



COMFORT IN AUTOMATED VEHICLES

With passengers not having to focus on driving, comfort becomes a major consideration in the design of automated vehicles. In turn, carsickness is a leading factor in comfort. This Joint Industry Project (JIP) aims at performing pre-competitive research to minimise carsickness in automated vehicles.



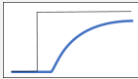
BACKGROUND

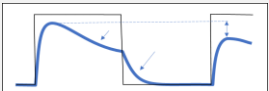
2/3 of all current car occupants are drivers. Drivers, however, do not suffer that much from carsickness, while 2/3 of all passengers do. An extension of the ISO2631-1:1997 model was developed successfully in a previous JIP, including 1) symptoms other than vomiting, 2) the effect of horizontal motions, 3) out-the-window vision, and 4) an individual's susceptibility, gender, and age. The COMFCAR project aims at elaborating on a number of remaining issues.


RESEARCH TOPICS


The following topics have been identified as essential for a further optimisation of comfort, and can be addressed in the proposed project as jointly decided by the partners:

- Accumulation.** According ISO, motion sickness increases with the square root of exposure duration. Shortcomings are known, better alternatives required.


- Habituation, recovery, retention.** After progression of symptoms, most people do habituate to enduring motions to some extent (habituation). When motion stops, sickness generally disappears gradually (recovery). When being exposed again to a nauseous stimulus, people generally suffer again, yet less than previously (retention). Although of practical use, knowledge is largely lacking.


- Rotations.** Apart from resultant accelerations, the effect of angular motions per se on carsickness is still unclear.


- Single events.** Apart from analyzing car motion by frequency spectra to which an (extended) ISO model can be applied to predict carsickness, car motion is also characterised by unpredictable single events (accelerating, braking, cornering). No models exist taking into account these single events.

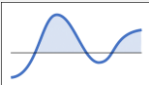

- Interactions.** Different from what ISO2631-1:1997 assumes, interactions between different degrees of motion freedom may affect sickness in different ways.

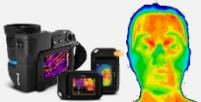
$$S(a,b) = \dots$$

$$s_1 a + \dots$$

$$s_2 b + \dots$$

$$s_3 ab$$
- Thresholds.** Small motions generally do not result in motion sickness, different degrees of freedom likely having different threshold values. Dependencies on other factors are assumed, but unknown as well.


- Biomarkers.** The search for (early) biometrical physiological markers of motion sickness still has not resulted in predictions that are both sensitive and specific. New technology may offer new possibilities.



SCOPE OF WORK / DELIVERABLES

The topics listed above will be studied experimentally with human subjects in lab and on-road trials, using a variety of motion devices and instrumented vehicles, each with its specific advantages. Sickness will be rated throughout by means of a Motion Illness Symptoms Classification method (MISC) taking advantage of the observation that motion sickness symptoms generally progress in a fixed order. This classification has been proven to allow for criteria that better apply to comfort in cars than a criterion based on vomiting only. The project, in its form as described above, is foreseen to take about two years with a total research budget of around 1 M€.



45 m linear sled



6DoF Desdemona motion platform



3 DoF free moving bases



On-road trials

The appropriate literature and the experimental data will each be reported on in separate reports. Whenever possible, the observed levels of sickness depending on the variables studied will be described by mathematical equations on which unambiguous criteria can be based.

PARTNERS

- OEMs
- Automotive suppliers

WAY AHEAD

With sufficient interest, we propose a half-day workshop to identify the most prominent needs of the potential project partners. TNO and RCA will subsequently work out a detailed proposal and a consortium agreement will be negotiated, including IP-issues.

In parallel we are working on a similar and possible joint proposition for the maritime industry. This is based on the simple fact that many motion sickness characteristics are independent of the environments in which they occur.

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