Chapter XI

Watermarking on Compressed/ Uncompressed Video Using Communications with Side Information Mechanism

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Digital watermarking has been proposed as very useful technology in the protection of digital data such as image, audio, video, formatted documents (PDF or PS), and 3D objects. In the literature, most of the existing watermarking approaches are conducted on images. However, video is even more useful and should be protected with higher priority. In particular, video sequences usually contain rich properties that images do not have. On the other hand, the types of attacks applied on a video are much different from those applied on an image. In this chapter, we will focus ourselves specifically on video watermarking. The content of this chapter is divided into two parts. In the first part, the existing video watermarking techniques are briefly reviewed. We have pointed out their advantages and disadvantages to realize what can be done about video watermarking. In the second part, we propose a compressed domain video watermarking scheme for copyright protection. For the sake of real-time video watermark detection, our method is directly conducted in the MPEG-2 bitstream. More specifically, watermarks are inserted into the VLC domain. We shall discuss how to select proper data in a video bitstream to embed watermarks while preserving perceptual fidelity. In addition, video watermarks are embedded by a new

proposed watermarking technique, which is based on the concept of communications with side information. The power of our method is reflected by its robust capability against attacks. Future work will also be pointed out to further improve the current scheme.

INTRODUCTION

Digital Watermarking

The quality of multimedia signal stored in an analog format may be degraded after duplication. Under that circumstance, people do not have to worry about the illegal duplication problem. However, the situation has been changed since multimedia data stored in a digital format became the main stream. In the digital world, one can easily copy digital multimedia data without losing any quality. As a result, the intellectual property protection problem becomes an urgent issue in the digital world. Traditionally, protection by means of encryption has been extensively applied to securely protect data. Before transmission, the sender can encrypt a piece of digital data, then the encrypted data can be transmitted to the receiver through network. When the receiver gets the encrypted data, he/she must have the keys (parameters), either secret or public, to decrypt the encrypted data. The encryption algorithms such as RSA, MD4, SHA (Rivest, 1990; Goldwasser and Mellare, 1996) are all well-known in the literature. When the receiver decrypts the encrypted data, the decrypted data will be exactly the same as the original. Therefore, if a pirate somehow knows the secret keys, he/she can easily steal away all the data without losing any quality. Basically, this is the major drawback of an encryption-based protection scheme. As a consequence, it is necessary to seek an alternative method for digital data protection.

Recently, a new intellectual property protection scheme called "digital watermarking" (Hartung and Kutter, 1999; Petitcolas, Anderson and Kuhn, 1999) has received much attention due to the rapid advances of the Internet. Unlike encryption, watermarking aims to conceal a piece of invisible information into media data for the sake of protection instead of making the media data intangible. Usually, a typical watermarking system should satisfy the following requirements:

- Perceptual transparency: When a watermark is embedded into a medium, there should be no perceptual difference between the original data and the watermarked one.
- Robustness: A hidden watermark should survive when encountering an incidental modification or a malicious attack (Hartung, Su and Girod., 1999; Petitcolas et al., 1998).
- Blind detection: Watermarks could be detected with or without the help of the original data. If the original data is used for detection, it is called non-blind detection. On the other hand, if the original source is not required in the detection process, then we call the detection a blind one.
- Capacity: Capacity (Barron, 2000; Baudry, Nguyen and Maita, 2000; Chen, 2000; Chou, El Ghaoui, Pradhan and Ramchandran, 2000; Moulin and O'Sullivan, 2000) is defined as the maximally allowable information that can be embedded in an original data.

Since early 1990s, watermarking (Hartung and Kutter, 1999; Petitcolas et al., 1999) has been applied extensively to different media types such as images, audios, videos, and graphics. In this chapter, we will focus ourselves specifically on video watermarking. Some state-of-the-art video watermarking schemes will be reviewed in the next subsection.

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