Validity of Virtual Reality driving simulators for ergonomic assessment

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Performing ergonomic tests of vehicles early in development with physical models and mock ups is a time consuming and costly process. If readily available CAD models of newly constructed cars can be used for tests in a virtual reality simulation, costs of ergonomic testing could be reduced. In addition, new design options could be easily introduced and tested by software changes. To test whether ergonomic assessment is possible with this approach, two driving simulator systems were developed (EU project VIRtual 1999-GRD-11030) which differ in the degree of immersion provided. System 1 uses wide screen stereo projection, while System 2 uses immersive technology. Thirty-six subjects with different driving experience performed a predefined set of driving tasks in a real instrumented vehicle and in the simulators. Objective performance and subjective evaluation of ergonomic features of the vehicle were measured in the real car and the simulators, and specific aspects of car ergonomics which can be examined fruitfully in the systems were identified. Additional tests for simulator sickness, simulation quality and user acceptance ensure that the systems can be used for ergonomic testing with end users.

Introduction

Ergonomic tests of new vehicle designs should be performed as early as possible within the development cycle of a new product, in order to avoid costly system changes late in development. Unfortunately user tests can only be performed with mock-ups or models which are costly in themselves and have only limited flexibility to accommodate system changes. The alternative approach, using virtual mannequins in 3D CAD environments requires knowledge of ergonomics criteria which have to be based on experimental data involving users.

These disadvantages could be circumvented by allowing users to experience and test 3D CAD models of new design solutions directly in meaningful scenarios. Thanks to the advent of Virtual Reality (VR) technology, this approach is feasible now. Three-dimensional software models of cars can be animated and placed in driving scenarios, so that users can for example check visibility of instruments or evaluate obstructions of view generated by car structures. Different design solutions like changes in dimensions or placement of vehicle structures can be easily realised by software. Moreover, compared with the human modelling approach, VR permits the direct involvement of the user in the evaluation of innovative solutions. In VR

In D. de Waard, K.A. Brookhuis, S.M. Sommer, and W.B. Verwey (2003), Human Factors in the Age of Virtual Reality (pp. 131 - 143). Maastricht, the Netherlands: Shaker Publishing.