

Encoding a Hidden Digital Signature Using Psychoacoustic Masking

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Abstract

The Interactive Video Data System (IVDS) project began with an initial abstract concept of achieving interactive television by transmitting hidden digital information in the audio of commercials. Over the course of three years such a communication method was successfully developed, the hardware systems to realize the application were designed and built, and several full-scale field tests were conducted.

The novel coding scheme satisfies all of the design constraints imposed by the project sponsors. By taking advantage of psychoacoustic properties, the hidden digital signature is inaudible to most human observers yet is detectable by the hardware decoder. The communication method is also robust against most extraneous room noise as well as the wow and flutter of videotape machines.

The hardware systems designed for the application have been tested and work as intended. A triple-stage audio amplifier buffers the input signal, eliminates low frequency interference such as human voices, and boosts the filtered result to an appropriate level. A codec samples the filtered and amplified audio, and feeds it into the

digital signal processor. The DSP, after applying a pre-emphasis and compensation filter, performs the data extraction by calculating FFTs, compensating for frequency shifts, estimating the digital signature, and verifying the result via a cyclic redundancy check. It then takes action appropriate for the command specified in the digital signature. If necessary it will verbally prompt and provide information to the user, and will decode infrared signals from a remote control. The results of interactions are transmitted by radio frequency spread spectrum to a cell site, where they are then forwarded to the host computer.