Towards behavioral models for autonomous driving acceptance

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Introduction

- Acceptance of users relies on the understanding and trust automation.
- Development of AVs successfully handling the risks of traffic as an “average driver” is necessary.
- Modelling behaviour of an AV is vital for safe vehicles of high driving performance.
- Integration of existing models to autonomous vehicles requires modelling the behaviour of the AV “driver”/operator.

Scope of this work

- Analysing the aspects of AV “driver”/operator behaviour.
- Conceptualizing the changes that should be introduced to existing behavioural models.
- Addressing the requirements of AV traffic and road safety and increase the acceptance.
- Three popular modelling alternatives:
  - Summala’s Multiple Comfort Zone
  - Fuller’s Risk Allostasis Theory (RAT)
  - Vaa’s Risk Monitor Model (RMM)

Driver Behavioral Models

- Change of key concepts, conceptions and theories
- The three analysed models:
  - Shared basis in neuroscience, i.e. adopting Damasio’s paradigm
  - Have been further developed for being well suited to state hypotheses to be tested in contexts associated with AV

Summala’s Multiple Comfort Zone

- Incorporates factors influencing safety margins
- TTC, time to lane crossing, speed level and time headway, within an acceptable range $\rightarrow$ satisfaction, comfort
- Comfort zone enables drivers to react properly

Factors influencing driving behavior and comfort zone boundaries

<table>
<thead>
<tr>
<th>Sufficient space</th>
<th>Road system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sufficient time</td>
<td>Roadway complexity</td>
</tr>
<tr>
<td>Vehicle characteristics</td>
<td>Driver experience</td>
</tr>
<tr>
<td>Speed limits</td>
<td>Driver’s response style</td>
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</tbody>
</table>

Fuller’s Risk Allostasis Model (RAT)

- Feeling of risk within the preferred range.
- This feeling defines, controls and influences driving behaviour
- Driver behaviour changes for maintaining the feeling of risk within the range
- Speed choice and time or distance headways adjustment for feeling of risk maintenance

Factors influencing feeling of risk

<table>
<thead>
<tr>
<th>Driver’s motivation</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver capabilities</td>
<td>Road environment</td>
</tr>
<tr>
<td>Human factors</td>
<td>Vehicle characteristics</td>
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</tbody>
</table>

Vaa’s Risk Monitor Model (RMM)

Challenges

- Lack of relevant data for understanding AV behavior under various traffic and weather conditions is critical
- Ensure safety of drivers and other road users under autonomous mode
  - Technology
  - Hacking risks
- “Human vs machine” $\rightarrow$ public acceptance and technology adoption
- Should the humans be adapted to the machine behavior or the machine to the different driving behaviors?

Conclusions

- AV behavioral model determines public acceptance and adoption
- AVs should have increased levels of safety, security and comfort
- AVs should be able to adopt in different (non)emergency and extreme conditions
- Definition of parameters $\rightarrow$ Extension of behavioral models for including autonomous operation

Acknowledgments

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More information

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