Looming on the Horizon: Autonomous Vehicles

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In the next 25 minutes

• AV 101
  ▪ What’s an autonomous vehicle (AV)?
  ▪ What’s on the road now?
  ▪ What’s coming and when?
  ▪ What does the public think about AVs?
  ▪ What are current state laws on AVs?

• Traffic safety issues for states
  ▪ AV testing
  ▪ AV operations
  ▪ What should states do
  ▪ What should national organizations do
Autonomous = self-driving, right?

So what’s the challenge?

• When all vehicles are autonomous:
  ▪ The passenger economy: transportation as a service
  ▪ No crashes (at least none due to driver error – about 94% currently)
• And it’s coming soon
  ▪ 26 states and DC with AV legislation or executive orders
    (and AVs probably can operate in most states without law changes)
But …

• It’s far more complicated than that
What’s an AV?

• Level 0: no automation, driver in complete control
• Level 1: driver assistance
  ▪ Cruise control or lane position, driver monitors at all times
• Level 2: occasional self-driving
  ▪ Control both speed and lane position in limited situations, like Interstates; driver monitors at all times
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• Level 3: limited self-driving in some situations, like Interstates
  ▪ Vehicle in full control, informs when driver must take control
• Level 4: full self-driving under certain conditions
  ▪ Vehicle in full control for entire trip, such as urban ride-sharing
• Level 5: full self-driving at all times

What’s on the road now?

• Level 1 available for many years
  ▪ Adaptive cruise control, lane-keeping assistance
• Level 2 available now
  ▪ Tesla Autopilot
• Levels 3-5 coming soon
  ▪ Waymo (Google) test fleet: 3 million miles as of May 2017
  ▪ Uber in Pittsburgh, Tempe; Lyft in Boston; pizza delivery in Ann Arbor
  ▪ 38 companies with AV testing permits in CA as of October 2017 – up from 12 in March 2016
  ▪ By 2020: available (perhaps) from Audi, BMW, Ford, Tesla, Volvo, VW; Delphi, Lyft, NuTonomy, Uber, Waymo ...
The AV begins with a map

Senses what’s around it
Predicts where things will move

And chooses route and speed
What’s coming and when?

![Autonomous Vehicle Fleet Projections](image)

What does the public think about AVs?

- **Skeptical**
  - Prospect of wide use? 34% excited, 57% worried
  - Will AVs reduce crashes? 35% yes, 46% no
  - Would you ride in an AV today? 17% yes, 75% no
  - Would you buy an AV when available? ≈ 20% yes, ≈ 50% no

- **Prefer AVs that allow drivers to take control**
  - Over 80% in two surveys

5 surveys (4 in 2016 and 1 in 2015), 4 in US and 1 in Canada
The big takeaway

- AVs and DVs (driver-controlled vehicles) will share the road for a long time – perhaps forever

The hybrid fleet: AVs and DVs

- The safety challenge: human behavior
  - Drivers, of AVs and DVs
  - Other road users as they interact with AVs

- A few examples
  - Tesla fatality – Level 2 AV; driver had hands off steering wheel for more than 36 minutes out of 37; ignored warnings from car; ran into semi
  - Waymo (Google) car pulled into the left lane and ran into the side of a bus coming from the rear; Waymo car assumed the bus would yield
  - Uber car in leftmost of 3 lanes; traffic stopped in right 2 lanes. Driver in cross street was turning left in front of the 2 stopped lanes and didn’t see Uber in third lane.
  - Kids running in front of AVs
The hybrid fleet: AVs and DVs

- The institutional challenge: AVs are disruptive technology
  - Hardware v software
  - Federal and state roles
    - Federal role: regulate vehicles
    - State roles: license vehicles and drivers, establish and enforce traffic laws, vehicle insurance and liability
  - Many new players: Waymo (Google), Uber and Lyft, ...
  - Many issues: liability, data security, infrastructure needs, ...
  - And it’s all moving very quickly – How to prepare for technology that’s developing rapidly

What should states do?

- AV testing
- AV operations
State AV policy issues - testing

Encourage AV testing while protecting public safety

• Final testing is on public roads
• Some considerations
  ▪ Must testing organizations apply to the state
  ▪ How and where will testing be conducted
  ▪ Test driver selection and training
  ▪ Test vehicle identification
  ▪ Testing organization’s safety culture and safety plan
  ▪ Testing organization’s insurance
  ▪ Reporting: test trips, incidents, crashes, injuries

Most topics are suggested in NHTSA’s AV Policy

State AV policy issues - operations

Encourage AV operations while protecting public safety

• AV drivers
  ▪ Licensing and training for Level 3-4 AV drivers

• Data systems
  ▪ Identify AVs in vehicle title and registration, driver licensing, crash reports
  ▪ For Level 3-4 AVs, identify where AV can operate autonomously (Operational Design Domain)
  ▪ Track software changes
Encourage AV operations while protecting public safety

- **Laws on AV operations**
  - Who’s the driver
  - AVs and traffic laws – speed limits, following too closely
  - Distracted driving laws – hands on wheel, cell phones, ...
  - DUI and DUID laws

- **Law enforcement**
  - How to identify AVs on the road: e.g., cell phone law enforcement
    - Is it a Level 3? A Level 4 within its ODD?
  - Traffic stops; vehicle pursuit: how to flag down an AV
  - Road rage of human drivers interacting with AVs
  - AVs suspected of carrying contraband

Encourage AV operations while protecting public safety

- **Crash investigation**
  - How to identify AVs at a traffic stop or crash
  - Officer and emergency responder safety: can the AV start moving without a driver

- **Liability and insurance**
  - Who is liable – manufacturer, software provider, owner, operator

- **Coordination across states**
What should states do?

• Be informed; stay informed
• Be a player
  ▪ Join or start a state AV task force; include industry partners
  ▪ Work with other states to develop consistent laws, policies, procedures
• Consider AV laws and regulations carefully
  ▪ Encourage AVs while protecting public safety
• Be flexible
  ▪ AVs are disruptive technology, developing very quickly

What should national organizations do?

• Develop model AV laws and regulations
• Document the traffic safety issues of AVs
• Develop model public education materials
• Establish an AV information clearinghouse
• Issue vehicle regulations and guidance promptly
• Establish regulations or guidelines to identify AVs easily
• Involve law enforcement, SHSOs, and DMVs in AV discussions
NHTSA Guidance

- Released Sept. 12, 2017
- Guidance, not regulation
  - “Encourage” rather than “require”
- Framework, not detail
  - Generic, not specific
  - What, not how
- New acronym: ADS = Automated Driving System

Guidance for ADS developers

- 12 points
  - Design for and validate overall system safety: “free of unreasonable risks”
  - Define the system’s ODD = Operational Design Domain
  - Detect and respond to safety risks: objects, events
  - Identify and deal with system malfunctions
  - Testing and validation
  - Interaction with ADS drivers
  - Cybersecurity
  - Crashworthiness
  - Post-crash ADS behavior
  - Crash and event data recording
  - Consumer education and training
  - Federal, state, and local laws
  - Voluntary self-assessment of these points
Guidance for states

- **Best practices - general**
  - Technology-neutral
  - Licensing and regulatory procedures
  - Reporting and communications
  - Traffic laws and regulations

- **Best practices – framework**
  - Administrative: ADS lead agency, technology committee
  - ADS testing: application, drivers, operations
  - Public safety official considerations
  - Liability and insurance

Last week’s word

*The New York Times*

**Not So Fast on Self-Driving Cars**

When the owner of an automated taxi was killed in a crash last year, the coronavirus pandemic, like most, surged our nation into the future.

"It's an exciting time that's remarkable, yet effectively demands people using an autonomous vehicle," Mr. Musk said. "You're killing people!"

"Sorry, but self-driving vehicle proponents like Mr. Musk envision a world where cars would be fast and eliminate traffic accidents, unleash our productivity and allow the old and disabled to travel freely."

Manufacturers say their vehicles will save lives.
For more information

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Download the report: www.GHSA.org