



NHTSA Role in The Future of Automated Vehicles

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YOU'VE COME A LONG WAY BABY!



First horseless carriage in Vancouver. Circa 1899. From City of Vancouver Archives.
<http://searcharchives.vancouver.ca/first-horseless-carriage-in-vancouver;rad>

NHTSA's Mission

Save lives, prevent injuries and reduce economic costs due to road traffic crashes, through education, research, safety standards and enforcement activity.

Automated Vehicles: NHTSA Perspective

- **The relationship between motor vehicles and drivers will change more significantly in the next 10 to 20 years than they did in the last 100 years.**
- **Advancements in Crash Avoidance technology can significantly reduce crashes and the human and economic costs therein.**



Automated Vehicles: NHTSA Perspective

- NHTSA is responsible for developing, setting, and enforcing Federal Motor Vehicle Safety Standards (FMVSS) and regulations for motor vehicles and motor vehicle equipment.
- The purpose of NHTSA's safety programs is to reduce or mitigate motor vehicle crashes and their attendant deaths and injuries.

Automated Vehicles: NHTSA Perspective

- NHTSA is currently evaluating the effectiveness of automated braking systems in avoiding or mitigating crashes.
 - Developing test procedures to evaluate the technologies and methods to assess their safety benefits.
 - U.S. DOT modal administrations and industry are conducting in-depth research and demonstration of Vehicle-to-Vehicle (V2V) communication technology.

Automated Vehicles: NHTSA Perspective

- Three distinct but related streams of technological change and developments are occurring simultaneously:
 - In-Vehicle crash avoidance technology that provide warnings or limited automated control of safety functions
 - V2V communications that support various crash avoidance applications
 - Self driving or autonomous vehicles

Automated Vehicles: NHTSA Perspective

- While NHTSA is conducting research along the entire automation continuum, our emphasis initially is on determining whether those crash avoidance and mitigation technologies that are currently available are safe and effective.
- Because these technologies will be building blocks for what may lead to a driverless vehicle, we have begun research focused on safety principles that may apply to higher levels of automation: i.e. driver behavior in the context of highly automated vehicles.

NHTSA's Research Plan

NHTSA has been conducting research on vehicle automation for many years.

- Issued a standard for Electronic Stability control (ESV) an Automation Level 1 technology, making it mandatory on all light vehicles for the MY2011.
- Conducting on-going research on lane departure, and forward collision warning systems
- NHTSA has included these technologies in our New Car Assessment Program (NCAP) to encourage consumers to consider choosing models with these features.

NHTSA's Research Plan

- NHTSA is engaged in research on automatic braking technologies (dynamic brake support and crash imminent braking).
- Within the next year, NHTSA will decide whether these braking technologies will be considered for rulemaking and/or inclusion in our NCAP program.
- Our current work involves development of test procedures and assessment of benefits for these Level 1 technologies.

NHTSA's Research Plan: Levels 2-4

U.S. DOT has identified three key areas to conduct research for more advanced automated vehicle systems:

- Human factors
- System performance requirements
- Electronic control system safety

NHTSA's Human Factors Research Plan: Levels 2-4

- Development of requirements for the driver-vehicle interface (DVI)
- Transition between automated and non-automated vehicle operation (Levels 2&3)
- Automated driving concepts emerging in relation to how the driver interacts with the vehicle

NHTSA's Human Factors Research Plan: Levels 2-4

- Driver/Vehicle interaction: communication methods between driver and vehicle to ensure safe vehicle operation
- Ensuring proper allocation of vehicle control functions between driver and vehicle
 - Division of labor and control authority
 - Transitions: appropriate means of transferring control from vehicle to human and vice versa
- Driver Acceptance: factors leading to driver acceptance(false alarm rates, nuisance warnings, automation system availability and reliability)

NHTSA's Human Factors Research Plan: Levels 2-4

- Driver Training – Evaluating training requirements for Levels 2&3 systems
- Developing human factors research tools-
Appropriate test and evaluation tools(e.g. simulators, test vehicles) to evaluate driver and system performance for various vehicle concepts.

Electronic Control Systems Safety Research Plan: Levels 2-4

- NHTSA is well aware of ISO 26262 which establishes uniform practices for achieving specific levels of safety integrity in complex embedded control systems.
- NHTSAs work will focus on development of functional safety requirements, reliability requirements in the areas of diagnostics, prognostics and failure response (Fail Safe) mechanisms.

Electronic Control Systems Safety Research Plan: Levels 2-4

- Electronic Control Systems Safety:
 - NHTSA has initiated research on vehicle cybersecurity, with the goal of developing an initial baseline set of requirements.
 - Security: resistance to cyber attacks
 - Risks: gaps in the system that can be compromised by attacks
 - Performance: effectiveness of security systems
 - Unintended consequences: Impact of cybersecurity on system performance
 - Certification: Assurance that critical systems are secure

System Performance Requirements

Research Plan: Levels 2-4

- Support the development of any potential technical requirements for automated vehicle systems.
 - Developing detailed functional descriptions for emerging Level 2&3 operational concepts
 - Data Analysis-Evaluate naturalistic data and crash data and develop real world scenarios that match the descriptions of Level 2&3 automated vehicle systems
 - Evaluate constraints on level 2 and 3 system performance
 - Develop test and evaluation methods

NHTSA's System Performance Requirements Research Plan: Levels 2-4

Determine the performance and operating envelope for emerging level 2&3 systems (appropriate operating boundaries)

–Leverage results from electronic control systems research

- Understand system failures modes for each automated systems
- Identify points of failure for each system (braking, steering, etc.) installed on the vehicle and determine how the systems reach in static and dynamic situations

–Develop objective performance tests and associated pass/fail criteria

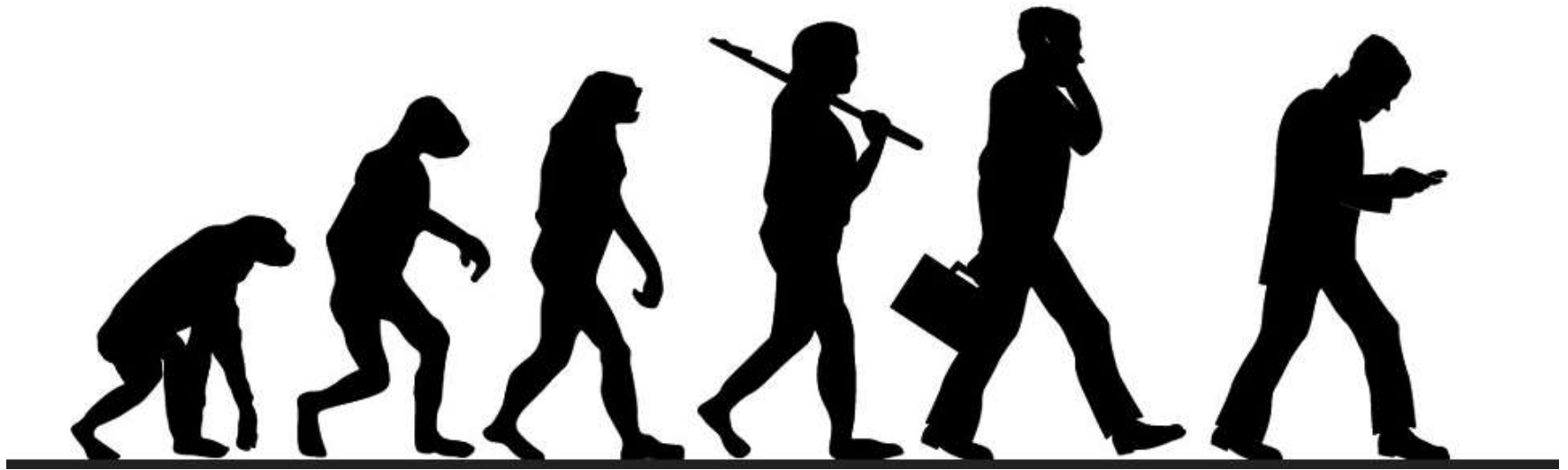
Electronic Control Systems Safety Research Plan: Levels 2-4

- A common element in all levels of automation is safety-critical electronic control systems
- NHTSA generally regulates by developing performance standards for specific vehicle systems or sub-systems to address a specific safety risk
- The centrality of electronic systems to nearly all vehicle controls may require the agency to develop requirements for electronic control systems to ensure their reliability and security.

NHTSA Perspective

- NHTSA is encouraged by innovations in automated driving and their potential to transform our roadways.
- The potential for reducing crashes, congestion, and economic and personal losses associated with both is enormous.
- **BUT we must tread carefully.**

Technology sometimes has unintended consequences.



The road ahead is very exciting!



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