Enhancing Safety Through Automation

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National Highway Traffic Safety Administration
NHTSA’s Missions

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

- **Consumer Programs**
  
  Increase fuel economy, damageability protection, and theft protection, reduce odometer tampering, and provide consumer information.
The Problem!!!

Safety
• 32,788 highway deaths in 2010
• 6,000,000 crashes/year
• Leading cause of death for ages 4 - 34

Mobility
• 4,200,000,000 hours of travel delay
• $80,000,000,000 cost of urban congestion

Environment
• 2,900,000,000 gallons of wasted fuel
Fatalities in Motor Vehicle Traffic Crashes 2009

Human Error is Critical Reason for 93% of Crashes
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<th>Crashworthiness</th>
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Evolution of Vehicle Electronics

Crash Avoidance and Injury Mitigation

- Long Range Radar Sensor
- Automated Vehicle Control

- Short Range Radar Sensor
- Camera Based Lane Detection
- Integrated Human System Interface

Information
Focus on Safety

- Automation should be focused first on safety
- Not enough to be “as safe” as human drivers
- Automated car goal: “crash-less”
Definitions are Important

- **Autonomous**
  - “not subject to control from outside; independent” *
  - “undertaken or carried on without outside control” #

- **Automated**
  - “automatically controlled operation of an apparatus, process or system by mechanical or electronic devices that take the place of human labor” #

- **Cooperative**
  - “acting together for a common purpose or benefit” *

Sources: *
http://dictionary.reference.com
# http://www.merriam-webster.com/dictionary
## Levels of Automation (NHTSA Draft)

<table>
<thead>
<tr>
<th>Levels of Automation</th>
<th>Monitoring Roadway</th>
<th>Active Control</th>
<th>Responsibility for Safe Operation</th>
<th>Driver/Occupant Availability</th>
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<td>Level 2 - Monitored Automation</td>
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D = Driver  
R = Robot
Building Blocks for Autonomous Operation

- Automated Operation
  - Policy Considerations
  - Infrastructure Changes?
  - Active Driver Engagement?

- GPS/Maps for Positioning
- On-Board Data Collection
- Radar/Camera for Crash Avoidance
- Network for Cybersecurity
- AI for Decision-Making
- Driver Information Systems

- Reliability
- Security
- HMI
Automation Challenges Include:

- Human Factors (Driver Engagement/Re-engagement)
- Sensor Performance
- Artificial Intelligence Decision-Making Capability
- Electronic Control Systems Safety
- Cybersecurity
- Testing and Evaluation Methodology

Regulatory Approaches:
- Performance requirements/objective testing for various levels of automation.
- Standardization - Are different concepts for achieving automation compatible on the roadway?

- Operating environment - operating in mixed traffic and on public roads?
- Infrastructure modifications
- Liability
- etc…….
Motor Vehicle Automation Research Roadmap

Goal: to improve motor vehicle safety by investigating the requirements for automated driving that is:

- Operational only to the extent granted by the driver
  - Including override capability

- **Electronically Reliable and Secure**
  - Functionally safe w/appropriate data storage/diagnostics/prognostics
  - Secure from malicious external control and tampering

- **Operationally intuitive for drivers**
  - under diverse driving conditions
  - within limits understood by the driver

- **Focused on reducing crashes!**
Objectives

1. **Support policy decisions on emerging system concepts (Level 2 and Level 3 systems)**
   - Near production concepts are already here

2. **Facilitate development/deployment of safety enhancing automated systems**
   - Defining concepts of automated operation including the integration of safety systems [safety enhancing concepts]
   - Developing technical requirements and associated performance tests
   - Assess safety benefits & system performance
Motor Vehicle Automation Research Roadmap

**Efforts**

1. Support Policy Decisions
   - Complete human factors studies to evaluate emerging concepts
2. Program Planning/Knowledge Base
   - Evaluate critical issues. Synthesize findings to define critical research gaps
3. Develop System Performance Requirements
   - Performance requirements for automation levels and associated system concepts
4. Address Electronic Control Systems Safety
   - Reliability and cybersecurity requirements
5. Improve Driver Awareness & Response
   - Driver-Vehicle Interface (DVI) criteria and guidelines
   - Driver Training & Licensing req’ts
6. Evaluate System Operability
   - Develop obj. tests
   - Define safety and perf. metrics
   - Complete Evaluation studies
   - Estimate Benefits

**Outcomes**
Automation Challenges Can be Met

- The goal is a worthy one
- Great potential for improving vehicle safety
  - And other transportation goals
- NHTSA establishing a comprehensive research plan
- Will require collaboration
  - product developers,
  - insurers,
  - academia,
  - state and federal governments,
  - and many others.....
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