Motorcycle HMI Design for Cooperative Intelligent Transport Systems (C-ITS)

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• CMC Task group HMI for C-ITS
• Study on information timing
  • Background
  • Methods
  • Results
  • Discussion
• Conclusion
CMC aims at integrating motorcycles in a world of future connected mobility
“[…] When developing ITS systems for powered two wheel vehicles, it is crucial to devote particular attention to the human-machine interface in order, for example, to avoid distracting riders and to increase the degree to which these systems are accepted by riders. The distinctive nature of riding powered two wheel vehicles has to be taken into account, since riding a single-track vehicle is very different from driving a car. […]”

(German Insurance Association GDV, 2018; p. 13)
Our work…

• Create application-independent HMI specifications
  • As a baseline to start from
  • Including e.g. guidelines from the automotive sector

• Conduct studies
  • On topics that are perceived as highly relevant / PTW specific
  • From online surveys to simulator and test track studies
Information timing for motorcycle C-ITS

- Background
- Methods
- Results
- Discussion
Schematic time frame

**Effect of cooperative perception:**
- Information about conflict ‘advisory warning’
  - Goal: Attention direction, Preparation for possible reaction
- Early information without annoyance and lowering of acceptance

**Effect of cooperative perception:**
- Optimisation of warning ‘imminent crash warning’
  - Goal: Immediate reaction (braking, steering)
- Optimal time frame for warning

**Conflict can be perceived by onboard sensors/driver**

**Potential conflict can be predicted cooperatively**

* Naujoks & Neukum, 2014; p.159
DESMORI motorcycle simulator

- Mockup: BMW F 800 R
- 6 DoF Steward platform
- 220° horizontal field of view
- In-helmet sound system
- Body shaker
- Steering torque (up to ~80 Nm)
- TFT-Displays as cockpit and mirrors
Panel description

• All riders from WIVW rider panel, familiar with the simulator
• $N = 16$ (14 male, 2 female)
• No professional riders
• Mean age: 35 years ($sd = 14$; from 19 to 60)
Independent variable: information timing

- 3 levels of Time Headway ($t_1 = 8 \text{ s}; t_2 = 11 \text{ s}; t_3 = 14 \text{ s}$)
Methods

Road Hazard without C-ITS application
Road Hazard with C-ITS application
Methods

Independent variable: information timing

Possible levels of information timing

latest possible point in time to avoid collision

Warning period

$t_0$

Event
Methods

Time interval: $\text{[Time Headway} = T_i , \min(\text{Time Headway})]\]

Sample Data

Module

THW

$T_8s$ $T_{11s}$ $T_{14s}$
No significant differences in vehicle speed while information was displayed.

This holds true for all levels of information timing and C-ITS applications.

\[(F(2,30) < 1)\]
Results

• All levels of information-timing lead to moderate braking manoeuvres. \((F(2,30) < 1)\)

• No significant differences in numbers of load changes between issuing of information and event. \((F(2,30) = 2.40, p = .108)\) \(\eta^2_p = 0.088\)
• The 11s information timing is preferred.
• 2 riders would prefer later information presentation than 8s while none prefers earlier than 14s.
Results

- Majority of riders state to change their behaviour after information presentation.
- Majority would like to use such system.

![Bar chart showing responses to "Did the information affect your riding behaviour?"
Yes: 14, No: 2, Unsure: 0]

![Bar chart showing responses to "Would you like to use this assistance system on your bike?"
Yes: 14, No: 2, Unsure: 0]
Discussion

- All timings appropriate as to attention allocation and action preparation
- No collisions
- No annoyance
- Preference for 11s timing
  - Raised situation awareness…
  - …without creating uncertainty.
Pioneering work

- No motorcycle-specific recommendations for C-ITS application’s HMI design available so far.
- Simulation delivers empirical evidence for proper HMI design.
- Only when applications are in use, can riding be safer.
Thank you for your attention

BMW Motorrad  HONDA  YAMAHA

ALPS  Autotalks  Kawasaki  KTM  SUZUKI

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