The European Commission’s science and knowledge service
Joint Research Centre

Assessing the impact of Connected and Automated Vehicles: A freeway scenario.

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Anticipated impacts from AVs

Less congestion
Shorter travelling time
Less pollution
Less energy consumption
Less accidents
More parking space
Higher mobility (elderly, kids, etc)

So, is AV-technology that really promising?
Anticipated impacts from AVs

Improvement, probably, won’t come unconditioned for reasons such as:

- No clear relationship between penetration of AVs and potential gain (congestion, energy etc).
- Future traffic demand cannot be easily estimated
- Electrification is not interwoven with Automation
- New industry business – uncharted waters
Anticipated impacts from AVs

In this work, we study the impact of Connectivity and Automation on a freeway scenario assessing the CACC logic*.

Summarized preliminary results show:
- Less congestion does not necessarily mean less energy consumption.
- Vehicles’ coordination might needed to exploit better the potential of the technology.

Case study – Ring road of Antwerp

The idea is to run simulation experiments based on real data on a real network and study the benefits of CACC on a highway.
Ring road of Antwerp and Network

- Connects the 2nd biggest port in Europe with the continent

- Is responsible for over half of the overall pollutant emissions generated by road transport in the city

- The final supply model of the network consists of 119km of roads with 27 centroids (origin/destination points) and 117 intersections.
Ring road of Antwerp and Network

- Traffic demand based on real counts during peak hours
- Post-processing of the loaded network
Simulation scenarios

- Variable CACC penetration rates
- Variable traffic demands
- 3 hours of simulation (load – peak – unload)
Assessment metrics

- Harmonic average speed
- Standard deviation of the speed
- Average density of the network
- Average flow of the network
- Total energy consumption on wheels*

Simulation results - Speed

![Graph showing speed over time for various penetration rates](image)

- PR 0 D 0.8
- PR 0.25 D 0.8
- PR 0.5 D 0.8
- PR 0.75 D 0.8
- PR 1 D 0.8
Simulation results - Speed
Simulation results - Speed

Time - Speed for various penetration rates

Speed (m/sec)

Time (min)

PR 0 D 1.2
PR 0.25 D 1.2
PR 0.5 D 1.2
PR 0.75 D 1.2
PR 1 D 1.2
## Results – Energy consumption

<table>
<thead>
<tr>
<th>CACC Penetration rate</th>
<th>Traffic Demand D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.8D</td>
</tr>
<tr>
<td>PR 0</td>
<td>3468.9 kJ</td>
</tr>
<tr>
<td>PR 0.25</td>
<td>1.60%</td>
</tr>
<tr>
<td>PR 0.5</td>
<td>3.85%</td>
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<tr>
<td>PR 0.75</td>
<td>5.57%</td>
</tr>
<tr>
<td>PR 1</td>
<td>4.30%</td>
</tr>
</tbody>
</table>
Conclusions

• CACC, higher demands, higher efficiency
• Penetration rate and CACC efficiency are not linearly correlated
• Particularities of the network need consideration
• Communication with the infrastructure and coordination of AVs could help
• Human behavior (i.e. exceeding speed limit) can potentially facilitate flows
Stay in touch

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JRC will host the 2nd Symposium on Management of Future Motorway and urban traffic systems

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