TRB and CAVs

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Publications and Databases

• Transportation Research Record: Journal of the Transportation Research Board (TRR)
  – 6400 papers submitted by August 1, 2019
  – ~3000 selected for presentation at TRB Annual Meeting
  – 900 published in the Transportation Research Record

• TR News, bimonthly magazine

• Work that’s done: trid.trb.org

• Work that’s underway: rip.trb.org
TRB Forum on AVs/Shared Mobility

• Discusses research needs in order to deploy AVs and shared mobility how and when they can have the most positive effects
• Members include federal, state, local governments; OEMs; academics; consulting firms; TRB committees
• Published white papers, held workshops, ranked research needs
Standing Committees

• ABJ70: Artificial Intelligence and Advanced Computing Applications
• AHB15: Intelligent Transportation Systems
• AHB30: Vehicle-Highway Automation
• AL040: Emerging Technology Law
• AND20: User Information Systems
• AP040: Automated Transit Systems
• (There are currently 200+ more, and another 300+ subcommittees)
Cooperative Research Projects

• NCHRP: funded at $42 million by state DOTs
  – NCHRP 20-102 began in December 2014
• ACRP: funded by FAA at $15 million
• TCRP: funded by FTA at $5 million
• BTSCRP: funded by NHTSA at $0.3 million
• Former CRPs
  – NCFRP (freight)
  – NCRRP (rail)
  – HMCRP (hazmat)
Some Completed CRP Reports

• Updating Regional Transportation Planning and Modeling Tools to Address Impacts of Connected and Automated Vehicles [NCHRP Report 896]

• Dedicating Lanes for Priority or Exclusive Use by Connected and Automated Vehicles [NCHRP Report 891]

• Implications of Connected and Automated Driving Systems [NCHRP Web-Only Document 253]
Some Completed CRP Reports

- Advancing Automated and Connected Vehicles: Policy and Planning Actions for State and Local Transportation Agencies [NCHRP Report 845]
- Challenges to CV and AV Application in Truck Freight Operations [NCHRP Web-Only Document 231]
Some Completed CRP Reports

• A Look at the Legal Environment for Driverless Vehicles [NCHRP Legal Research Digest 69]
• State CEO Leadership Forum on Connected & Autonomous Vehicles and Transportation Infrastructure Readiness [NCHRP 20-24(111) Final Report]
• Unmanned Aerial Systems (UAS) at Airports: A Primer [ACRP Report 144]
Some Completed CRP Reports

- Shared Mobility and the Transformation of Public Transit [TCRP Report 188]
- Broadening Understanding of the Interplay Between Public Transit, Shared Mobility, and Personal Automobiles [TCRP Report 195]
- Private Transit: Existing Services and Emerging Directions [TCRP Report 196]
- Transportation Network Companies: Challenges and Opportunities for Airport Operators [ACRP Synthesis 84]
AVS 2019

• Orlando, FL: July 15-18, 2019
• Approximately 1350 attendees
• Keynote Speakers included:
  – Chris Urmson, Aurora
  – Nicole Nason, FHWA Administrator
  – Raymond Martinez, FMCSA Administrator
• 7 sponsors of outdoor demonstrations
• 36 breakout sessions to discuss what research needs are and how that research can be most effective
Policy and Planning

Working with Infrastructure Owner-Operators to Overcome Public Sector Institutional Barriers and Safely Implement Roadway Automation

– Standardization and consistent communication of basic investment priorities nationwide

• FHWA should lead the development of a National Infrastructure Standard with a focus on the Interstate and National Highway Systems.
• Identify corridors for small cell & truck platooning pilots
• Develop a consistent set of standards/terms
• Address current funding limitations by incorporating R&D efforts into existing construction projects.
Policy and Planning


- DOE ARPA-E NEXTCAR tech successfully optimizes reduces CAVs vehicle energy consumption by 20%
- Environmental outcomes depend on regulator’s ability to set policies for OEMs – no CAV energy regulations exist yet
- Does AV technology finally clear the hurdle of EV penetration with the ability to self charge (wirelessly?) and remove range anxiety?
- Are consumers willing to trade off longer travel time for fuel economy in CAVs? (dominated by behavioral aspects)
Policy and Planning

Regulatory Policy for AVs

- International: Korea and Japan to roll out level 3 AVs by 2020, level 4 AVs by 2030
- Agreements to share and protect data are critical
- NHTSA/DOT need to issue guidelines on development of technology
- Public education needs to improve. Confusion about AVs is a major problem
The purpose of trucking automation can be summed up in two words, “ripe tomatoes.” (safe and reliable same-day delivery supply line)

– Platooning
  • Much global interest, but must be recognized as a tool for specific needs with a focus on truck operator buy-in; lateral control of paired trucks may be a key solution
  • Need closure on long-term comm. spectrum issues
– Industry and regulators need more public data on common safety and efficiency metrics
Operations and Applications

Game Changer! Using Dedicated Lanes for Early AV Deployment

- Need to study the challenges of dedicating lanes for different speed travel.
- CAV platooning within dedicated lanes and the impacts it has when these platoons disperse back into the general use lanes.
- Means to forecast empty vehicle movement in demand modeling
Operations and Applications

Catching Up with Low-Speed Autonomous Shuttles: Research Needs

- On-road signing
- Common evaluation methodologies
- Core questions for user and public surveys
- Workforce impacts
- Sensor robustness and performance
- Remote supervision and monitoring
- Ensuring accessibility for all users
Operations and Applications

Automated Vehicle (AV) DATA – Who has it? Who wants it? What format?

– Role of infrastructure owner operators; DOT workforce development challenges

– Research:
  • Evaluation of which DOT data is most relevant to AVs – this will help in prioritizing investments
  • Cost/benefit analysis of digitizing various infrastructure elements

– Scalability is necessary; CAVs cross state lines
  • Pooled fund studies, AASHTO, USDOT can play a role
Operations and Applications

Connected Infrastructure: Enabling Automated Vehicles in Smart Communities

- Emergency responders are the “missing mode”
- Consider V2R(responder) communications – e.g. vehicle and occupant characteristics and condition information – and applications
- Need mature approaches to supporting communications technology evolution (5G, DSRC, and beyond)
- Need to address basic security requirements (lock the signal cabinets!)
Technology

Enabling Technologies – A Peek Under the Hood

– Ongoing technology challenges: weather, LIDAR, reliability, hardware cost, definition and validation of safety thresholds

– Research needs:
  • Sensors with higher end processors
  • Develop ability to assess safety processes for dynamic driving tasks within Operational Design Domains (ODD)
  • How to make AVs safe enough to be accepted by society
Technology

New Simulation Tools for Training and Testing Automated Vehicles

– Existing solutions still time and effort intensive, although standards like OpenDrive are enabling collaboration
– More work is needed on how to design scenarios and validate their utility
– More standardization would greatly facilitate progress.
  • HD map formats, GPS data, ODD for scenarios, V2X models
– We need methods to share models w/o compromising IP
  • Black box sensor models
  • Work with encrypted data
Technology

Role of Artificial Intelligence and Machine Learning in Infrastructure Readiness for Vehicle Automation

- Contextual information (e.g., signal control and lane markings) is key area for trajectory projection for vehicles, pedestrians and e-bikes
- Infrastructure design may be key to improve AV perception in adverse weather
- Need to explore AI applications in transportation network and traffic operations; AI and ML methods for transportation data analytics
- Collaborations among AVs are critical for future smart and connected transportation systems
Technology

Automated Vehicles Ecosystem End-to-End Cybersecurity

– Threat and hazard assessment for each component involved in the AV ecosystem; redone regularly
– Learn how to hand-off security to the subsequent element in the system for end-to-end security
– Understand how to involve the user in the mitigation of cyberattacks. (Is this still valid in Level 4+ automation?)
Technology

Blockchain: Enabling Coordinated Autonomy

– World First! MOBI release of the industry’s first blockchain vehicle identity standard

– Research Needs
  • Continue to educate the transportation industry on the potential of this technology and grow a user community
  • Flesh out AV and mobility use cases for blockchain
  • Investigate strategies to reduce the latency of blockchain transactions to support more real-time AV and mobility use cases.
  • Additional work on orchestrated autonomy for the entire system
Technology

Spectrum Needs for Cooperative Automation

- Global spectrum for future CAV applications
- Need to consider specific approaches to acquire spectrum
  - ITU/WRC 2019/2023/2027
- Need white paper and “call for action” to from transportation community – awareness and participation
Technology

Reading the Road Ahead: Preparing Infrastructure for ADAS and High Automation

- Lane markings and delineation are and will remain critical for lateral positioning functions in ADAS and HAV machine vision systems
- Demonstrate the need for agency investment in pavement marking programs
- Determine true machine *and* human ability to differentiate between patterns and widths of pavement markings
Technology

CARMA – Automated Vehicles Working Together

- Reviewed TSMO Use Cases for CARMA (Basic Travel, Traffic Incident Management, Work Zone Management, and Road Weather Management)
- Discussed cooperative automation standards
- Shared existing applications of CARMA platform in private and public sector
Users and Human Factors

How Can Automation Improve Rural Accessibility and Mobility?

– Challenging and diverse environment
– What kind of new business models (public, private, hybrid), partnerships and frameworks can be used to encourage and facilitate innovative mobility & mobility management?
– How can we leverage existing resources, infrastructure and knowledge to integrate new technologies and improve rural mobility?
– Will longer distances in less populated rural settings prove too difficult for shared services (personal security, financial viability, service reliability)?
Users and Human Factors

Not So Autonomous Vehicles: A Path to Consumers’ Changing World

– We can learn a lot about consumer interest in self-driving vehicles by examining consumer perspective on lower levels of automation (L1 and L2)
– Still many issues in this area (terminology and trust)
– Review “levels” concept for consumer consumption? Get rid of term “automated vehicle” altogether? Replace with “automated features”?

[The National Academies of Sciences • Engineering • Medicine]

[TRANSPORTATION RESEARCH BOARD]
Users and Human Factors

AVs & Vulnerable Road Users: Representing the Under-Represented

– The tradeoff between operations and safety must be explicitly considered when risks may fall disproportionately on vulnerable road users

– Identify methods to quantify safety and communicate it in a meaningful way to the public. (e.g. “safer than a novice driver”)

– Identify methods to leverage education to improve trust, explain benefits and protect VRUs around AVs

– Develop ways to design future infrastructure to be adaptable AND inclusive
2020 TRB Annual Meeting
Washington, DC
January 12-16, 2020

2020 Automated Vehicle Symposium
San Diego, CA
July 27-30, 2020

(And about 4,271,977 other events)
The End

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