Abstract

This article provides a general ergonomic framework of cooperative guidance and control for vehicles with an emphasis on the cooperation between a human and a highly automated vehicle. In the twenty-first century, mobility and automation technologies are increasingly fused. In the sky, highly automated aircraft are flying with a high safety record. On the ground, a variety of driver assistance systems are being developed, and highly automated vehicles with increasingly autonomous capabilities are becoming possible. Human-centred automation has paved the way for a better cooperation between automation and humans. How can these highly automated systems be structured so that they can be easily understood, how will they cooperate with the human? The presented research was conducted using the methods of iterative build-up and refinement of framework by triangulation, i.e. by instantiating and testing the framework with at least two derived concepts and prototypes. This article sketches a general, conceptual ergonomic framework of cooperative guidance and control of highly automated vehicles, two concepts derived from the framework, prototypes and pilot data. Cooperation is exemplified in a list of aspects and related to levels of the driving task. With the concept 'Conduct-by-Wire', cooperation happens mainly on the guidance level, where the driver can delegate manoeuvres to the automation with a specialised manoeuvre interface. With H-Mode, a haptic-multimodal...
interaction with highly automated vehicles based on the H(orse)-Metaphor, cooperation is mainly done on guidance and control with a haptically active interface. Cooperativeness should be a key aspect for future human--automation systems. Especially for highly automated vehicles, cooperative guidance and control is a research direction with already promising concepts and prototypes that should be further explored. The application of the presented approach is every human--machine system that moves and includes high levels of assistance/automation. Practitioner Summary: The aim of this article is to sketch a general ergonomic framework of cooperative guidance and control. After a general description, the framework is illustrated through descriptions of two examples for which prototype embodiments have been developed and preliminary evaluations conducted. Major findings of pilot studies show good system performance.