Driver Assistance vs. Automated Vehicle Safety

August 2021
Overview

- Driver Assistance:
  - Help human drivers be better & safer

- Driver Automation:
  - Vehicle actually drives

- Compare & contrast
  - Safety argument implications
  - Technology challenges

- Start with:
  - Automation modes for non-engineers

https://on.gei.co/2r2rzg
<table>
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<tr>
<th>Operating Mode</th>
<th>Human Role</th>
<th>Driving</th>
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<tr>
<td>ASSISTIVE</td>
<td>Driving</td>
<td><img src="image1" alt="Driving" /></td>
<td><img src="image2" alt="Driving Safety" /></td>
<td><img src="image3" alt="Other Safety" /></td>
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<tr>
<td>SUPERVISED</td>
<td>Eyes ON the road</td>
<td><img src="image4" alt="Eyes ON the road" /></td>
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<td>AUTOMATED</td>
<td>Eyes OFF the road</td>
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<tr>
<td>AUTONOMOUS</td>
<td>No human driver</td>
<td><img src="image8" alt="No human driver" /></td>
<td><img src="image9" alt="No human driver Safety" /></td>
<td><img src="image3" alt="Other Safety" /></td>
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</table>
Better execute driver commands
- Anti-lock brakes
- Electronic stability control

Momentarily intervene for safety
- Automated emergency braking

The driver is responsible for safety
- The vehicle obeys driver intent
- Interventions to improve driver performance
- Functional safety covers equipment failures (ISO 26262)
Supervised: Driver Monitors for Safety

- Vehicle (mostly) does the driving
  - Speed control & lane keeping

- Human driver responsible for safety
  - Intervene to handle edge cases

- Driver monitors and intervenes
  - Vehicle must let driver intervene when needed (ISO 26262)
  - Effective driver monitoring required for automation complacency
  - Safety Of The Intended Function (SOTIF) (ISO 21448) helpful
ADAS Safety – Helping the Driver

- Proper functionality helps driver
  - Reduce driver stress, control mistakes

- Active safety can help
  - Helps avoid crashes
  - Tune to avoid false activations

- Arguably, good enough active safety
  - ADAS claims credit for safety; human blamed for crashes
  - BUT: avoid unreasonable demands on human drivers
    - Unaided humans are terrible at monitoring boring automation
Automated: The Car Drives

- Vehicle drives & handles safety
  - Driver need not pay attention to driving
  - Driving problems *not* dumped onto driver

- The vehicle responsible for driving safety
  - By definition:
    collisions are not fault of a human driver

- Tension between safety and permissiveness
  - False non-detections (false negatives) generally hurt safety
  - False detections (false positives) generally hurt permissiveness
Autonomous: No Human Oversight

- Vehicle handles driving & vehicle safety
  - There is no driver; no human supervision
  - Ensures passenger & cargo safety
  - Handles non-driving issues (e.g., post-crash)

- The vehicle is responsible safe operation
  - Human does not help with safety
  - OK for vehicle to get help if it initiates request all on its own

- Adds requirement for non-driving sensing (UL 4600)
  - Passenger safety; cargo safety; vehicle equipment status
  - Beyond scope of Automated Driving System Levels in J3016
Driver Roles Contrasted

- **Assistive & Supervised**
  - Driver attention required
  - Vehicle responds to driver
  - Vehicle blame for unsafe intervention
    - Incentive for vehicle to under-perform

- **Automated & Autonomous**
  - No human attention on driving
    - Vehicle cannot count on human intervention for driving safety
  - Mode changes are requests, not demands by vehicle
    - Human actively confirms responsibility
Driver Mode Transitions

- Mode confusion is a problem
  - Driver positive acknowledgment
  - Request user attention, not “demand”

- Example issues:
  - Supervised changes to Assistive
    - Driver thinks vehicle is still steering
  - Automated changes to Supervised
    - Driver takes extended time to regain situational awareness
    - “Captain of ship” does not have a full driving license
  - Autonomous changes to Automated
    - Attendant rouses then falls back asleep (sleeps through alarm)
Automation Safety Challenges

- **Assistive**
  - More uniform adoption of ISO 26262

- **Supervised**
  - Safety credit if low false positives
  - Effective driver monitoring

- **Automated**
  - SOTIF, scenario completeness & coverage
  - Sensor fusion, perception, prediction
  - Blamed for false negatives

- **Autonomous**
  - UL 4600 coverage: drivers do more than drive
Component Safety Challenges

- Positive Trust Balance:
  - Engineering Rigor, Validation, Feedback, Safety Culture
  - Standards-driven safety

- Safety Performance Indicators (SPIs)
  - Integrators asking for component safety cases
  - Field feedback: development; deployed

- Scalability past pilot vehicles
  - Accurate perception/prediction is still work in progress
  - Transition from brute force data to safety case
  - Key point: avoiding multi-sensor correlated failures
Organizational Safety Challenges

- Significant pressure to deploy
  - Flurry of empty driver seat demos in 2020
  - Can teams take the time needed for safety?

- Industry transparency needed
  - Safety collaboration rather than competition
  - Public trust in face of an adverse news event

- Ensuring robust safety cultures
  - Robotics meets automotive engineering
  - Silicon Valley culture + automotive culture + no human driver

https://youtu.be/nhqyrze30bk
Yandex demo video, Ann Arbor, Aug 2020