A look into current driver behavior research

CHRIS SCHWARZ, TIMOTHY BROWN, & JOHN GASPAR
NATIONAL ADVANCED DRIVING SIMULATOR (NADS)
THE UNIVERSITY OF IOWA

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THE NATIONAL ADVANCED DRIVING SIMULATOR

THE UNIVERSITY OF IOWA

Our Motivation

90% of motor vehicle crashes are attributed to human error

In 2013…

32,719 traffic fatalities including 4,668 involving motorcyclists and 4,735 pedestrians

2.3 million people injured

31% of all traffic-related deaths involved alcohol

From 2004 to 2013, of all the states, Iowa had the largest increase in alcohol impaired driving fatalities at 45 percent

Drowsy drivers are involved in an estimated 21% of fatal crashes

22% of drivers tested positive for illegal, prescription, or over-the-counter drugs

16% of all police-reported motor vehicle traffic crashes involved distraction

Motor vehicle crashes are the leading cause of death for ages 5 through 24, 2nd leading cause of death for 25+

The economic cost to society exceeds $230 billion

-NHTSA, Traffic Safety Facts, 2013 Data

- AAA Foundation, Prevalence of Motor Vehicle Crashes Involving Drowsy Drivers, US, 2009-2013
CDC Data, 2013

Some of our research areas

- Driver impairment
  - Distraction
  - Alcohol and drugs
  - Drowsiness
  - Driver state detection and mitigation
- Vehicle technology
  - Connected vehicles
  - Automated vehicles

Driver distraction

Studying how distraction contributes to crashes

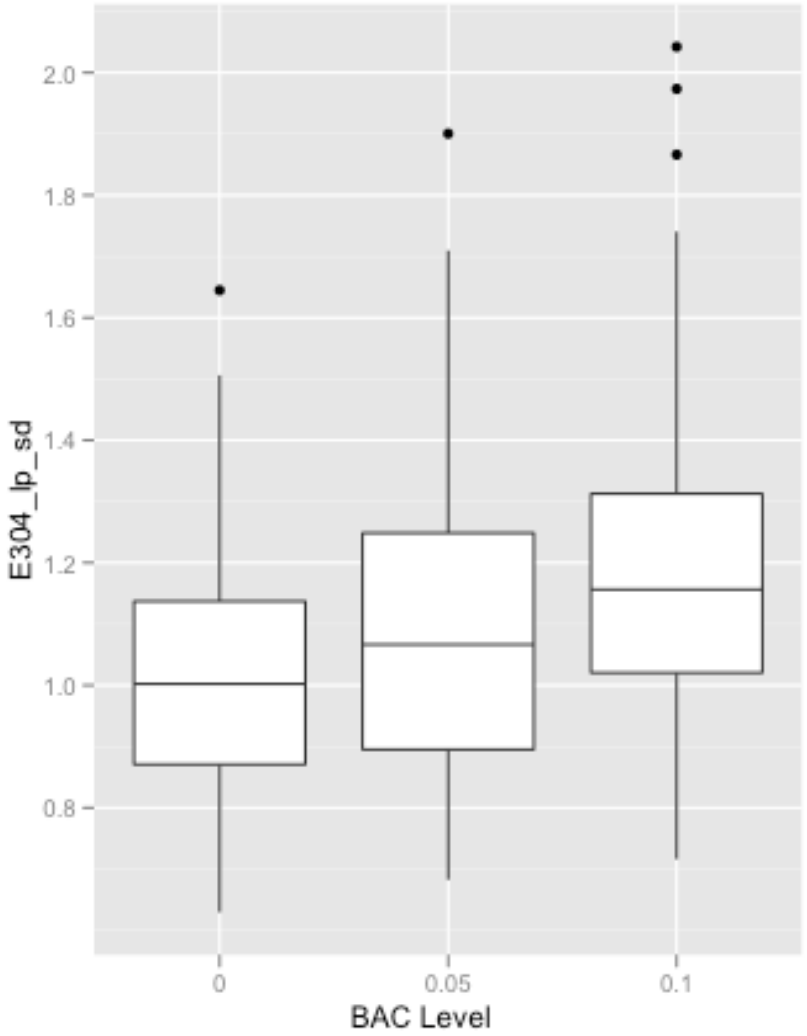
Forward collision warnings can help, particularly for distracted drivers

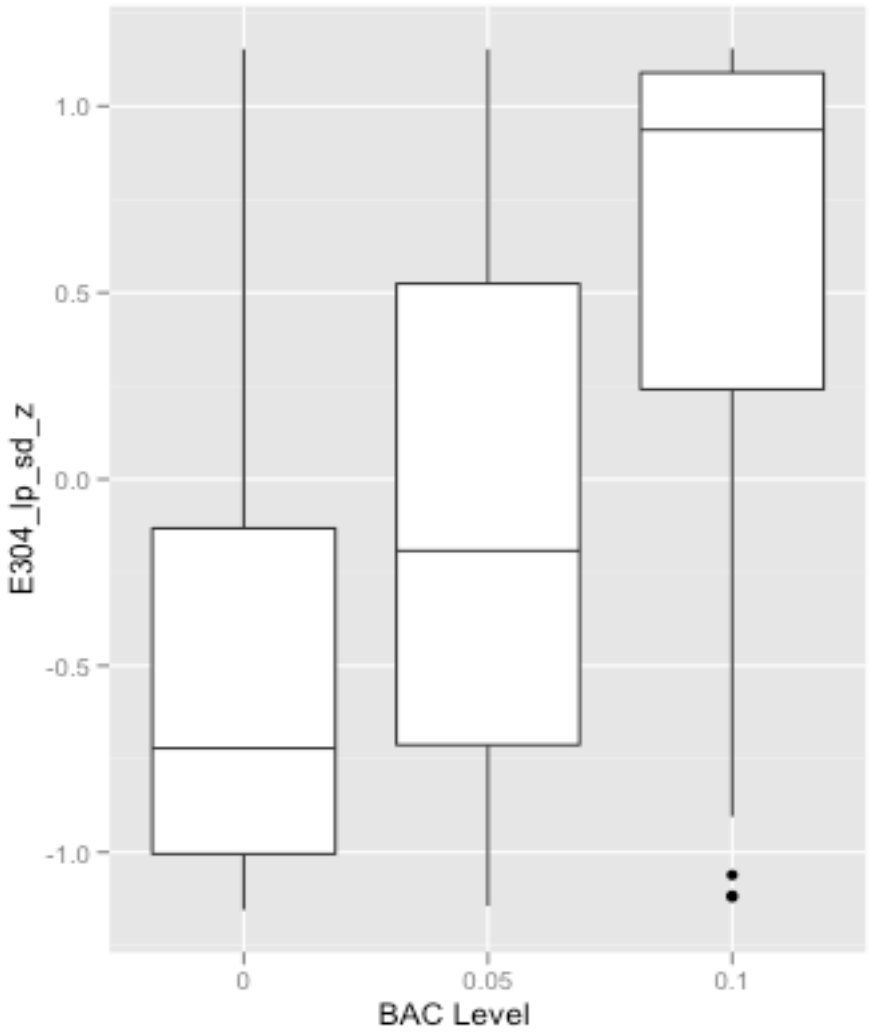
Alcohol

- IMPACT impaired driving scenario
- Multi-faceted driving scenario
  - Urban environment
  - Interstate driving
  - Rural two-lane environment
- Validated in detecting impairment via:
  - Alcohol (0.05 and 0.10 BrAC)
  - Cannabis
  - alprazolam
  - diphenhydramine
  - amphetamine salts
  - triazolam
  - caffeine

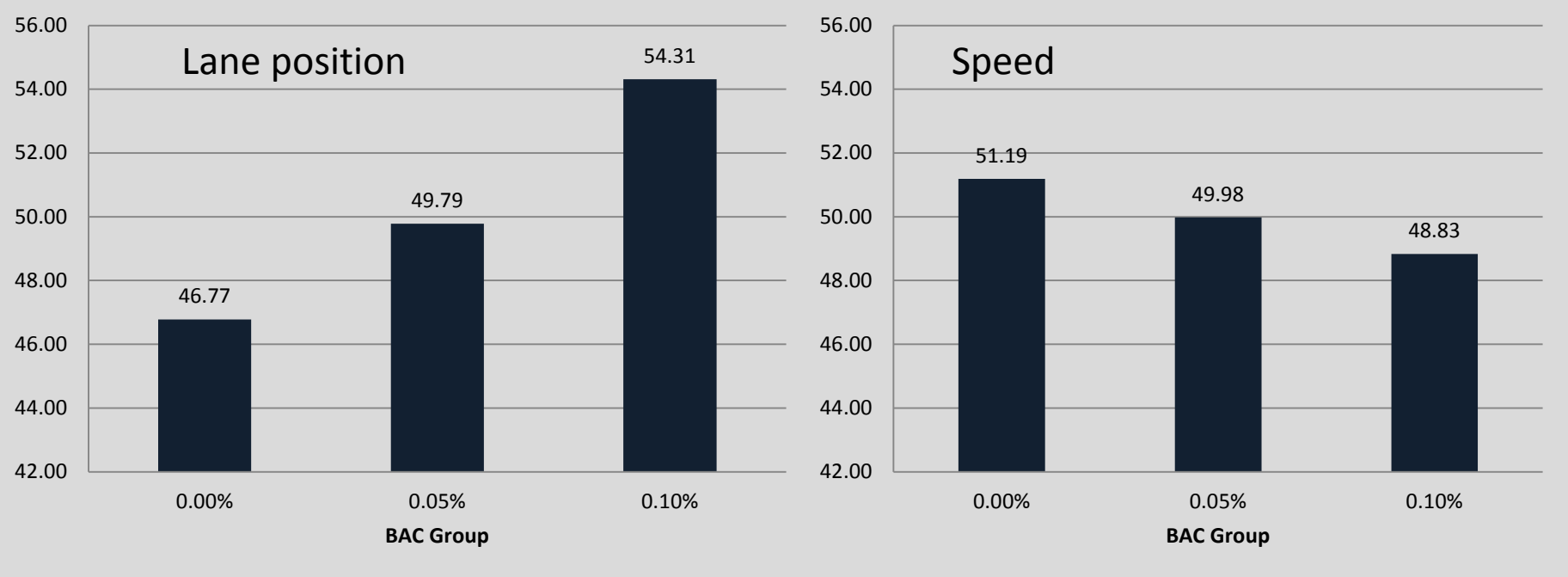
- Goal: To create a standardized driving scenario that is able to detect impairment by multiple drugs

Alcohol Signatures





Lane Keeping and Speed



Cannabis

NHTSA/NIDA/ONDCP

- Objective: Characterization of cannabis effects on driving performance with and without alcohol
- NADS-1 randomized placebo controlled crossover
- Within subjects design

NIDA
NATIONAL INSTITUTE
ON DRUG ABUSE

NIDA/Advanced Brain Monitoring

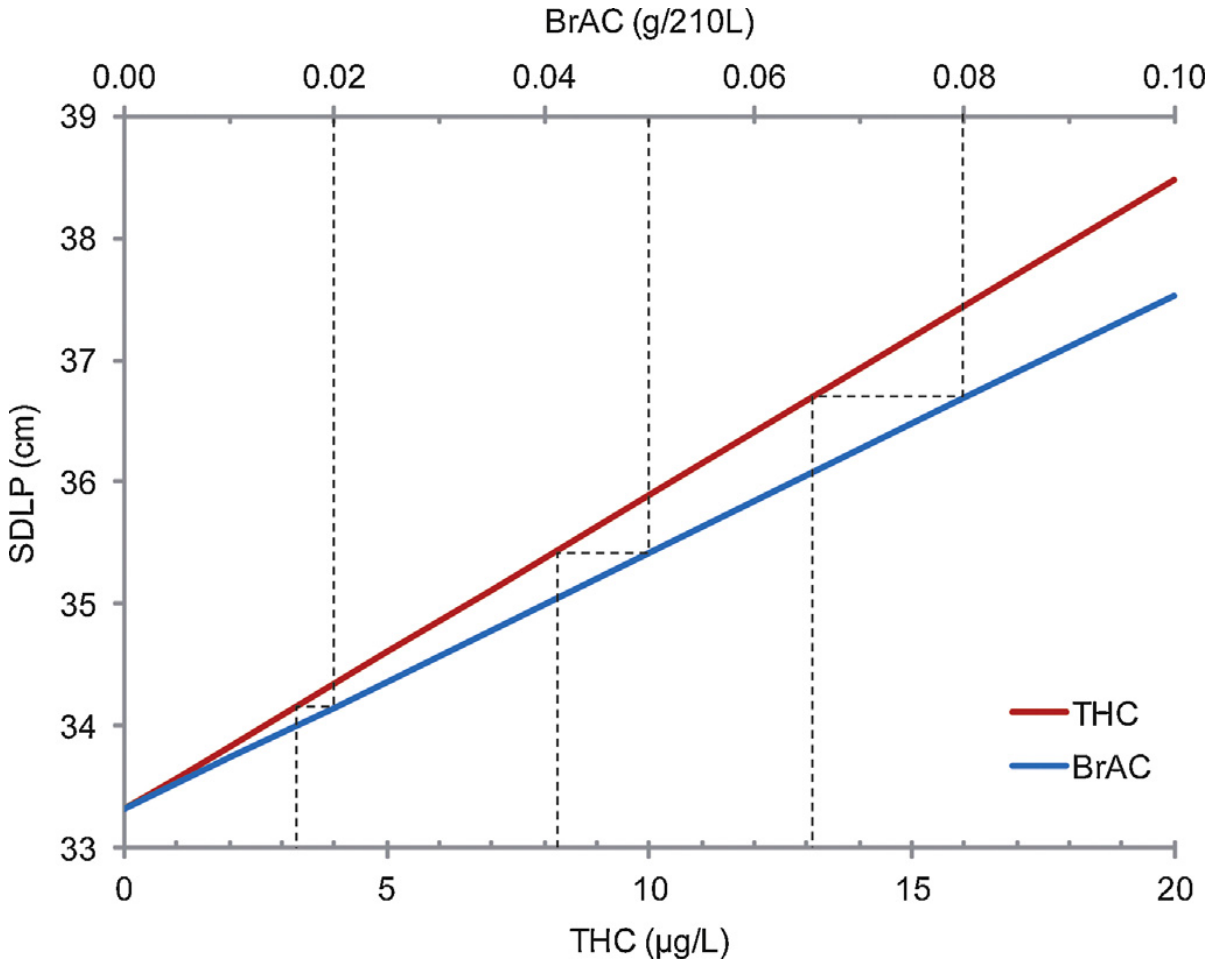
- Objective: Gather data for drug impairment algorithm based on EEG and driving performance
- miniSim randomized placebo controlled crossover study
- Results: time from dosing essential to impairment detection

B-Alert X10

The National Advanced Driving Simulator

The University of Iowa

Cannabis


BrAC (g/210L)
0.00
0.02
0.04
0.06
0.08
0.10
39
38
37
36
35
34
33
SDLP (cm)
0
5
10
15
20
THC (µg/L)
THC
BrAC

Prescription drugs

NIDA/ABM 1

- Baseline controlled
- Recommended adult doses of caffeine (No-Doz) and diphenhydramine (Benadryl)
- First look at EEG collected during drugged driving
- 50mg diphenhydramine very similar driving pattern to 0.10 BrAC

NIDA/ABM 2

- Placebo controlled
- Recommended adult doses of alprazolam (Xanax), and mixed amphetamine salts (Adderall)
- A look at more potent CNS depressant/stimulant
- Frequently abused prescription drugs

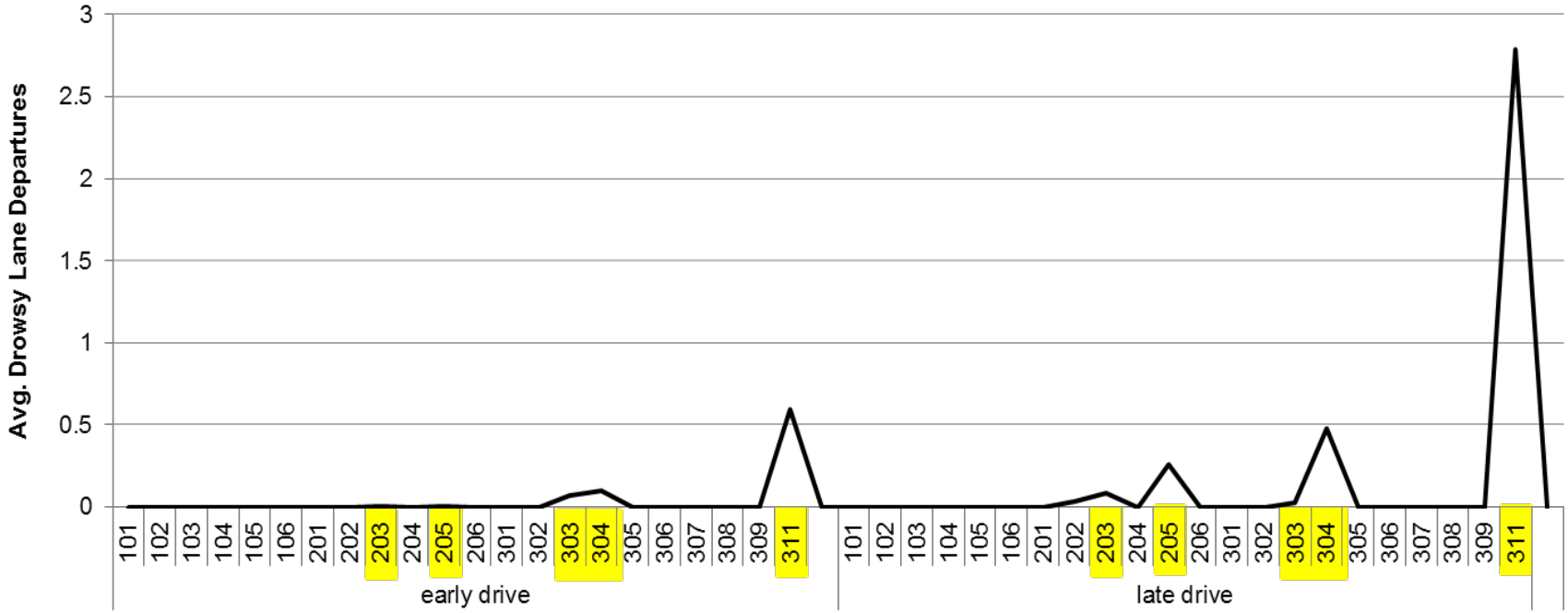
21% of All Fatal Crashes Involve a Drowsy Driver

- Participant awake for 21 hours
- 4:15am drive time
- 35 minutes into the drive
- About to experience micro-sleep
- Algorithm can predict drowsiness to warn before lane departures

https://www.aaafoundation.org/sites/default/files/AAAFoundation-DrowsyDriving-Nov2014.pdf

Crashes occur when drowsy drivers depart lane during microsleep

Increase in drowsy lane departures with sleep deprivation and drive time



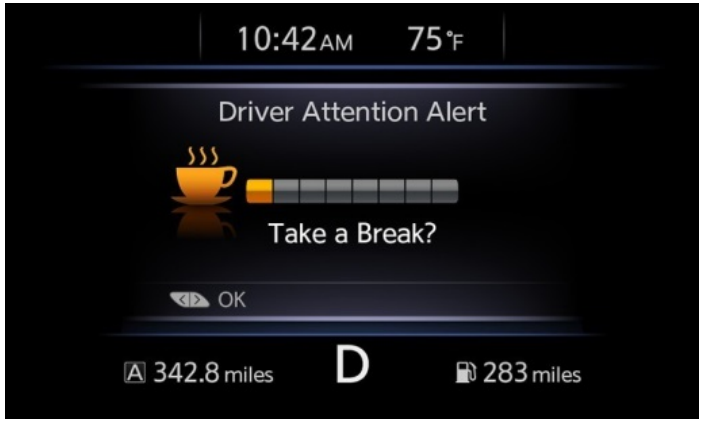
Driver State Detection

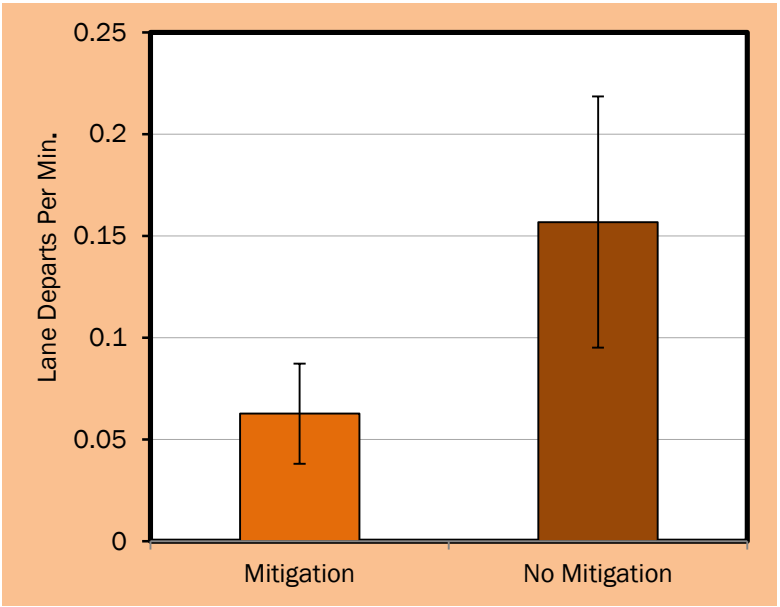
- Part of multi-year driver impairment detection program
  - Alcohol
  - Distraction
  - Drowsiness
- Goal
  - Detect driver state in real-time
  - Distinguish impairment from drowsiness vs. alcohol
- Method
  - Collect data from subjects across age groups and genders
  - Collect data: baseline, buzzed, drunk, semi-drowsy, drowsy, distracted a little, distracted a lot
  - Mine data to develop and train algorithms that identify and predict driver state

Mitigation provides warnings to distracted driver

Testing the effectiveness of drowsiness countermeasures

- Effective countermeasures will vary by type of impairment





- How do we get drowsy drivers to stop to rest?

Connected vehicles (V2V)

- Ability for vehicles to communicate with one another and infrastructure
- Ability to notify drivers before threats are visible

NHTSA Heavy Truck V2V Study

Connected vehicle instrumented vehicle study

Automated vehicles

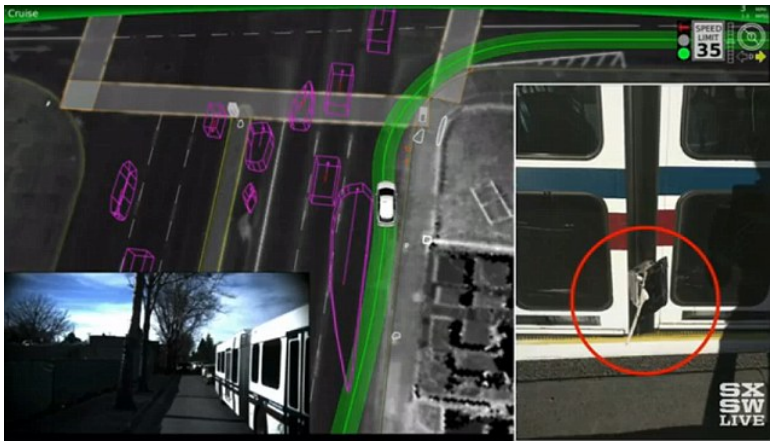
Automated vehicles

- Several unanswered questions
  - Automation failures
  - Transfers of control
  - State detection
  - Driver training
  - Driver acceptance

Ongoing automation research

- How willing are drivers to accept automated vehicles driving around them?

- How comfortable do drivers feel with automation?
  - Does this change after an automation failure or with experience?



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Contact Information E-mail:
contacts@nads-sc.uiowa.edu