A simple model to detect age-related individual differences in steering movements

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Abstract

Behavioural models may be useful to identify user characteristics in the context of adaptive interaction systems. A kinematic model of Plamondon (1995a) was extended to assess steering behaviour in a lane change task as a function of driver's age and preparatory state. The model assumes that steering wheel movements consist of centrally controlled movement segments which can be identified separately. Fitting the model to steering wheel movements was expected to allow identifying specific movement patterns in young and old participants depending on the state of response preparation. As expected, steering movements of older drivers were delayed and slower in their execution. Analysis of model parameters suggested that the temporal coordination of the movement segments differed between younger and older participants. Interestingly, preparation affected only the amplitudes but not the temporal coordination of movement segments. The results support the view that younger participants exhibit a higher integration of neuromuscular components than older participants, who tend to produce sequential rather than parallel muscular activity. The application of the model may allow analysing individual patterns of steering movements, which in turn can be used to adapt steering systems to the individual needs of drivers.

Introduction

The proportion of older drivers in Germany is constantly growing due to demographic changes, so that drivers older than 65 years will nearly double their travelled distance until 2050 (Oeltze et al., 2006). However, aging is associated with a decline of certain cognitive and motor abilities (Ketcham & Stelmach, 2004), that might become manifest in steering wheel movements (Hahn, Falkenstein, & Wild-Wall, 2010). It is well-known that as adults age, the execution of movement becomes slower and more variable and there is emerging evidence that the structure of the movements also changes (Ketcham & Stelmach, 2004; Pratt, Chasteen, & Abrams, 1994). Thus, age-related differences in steering behaviour might represent an interesting characteristic for adaptive systems detecting a certain driver state.

To adapt technical systems to the user it is necessary to evaluate user behaviour (Oppermann, 1994) for example by recording and analysing movement behaviour. Even very early theories in movement science assume that complex movements

In D. de Waard, N. Gérard, L. Onnasch, R. Wiczorek, and D. Manzey (Eds.) (2011). *Human Centred Automation* (pp. 23 - 34). Maastricht, the Netherlands: Shaker Publishing.