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Human-centered design of multimodal display technology: Psychophysical calibration of virtual event attributes

It may be argued that the most effective design of multimodal display systems is based upon knowledge of human factors in multimodal perception. For example, human tolerance for latency between audio and video reproduction for teleconferencing should be considered in system integration. Deployment of the multimodal display system described here required the coordination of signals for three sensory modalities, auditory, visual, and vibratory. Though a great deal of research has been done investigating audio/visual interaction, relatively little is known about interaction between reproduced acoustic and vibratory components of remotely captured events. After an introduction to human centered designed of immersive spatial media display system, this presentation focuses upon a case study in which an attempt was made to determine the intermodal delay required for brief acoustic and structural vibrations to be perceived as synchronous, as if generated by a single impact event. The structure-borne component of the bimodal stimuli was presented via a motion platform on which the observer was seated. The air-borne component of the bimodal stimuli was presented via a multichannel loudspeaker array, with a simulated direct sound arriving from a frontal location, and simulated indirect sound arriving from all around the observer. By varying the delay between the acoustic and structural components, thresholds for inter-modal delay values allowing successful time order judgment (TOJ) for two observers were estimated by a two-alternative, forced-choice (2AFC) tracking procedure. Then, in order to avoid sequential response biases in the tracking procedure, the method of constant stimuli was used to determine the range of intermodal delay values associated with the two observers' reports of perceived simultaneity. Results are discussed in relation to the creation of convincing virtual environments for applications such as teleconferencing and music reproduction.

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