

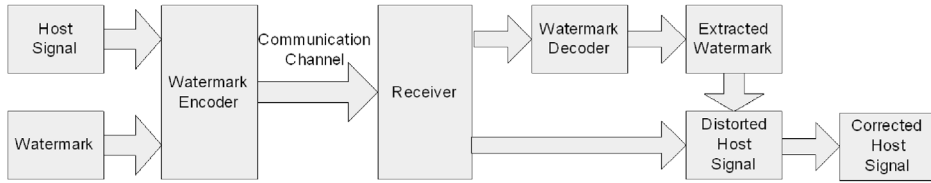
Chapter 3

Novel Applications of Digital Watermarking

The introduction chapter has presented the copyright related applications of digital watermarking include but not limited to broadcast monitoring, owner identification, proof of ownership, transaction tracking, content authentication, copy control and device control (Cox et al., 2002). This chapter will focus on not so typical watermark applications namely non-copyright related applications including:

- a. Error Detection, Concealment and Recovery
- b. Quality of Service In Multimedia Communications
- c. Subject and Subjective Signal Quality Measurement
- d. Bandwidth Extension
- e. Security / Air Traffic Control / Secrete Communication

Figure 1. General error detection, concealment and recovery communication system



3.1 ERROR DETECTION, CONCEALMENT AND RECOVERY

A general diagram of error detection, concealment and recovery communication system using watermarking is illustrated in Figure 1.

The watermark, which carries characteristics information of host signal, is embedded into host signal with watermark encoder in an un-intrusive way so that the introduced watermark is not perceivable. After being transmitted through the noise communication, the signal reached at the receiver is a distorted host signal. The watermark is extracted by the watermark decoder from the contaminated signal. This watermark then is used to help recover the host signal by correcting or concealing the errors.

Packet loss or delay usually occurs when transmitting multimedia in wireless and Internet environment. Protocols like UDP and TCP either leads to partial representation or requires re-transmission, which introduces intolerable time delay.

Lin et al. (2001) proposed an error detection and concealment in UDP environment using self-authentication-and-recovery images (SARI). Watermarks which contain content based authentication and recovery information are embedded into SARI image or video frames prior to transmission. At the receiver side, the embedded authentication information in the watermark is used to detect the locations of corrupted image blocks and the recovery information is employed to approximately restore the lost blocks.

The embedded watermarks are claimed to be compatible with quantization-based lossy compression like JPEG / MPEG. Since the watermarks are embedded prior to transmission, no extra control over the transmission or encoding process is needed. At the receiver side, the recovery is not based on adjacent image / video blocks, thus making it possible to restore packet loss in large areas or high variant areas.

Chen et al. (2005) proposed a fragile watermark error detection and localization scheme called “force even watermarking” (FEW) for wireless video communications, where compressed video streams are extremely sensitive to bit errors including random and burst bit errors, which hinder correct playing of the steaming video. In the proposed FEW algorithm, a fragile watermark is forcedly embedded on the DCT

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