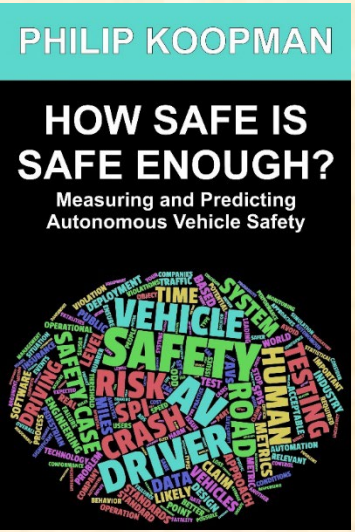

A Safety Framework for Shared Human/Computer Driving Responsibility

Prof. Philip Koopman

June 30, 2023

www.Koopman.us

Carnegie Mellon University

Overview

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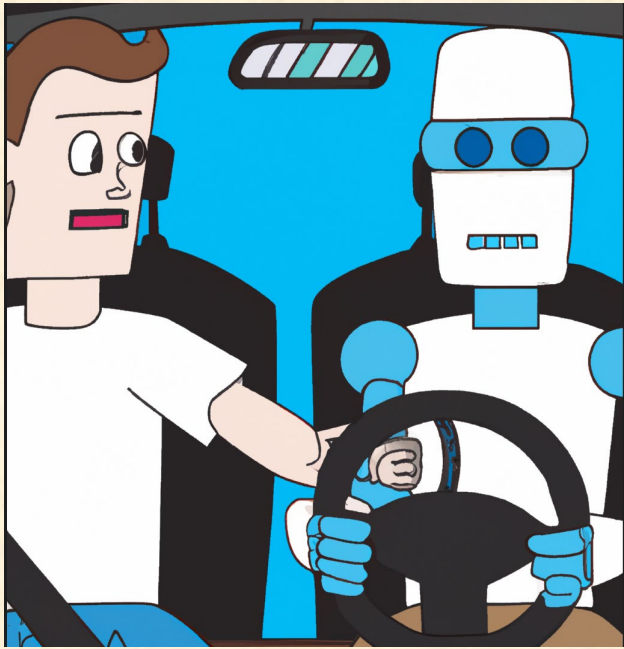
- "Computer Driver" as a concept
  - Same duty of care as a human driver
  - Perform as a "reasonable driver"
- What about shared responsibility?
  - Effective driver monitoring
  - Reasonable responsibility transfer process
- State liability laws play a key role
  - Buys time to sort out equipment regulation
  - Can work with a non-statistical definition of "safe enough"



[Dall-E]

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Key Approach: Computer Driver

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- Need more than statistical approach when computer drives
  - Challenges to predicting initial safety outcomes
  - Defective behaviors masked by net safety improvements
  - Risk redistribution to vulnerable populations
- Computer Driver should have a duty of care
  - Obligation to be a "reasonable driver"
    - Same criterion as for human driver negligence
- Comparison is "reasonable human driver" …
  … not "average human driver"
  - Manufacturer is responsible party for negligent computer driving

[Dall-e]

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Three “Pure” Operational Modes

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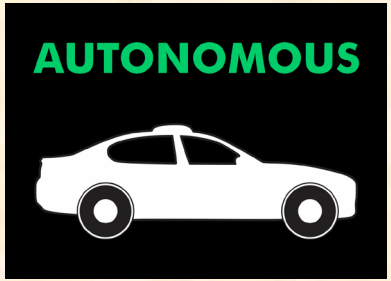
- Conventional: Human Driver steers
  - Human Driver responsible



- Fully Autonomous: Computer Driver steers
  - Manufacturer is responsible for Computer Driver

- Testing: Development, Beta, Pre-production
  - Manufacturer is responsible for safe test plan, qualification and performance of test drivers

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The Awkward Middle: Supervisory Mode

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- Human Supervises automated Control of steering
  - Computer Driver has sustained control of steering
  - Prone to Human Driver automation complacency

- This mode includes:
  - Driver told secondary tasks forbidden/acceptable
  - Hands on/off wheel
  - Eyes on/off road

- Unify SAE Levels 2-3 into single, flexible regulatory approach

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Need Rules To Avoid Moral Crumple Zone

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- **Moral Crumple Zone:** [Elish 2019]
  - Blaming nearest convenient human for an automation failure
- **Ineffective ways to improve safety:**
  - Blaming humans for exhibiting human error
  - Blaming victims
  - Liability immunity for manufacturers

Backup Driver Of Autonomous Uber SUV Charged With Negligent Homicide In Arizona

npr

2020 -- http://bit.ly/3Mwp1BG

Tesla driver charged with manslaughter in deadly Autopilot crash raises new legal questions about automated driving tech

A Tesla Model S driver accused of crashing his car while Autopilot was activated had run a red light and slammed into a Honda Civic, killing its occupants.

NEWS

2022 -- http://bit.ly/3Mt9ylV

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Rule #1: Driver Monitoring Rule

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- Manufacturer responsible for distracted Human Driver crash <u>unless:</u>
  - Effective distracted driver alert activated, AND
  - Alert lasts at least 10 seconds before crash, AND
  - Computer Driver ensures safety for those at least 10 seconds.
- Exception:
  - Malicious defeat of driver monitor

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Rule #2: Driver Intervention Rule

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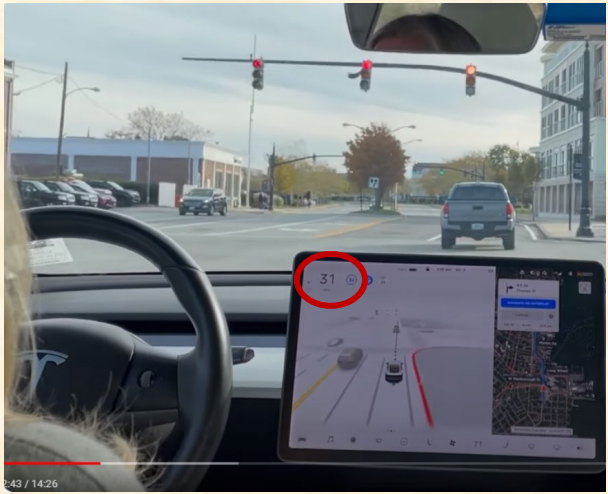
- Manufacturer responsible for Human Driver failure to intervene <u>unless:</u>
  - Undue risk of mishap readily apparent <u>with enforced level of attentiveness</u>, AND
  - Human Driver has adequate opportunity to intervene
    - Safe harbor for first 10 seconds



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- Computer Driver can demand that Human Driver intervene – but must follow this rule

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Implications: “Readily Apparent”

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- Must be obvious deviation from safe driving
  - Computer Driver deviates from its customary behavior
  - Conventional driver would recognize a danger
    - Given only amount of attention that is enforced
- Alarms can make issues readily apparent:
  - ODD departures
  - Equipment failures
- Operational concept affects this
  - Eyes-on-road makes road hazards more apparent
  - Eyes-off-road concepts make hazards less apparent

https://bit.ly/3GxJ2E6

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"Adequate Opportunity To Intervene"

- Human driver readiness
  - Attention and tasking status both matter
- Time to react
  - Enough time appropriate to circumstances
    - Time to recognize Computer Driver acting unsafely
    - Time to switch tasks
      - » What if watching a movie?
      - » What if hands full?
    - Complexity of road situation, severity of failure, etc.
    - Competent (not expert) driver can reasonably intervene successfully
  - Computer Driver ensures safety during reaction time

[Dall-e]

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Summary: Driving Safety Responsibility

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- Autonomous mode
  - Manufacturer – not owner, not the computer itself
- Testing mode
  - Test driver might contribute, but not a scapegoat
- Supervisory mode
  - Manufacturer <u>except:</u>
    - Rule 1: Human Driver ignores effective driver monitor
    - Rule 2: Human Driver had a fair chance to intervene
  - Manufacturer must respect inherent human limits

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What Happens Next?

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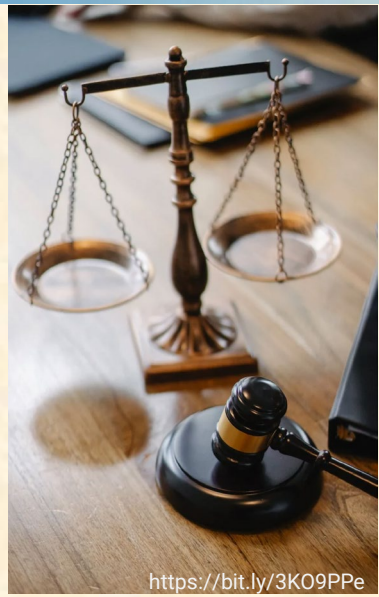
- Implementation: State Liability Laws
  - Sets a well-defined playing field for liability
  - Based on “reasonable” driver behavior
    - Uses same legal rules applied to human drivers
    - Source code analysis not required
- Technical implications
  - Indirectly regulates driver monitoring effectiveness
    - Can only take credit for driver attention that can be monitored
    - Monitoring sophistication higher for aggressive operational modes
  - Indirectly affects viable concepts of operation
    - Disincentivizes some moral crumple zone strategies



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Resources

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- Liability-based proposal for AV regulation & podcast
  - https://safeautonomy.blogspot.com/2023/05/a-liability-approach-for-automated.html
- Video lecture series on autonomous vehicle safety:
  - Keynote AV Safety overview video : https://youtu.be/oE_2rBxNrfc
  - Mini-course: https://users.ece.cmu.edu/~koopman/lectures/index.html#av
- “Safe Enough” book & talk video:
  - https://safeautonomy.blogspot.com/2022/09/book-how-safe-is-safe-enough-measuring.html
- UL 4600 book & talk video:
  - https://safeautonomy.blogspot.com/2022/11/blog-post.html

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