Chapter 1

Information Hiding for Audio Signals

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ABSTRACT

This chapter provides a general overview of audio data hiding. The general issues are discussed first, followed by the basic techniques used to hide data in audio signals, including bit stealing, spread spectrum methods, echo methods, and quantization index modulation. This is followed by a brief description of the recent proposals presented at the Institute of Electronics, Information, and Communication Engineers of Japan (IEICE) Multimedia Information Hiding (MIH) Technical Group Meetings.

INTRODUCTION

The concept of information hiding was first studied rigorously in the context of images and videos. Similar methods were then applied to audio signals. With the explosive growth in digital audio and speech data and the available communication bandwidth, the necessity of controlling the distribution of such data has contributed to the interest in research on audio watermarks, which is another form of data hiding for audio signals. Many of the methods of audio data hiding use the perceptual properties of the Human Auditory System (HAS) to hide the data without the possibility of detection. However, the amount of data that can be hidden remained quite small compared to the capacity of images and video. This is quickly changing, and high data rate hiding schemes have recently been introduced, including methods that are considerably robust against attacks. All of these factors contribute to the actual application of audio data hiding in practical audio systems.

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This chapter intends to provide a brief description of audio data hiding, followed by a brief description of the methods of data hiding proposed at the IEICE Multimedia Information Hiding Meetings. It is not intended to present a full description of the topic, but the reader will be provided with a comprehensive list of references for further detail.

DEFINITION OF INFORMATION-HIDING FOR AUDIO

Information-hiding applications are typically classified into two categories: watermarking and steganography. Figure 1 shows an outline of information-hiding technology for audio data. In Figure 1 the technology is classified by payload data and application type. As an introduction, the keywords that are usually applied in information hiding and their definitions are briefly introduced.

The data that are embedded are referred to as the watermark or payload data. The data to be embedded are referred to as the host data or cover data. As a consequence, the watermark is embedded in the host data. The majority of the embedding and extraction algorithms require a common key. This key is essentially different from the cryptography key. It defines where to embed or the order of embedding, which is intended to conceal the payload data in the embedding algorithm by altering the amount of physical variables used in the embedding. The data generated as a result of embedding are referred to as the stego data. The stego data are expressed as quantized waveform data or encoded bit-stream data. It is generally necessary to decode the latter data to the stego waveform data using the conventional decoder of the same codec used in the encoding process. The degradation in the quality of the stego waveform must be low enough to still serve the user’s appreciation or listening purposes. The payload data is extracted by the appropriate users and is utilized for the intended purpose.

Watermark or watermarking is a term used in information hiding that is mainly applied to copyright or digital rights management. A typical watermarking application embeds a content ID and/or a consumer ID into the host audio signal.

Figure 1. An outline of audio information-hiding technologies
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