Towards a Cognitive Model for the Adaption of Cooperative Takeover Systems

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Introduction

The takeover (TO) is an important issue approaching Level 3 & 4 in highly automated driving (HAD). Several studies have investigated in TO times, however to understand and improve the human-machine interaction (HMI) of cooperative systems this is not enough. As various factors influence the TO, current results concerning TO times and behavior in HAD illustrate various, but incomparable results.

It is thus inevitable to unravel the black box of cognitive mechanisms and gain an understanding of how the human processes the TO task in certain situations. This enables the comparison of empirical results and a user guided design of the HMI of cooperative systems. This can be done with a cognitive model of the TO. Yet no renowned cognitive model explicitly displays the TO. Such a model was developed here, using the cognitive architecture ACT-R [1]. During the development of the model the following questions arose:

What aspects of a particular complex situation influence TO behavior and in what way?

Does the time between the last glance on the road during non-driving related task (NDRT) and the takeover request (TOR) predict eye movement patterns during the TO to update situation awareness (SA) in certain situations?

These aspects should be implemented next to evaluate in what way they influence cognitive mechanisms during the TO.

WHY

Suitable HMI of Cooperative Systems for more Safety and Comfort in TO Situations

Understanding Black Box of Cognitive Mechanisms

Cognitive ACT-R model structure displaying cognitive, visual and motoric patterns during the TO process in different situations.

Update of near and far lane points first [2], followed by left and right lane [3].

WHAT

Cognitive TO model for predictions that allow user centered design and individual adaption of cooperative systems.

HOW

Objective Complexity of the Situation

Perceived (Subjective) Complexity of Situation

Topicality of SA

Warning Concept and Cooperative Systems

Workload of NDRT

OUTLOOK

Inclusion of individually varying parameters in cognitive model:

- Topicality of last SA Representation:
  → Occupation of imaginal and visicn

- Situation Familiarity / Complexity:
  → Attentional Shifts
  → Basis for reaction (knowledge-based, rule-based, skill-based [4])

Validation of model with empirical data

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