQ?t=411
Q&A
Questions & Answers
THANK YOU FOR YOUR ATTENTION