Head-Mounted Display – evaluation in simulation and flight trials

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Abstract

Pathway-in-the-sky displays may drive pilots' attention to the aircraft guidance task at the expense of other tasks particularly when the pathway display is located head-down. A pathway HUD may overcome this disadvantage. Moreover, the pathway may mitigate the perceptual segregation between the static near domain and the dynamic far domain and hence, may improve attention switching between both sources. In order to more comprehensively overcome the perceptual near-to-far domain disconnect alphanumeric symbols could be attached to the pathway leading to a HUD design concept called 'scene-linking'. Experimental studies were completed by conducting two different flight tests. The first mainly focused at usability issues. Visual and instrument tasks were evaluated comparing HMD navigation with standard instrument or terrestrial navigation. The study revealed limitations of the HMD regarding its see-through capability, field of view, weight and wearing comfort that showed to have a strong influence on pilot acceptance rather than rebutting the approach of the display concept as such. Additionally it was found that pilots had difficulties during segment transitions while using the HMD. In a second flight test a redesigned pathway-predictor-director concept was implemented. The trials were designed as a high workload task. The results exposed more or less the same difficulties regarding the usability of the display but showed a much better pathway following especially during segment transitions.

Introduction

Curved approach profiles to large airports in low visibility pose a particular challenge. Pathway displays increase flight path awareness of pilots enabling them to fly difficult, e.g. curved trajectories with high accuracy (Haskell, 1993; Grünwald, 1996; Wickens, 2004). Hence, by using pathway guidance systems air travel capacity improving the efficiency of airspace use could be improved as well as accident rates (e.g. CFIT reduction – controlled flight into terrain) could be reduced. However, these displays may drive the pilot's attention head-down at the expense of monitoring the outside scene referred to as attention fixation or attention capture (Flemisch, 2000; Thomas, 2004; Wickens, 2005). One way to overcome the disadvantage of increased head-down times associated with head-down pathway displays is to present pathway guidance symbology on a head-up display (HUD) or

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