

Sound design for auditory guidance in aircraft cockpits

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Abstract

Auditory information from the situation around us, available in open nature is lost in vehicles. To maintain the three-dimensional picture and situational awareness, pilots in an aircraft cockpit need to interpret two-dimensional data provided on flat screens. The visual information prevails; the auditory channel is used mainly for alerting or getting attention. In an ongoing research project we evaluate means to provide information using audio signals. For these audio signals, carrying information about state, direction, and amount of deviation explicit sound design is essential. Even when using voice commands, where the information is put into the words chosen, parameters exist that can support or oppose to this semantic information, like pitch (low to relax, high to alert), personality (robotic for regular automatic updates, human for unexpected trustworthy information). The paper shows, how an existing flight instrument is mapped to an audio display and what principles from psychology and music are applied to sound design.

Introduction

Since 1999, the Human-Machine Systems Engineering group of the University of Kassel conducted research in auditory displays for processes and vehicles. This research originated from the multi-media control room concept (Borys & Johannsen, 1997): in the clean, quiet, and safe control rooms in modern plants, information is mainly presented visually, and other modalities – noise, vibration, temperature, smell – is locked out. However, these sensations provide valuable information about a plant's status for an experienced operator and modern computer equipment, mainly from media and gaming applications, can bring back some of this experience in a safe and controlled manner. Later concentrating on audio displays, we evaluated how parameters known from music may be used for controlling industrial applications (Johannsen, 2004). This included short tunes to inform people about intended movements of a service robot (Johannsen, 2001), sound signals positioned in space for collision warnings in aircraft cockpits (Gudehus, 2002), and obstacle warning for the driver of a large construction vehicle (Carl, 2006).

An ongoing research project supported by the German Research Foundation DFG 2006 to 2008 evaluated several ways to support aircraft pilots with auditory signals in tasks, where quick and reliable perception of directions is necessary – collision warnings, approach and landing, and taxi guidance. A set of verbal auditory signals

In D. de Waard, J. Godthelp, F.L. Kooi, and K.A. Brookhuis (Eds.) (2009). *Human Factors, Security and Safety* (pp. 113 - 121). Maastricht, the Netherlands: Shaker Publishing.