# Interaction Patterns for Cooperative movement with vehicles

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## ABSTRACT

Why do we move? The walk to the supermarket, visiting the family and friends, dancing in a club or a sprint on the tartan track. We subsist and convert the respective energy in kinetic energy to move. The way how we move in order to efficiently reach our target is learned as we grow up and is stored in form of patterns. Patterns are proven solutions to repeating problems. When moving cooperatively, e.g. with other humans or with a horse, such patterns become interaction patterns for cooperative movement. This paper will present the concept of Interaction Patterns for cooperative movement and show how these patterns can be used with vehicles that (will) have more and more autonomous functionalities and become worthy to cooperate with.

## CCS CONCEPTS

• **General and reference → Design**; • **Human-centered computing → Interaction paradigms**; **Interaction design theory, concepts and paradigms**.


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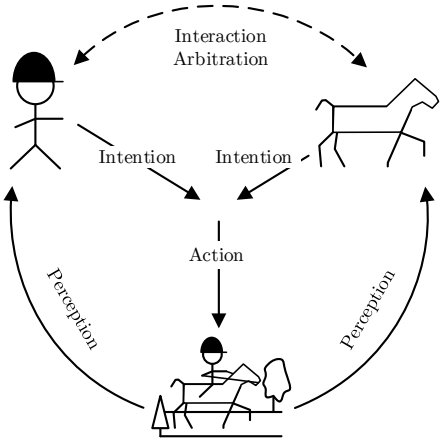


**Figure 1: Cooperative Guidance and Control: H-metaphor**

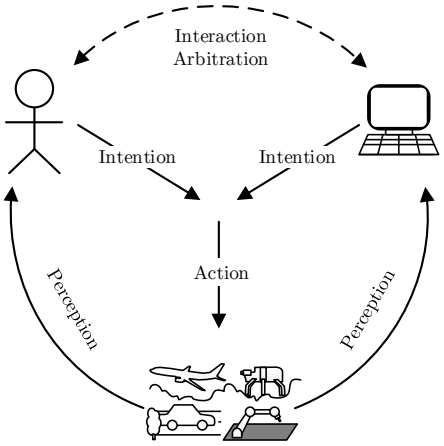


**Figure 2: Cooperative Guidance and Control: highly automated manipulator**

**KEYWORDS**

interaction patterns, human computer interaction, interaction design, image schemas

## INTRODUCTION

The idea presented in this extended abstract is to use interaction patterns for Cooperative movement with vehicles. The behaviour of interaction patterns depends on the driver's actions and the state of the environment. Their focus is to adapt the driver's actions towards a safer system state through multimodal interaction.

## COOPERATIVE GUIDANCE AND CONTROL

Cooperation becomes necessary when two or more actors with the ability to autonomous behaviour are supposed to work towards a common goal. A successful cooperation is characterized by a consistent, commonly accepted result generated by the actors. If those actors do not work cooperatively, the best outcome would be two results and the worst no result at all. When talking about cooperative movement, the cooperation or collaboration of at least two actors with the goal of changing the current location is addressed. Such actors can be e.g. a parent and a child hapticly coupled by the hands, a ballroom dance couple that is hapticly coupled over their whole bodies to achieve complex figures, a human and a dog coupled over a leash, or a rider and a horse hapticly coupled by the reins (see figure 1). In the so called H-metaphor [5] horse and rider perceive their environment and their action individually and try to react accordingly. Via leashes control is arbitrated between horse and rider and a common action results in cooperative movement. This metaphor can be used as a blueprint for a cooperation between a human and a computer acting together in a highly automated vehicle (see figure 2).

A possibility to make the interaction between actors more intuitive is the use of patterns and accordingly to arbitrate using interaction patterns [3, 4].

## FROM DESIGN PATTERNS TOWARDS INTERACTION PATTERNS FOR HIGHLY AUTOMATED DRIVING

The idea of using Pattern Languages has been discussed and applied for several years. It was first introduced by Alexander et al. in the area of architecture where they explain how a set of recurring designs can allow anyone to create its own house tailored to his needs by using previously known and tested solutions [1]. These solutions, so called design patterns, have the characteristic that they can be linked to one another allowing the user for complex and unique creations similarly to how a spoken language permits creating an unlimited quantity of sentences by arranging the words. Figure 3 shows an instantiation of such a pattern language in the area of assistance and automation [3].

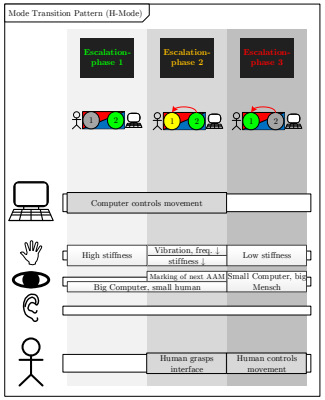


**Figure 4: Interaction pattern "Mode Transition" implementation of H-Mode**

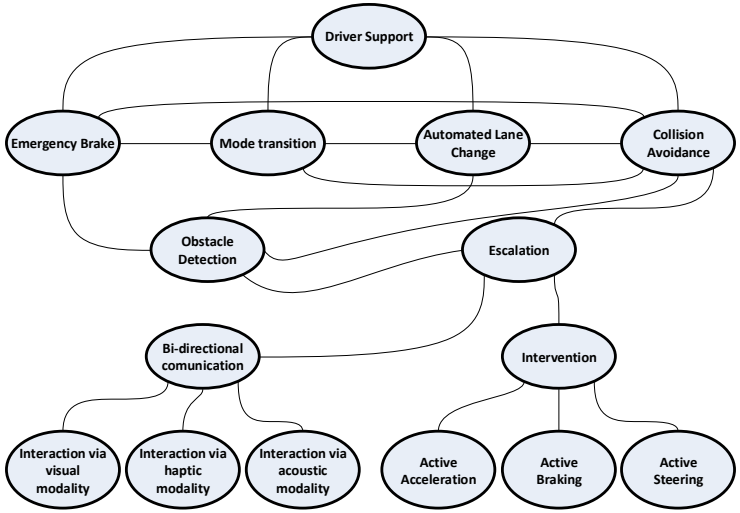


**Figure 3: Interaction Pattern Language [3]**

In this example an interaction pattern could be imagined that represents a transition of control, e.g. see figure 4 and 5. Such an interaction pattern would have the elements of an escalation (in the example three phases), where first the driver is warned to take over and is informed to confirm the take over, where the driver confirms and finally takes over control from the automation. The effectiveness of such patterns lies in the usage of intuitive interaction elements. Such can be built upon design metaphors or subconscious schemas, e.g. Image Schemas [6–8]: A RESISTANCE schema [9] can be implemented e.g. in a steering wheel to show that there is an antagonist (the computer) trying to prevent danger when steering in the respective direction, which can only be overcome by an extra effort. A STRONG grasp on the steering wheel shows that the agonist wants to take more control in the driving tasks (Tight Rein) [2, 5].

For the authors the overall approach of linking patterns with image schemas is a promising way to link knowledge about specific patterns and subconscious knowledge grounded in specific image schemas, and to make this available in the design process. But how can we determine, organize and combine good interaction patterns? Also how can we make this knowledge available in the specific design and engineering situation of real products in human machine systems that become more and more complex? Such questions need to be answered in research that is yet to come.

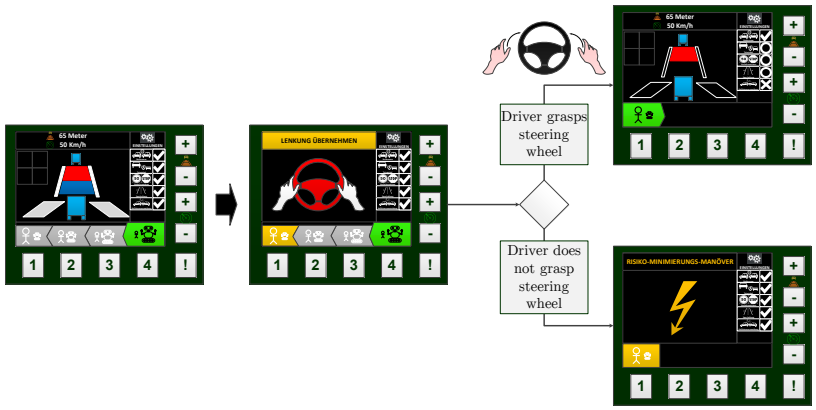


**Figure 5: Interaction pattern "Mode Transition" in the StrAsRob Display**

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