Friends or Foes?

Pedestrians, Bicyclists, and Autonomous Vehicles: What Do We Need to Know, and How Will We Learn It?

Justin M. Owens, Ph.D.
Research Scientist
Center for Vulnerable Road User Safety
Virginia Tech Transportation Institute
jowens@vtti.vt.edu

March 6, 2018
What are “Automated Vehicles”?

**Automation Level**

- **LEVEL 0**: No automation
- **LEVEL 1**: Automated systems can sometimes assist the human in some parts of the driving task.
- **LEVEL 2**: Partially automated systems can conduct some driving tasks while human monitors and performs other driving tasks.
- **LEVEL 3**: Conditionally automated systems can conduct all driving tasks in some conditions, but the human driver must be ready to take back control.
- **LEVEL 4**: Highly automated systems can conduct all driving tasks in certain conditions, but humans could drive without human control.
- **LEVEL 5**: Fully automated systems can perform all driving tasks in any conditions.

**Driver Role**

- **Active Control**
- **Monitoring/Awareness**
- **Passive Occupant**

**NHTSA:**

“Automated Driving Systems (ADS)”
Hypothetical AV Penetration Rate

- Market readiness rate still unclear, but...
- Mixed fleet for decades to come
Automated Vehicle Systems: Pedestrian Safety Potential

- Improved Perception
  - potentially at night (?)
- No Distraction/Fatigue/Emotion
- Faster Reaction Time
- Better Affordances for Peds w/Disabilities
- ...or with occlusion
- Improvements in Efficiency
Challenges for AV/VRU Interactions

• Wide variety of challenges all levels of AV control
  – Some apply in different ways across levels
  – Compounded by operator takeover in L2/3

• Further discussion available in:
How do Pedestrians Identify AVs?

Level 2

Level 4

Level 5*

www.tesla.com

www.easymile.com

newsroom.uber.com

www.cadillac.com

www.navya.tech

www.waymo.com

3/22/18

Advancing Transportation Through Innovation
Communication & Negotiation of Intent

• How do vehicles and pedestrians communicate control & intent?
• Shift from bidirectional human-to-human to user-machine interface
Determining Right of Way

- Legal, social & cultural issues
- Interpretation & respect for local customs and norms?
- Replicate or replace personal communication?
Vehicle Behavior Around Peds & Bikes

- How does an AVS determine when to pass a cyclist/pedestrian in the road?
  - vs. hanging back given roadway parameters
- How does it weigh giving lateral passing distance vs. crossing lane line?
Driver Engagement

- L2/3 – How do interfaces successfully maintain/obtain driver engagement?
  - Especially in unexpected or complex scenarios involving VRUs?
  - Some calls (e.g. NACTO) for restricting use of midlevel automation in city centers.
HF Considerations for VRUs w/Disabilities

• What accommodations can be developed to assist or improve safety?
  – Benefits of connectivity?
  – Extra crossing time
  – Advanced communication
  – Onboarding/offboarding
Legal/Ethical Questions

• Who to harm?
  – Trolley problem
• Who is liable?
• When can AVs break the law?
  – Major/minor
• Limitations on operational domain?

moralmachine.mit.edu
Infrastructure Development

• Designing for *now vs. future*
• Predicting future travel patterns
  – Increased/decreased pedestrian traffic
  – Parking vs. return trips
• Separated travel lanes/paths
• What is the *interaction* between design & HF?
Summary: A Call for Research

• Even (especially!) with automation, questions about interaction between humans & machines
• Opportunities for improvements over current (fallible) human perception & performance
• Many issues, need engagement from all sides
Thank you!

jowens@vtti.vt.edu