Information for 1676 to cover this lecture and likely repetitions of it.

Title: Latency and User Performance in Virtual Environments and Augmented Reality

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Abstract: System rendering latency has been recognized by senior researchers, such as Professor Fredrick Brooks of UNC (Turing Award 1999), as a major factor limiting the realism and utility of head-referenced displays systems. Latency has been shown to reduce the user's sense of immersion within a virtual environment, disturb user interaction with virtual objects, and to contribute to motion sickness during some simulation tasks.

Latency, however, is not just an issue for external display systems since finite nerve conduction rates and variation in transduction times in the human body's sensors also pose problems for latency management within the nervous system. Some of the phenomena arising from the brain's handling of sensory asynchrony due to latency will be discussed as a prelude to consideration of the effects of latency in interactive displays.

The causes and consequences of the erroneous movement that appears in displays due to latency will be illustrated with examples of the user performance impact provided by several experiments. These experiments will review the generality of user sensitivity to latency when users judge either object or environment stability. Hardware and signal processing countermeasures will also be discussed. In particular the tuning of a simple extrapolative predictive filter not using a dynamic movement model will be presented. Results show that it is possible to adjust this filter so that the appearance of some latencies may be hidden without the introduction of perceptual artifacts such as overshoot.

Several examples of the effects of user performance will be illustrated by three-dimensional tracking and tracing tasks executed in virtual environments. These experiments demonstrate classic phenomena known from work on manual control and show the need for very responsive systems if they are indented to support precise manipulation.

The practical benefits of removing interfering latencies from interactive systems will be emphasized with some classic final examples from surgical telerobotics.
and human-computer interaction.

Figure 1. Subject passes a virtual ring over a virtual path while completion time and number of ring-path contacts are studied as a function of system latency.

References:
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