Princeton University

PAVE PRINCETON AUTONOMOUS VEHICLE ENGINEERING

What We Don't Yet Know, What We Know & What We Can Do Now

by

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Presented at

Connected & Automated Vehicle Conference
What States Need to Know

June 22, 2016
Maritime Institute
NYC

Connected & Automated Vehicle Conference
What States Need to Know

CARTS
The Center for Automated Road Transportation Safety

What Problem are/should we be addressing

- Today (Self-Driving) … It is all about **SAFETY**!

What Problem are/should we be addressing

- Deaths/yr.: ~ **35K** US; ~**1.25M** World
- Leading cause of death for ages of **5 -> 35**
- One of the most dangerous occupations
  - Worse than coal mining
- NHTSA: Car Crashes cost US **$871B/yr** (~ **$2,800/person** 5/29/14)
  - (**$2.8K/person**); 1/3 Cash
- Liability expenses 2013 (Transit Buses, US) $500M/yr.
  - $6,300/bus/yr (120 fatalities/yr)
- > **90%** involve Human error
- The Bad news (Safety Council's Press release): **Things are getting worse!**

What Problem are/should we be addressing

Press Release on Feb 16, 2016:

NSC Motor Vehicle Fatality Estimates

Prepared by the Statistics Department
National Safety Council

Motor-vehicle deaths up 8% in 2015.

With continued lower gasoline prices and an improving economy resulting in an estimated 3.5% increase in motor-vehicle mileage, the number of motor-vehicle deaths in 2015 totaled 38,300, up 8% from 2014. The 2015 estimate is provisional and may be revised when more data are

http://www.nsc.org/NewsDocuments/2016/mv-fatality-report-1215.pdf

What Problem are/should we be addressing

- Today (Self-Driving) … It is all about **SAFETY**!

- Ultimately (Driverless) …It is all about **Enhanced Mobility**
  - "On Demand" for All
  - Substantially Cheaper
  - Substantially Safer
  - Substantially More Energy Efficient
  - Substantially Lower GHG & Other Pollutants
  - Substantially Less/Elimination of Road Congestion

What Are We Talking About

- **Self-driving** vehicle automation & intelligence.

(Reliably keep vehicle centered in a lane, follow traffic, not hit anything

Enhances and Relieves Human Driver

- **Driverless** vehicle automation & intelligence.

(Reliably operate at highway speeds in mixed traffic with no one

Replaces Human Driver

Will necessarily require Some Oversight/Monitoring; thus requi

- **Connected** vehicle information.

(Communication between Vehicles & Infrastructure,

Enhances Human Driver & Self-driving and Necessary for Driverless

Has existed for a while: Ex.: Real-time traffic & CoPilot|Live

What We Don't Yet know

- **Self-driving** vehicle automation & intelligence.

(Reliably keep vehicle centered in a lane, follow traffic, not hit anything ~Tesla AutoPilot/MB Driver Assist)

How to properly transition between Conventional Driving & Self-driving

- **Driverless** vehicle automation & intelligence.

(Reliably operate at highway speeds in mixed traffic with no one in the vehicle)

To date this is simply a "Sunday Supplement" Concept

No idea about the Fleet-management aspects including the public oversight aspects

- **Connected** vehicle information.

(Communication between Vehicles & Infrastructure, V2X)

No idea about how to fund the infrastructure needs of a centralized "V2X" concept

What We Know

- **Self-driving** vehicle automation & intelligence.

(Reliably keep vehicle centered in a lane, follow traffic, not hit anything ~Tesla AutoPilot/MB Driver Assist)

Available Today

This is what Is Important to I-95 CC

- **Driverless** vehicle automation & intelligence.

(Reliably operate at highway speeds in mixed traffic with no one in the vehicle)

Doesn't Exist Today

The Easy Part will be the Driverless portion on "I-95s"

The Hard part will be getting to/from I-95s Driverless

- **Connected** vehicle information.

(Communication between Vehicles & Infrastructure, V2X)

Add-on that enhances Self-driving and Driverless

Otherwise way too "Orwellian"

What We Know

- **Self-driving** vehicle automation & intelligence.

(Reliably keep vehicle centered in a lane, follow traffic, not hit anything$_{\sim \text{Tesla AutoPilot/MB Driver Assistance package}}$)

$$\textbf{Cost}_{\text{Today}} \leq \$2{,}500. \text{ (consumer)}$$

$$\textbf{Cost}_{\text{Today}} \sim \$ \quad 0. \text{ (public sector)}$$

$$\textbf{Tangible Value}_{\text{Accident Liability Reduced by 50\%}} \geq \$1{,}000/\text{year}$$

$$\textbf{RoI}_{\text{Today}} \leq 3 \text{ years} \text{ on a vehicle life} \geq 10 \text{ years}$$

This is a REAL Business Case!

This one is **Inevitable**

What We Can Do Now

- **I-95 Corridor should be Welcoming to Self-driving**
  - **View Self-driving Cars as our Customers (helping us be safer and more efficient)**
  - **Variable message signs should encourage use of**
    - **Cruise Control, Intelligent Cruise Control & Self-driving (when appropriate)**
- **I-95 Corridor should pride itself in always having good & consistent "paint" (visual lane markings) and signs**
    - **These benefit every driver (and every self-driving system) today and tomorrow.**
- **I-95 Corridor should establish a relationship with each manufacturer to monitor using crowd sourcing the performance of its Self-driving systems throughout the corridor**
    - **And have this information used in maintaining the corridor.**
- **I-95 CC should request that NHTSA permit vehicles to visually display when they are using self-driving.**
    - **Conventional drivers need to know which neighboring vehicles are behaving like human drivers (constant depression of the gas pedal, or self driving.**

Discussion!

Thank You

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www.SmartDrivingCar.com