

Chapter 5

Genetic–Algorithm–Based Optimization of Fragile Watermarking in Discrete Hartley Transform Domain

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ABSTRACT

In this chapter, a fragile watermarking scheme based on One-Dimensional Discrete Hartley Transform (1D-DHT) has been proposed to verify the authenticity of color images. One-Dimensional Discrete Hartley Transform (1D-DHT) converts each 1×2 sub-matrix of pixel components into transform domain. Watermark (along with a message digest MD) bits are embedded into the transformed components in varying proportion. To minimize the quality distortion, genetic algorithm (GA) based optimization is applied which yields the optimized component corresponding to each embedded component. Applying One-Dimensional Inverse Discrete Hartley Transform (1D-IDHT) on 1×2 sub-matrices of embedded components re-generates the pixel components in spatial domain. The reverse approach is followed by the recipient to retrieve back the watermark (along with the message digest MD) which in turn is compared against the re-computed Message Digest (MD') for authentication. Simulation results demonstrate that the proposed technique offers variable payload and less distortion as compared to existing schemes.

INTRODUCTION

The idea of concealing secret information inside other digital media either in spatial domain or in transform domain is termed as the digital watermarking, which is widely used to authenticate or to verify the owner-ship of a digital content. In spatial domain, robustness and security of the fabricated watermark are two key challenges. In contrast, transform domain techniques fabricates secret bits into

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the transformed coefficients for better security and robustness. According to the general characteristics, digital watermarking process is classified into three categories namely fragile, semi-fragile and robust respectively. The generic nature of fragile watermarking is to maintain the integrity of digital images and therefore, the embedded watermark is expected to be destroyed while any sort of alterations are made on the watermarked image. Semi-fragile watermarking permits some kinds of alterations on the watermarked images however, severe attacks on the watermarked image are not allowed. The copy-right protection and ownership identification can be accomplished based on the robust watermarking which can resist a designated class of geometrical as well as visual alterations. Fragile watermarking scheme operates the authentication process and checks whether any alteration is occurred. Even a single bit error leads to a different authenticator.

In general, majority of the watermarking schemes are primarily focused to achieve high robustness against common attacks which made watermarking as an effective tool for copy-right protection. Unlikely, limited people had chosen digital watermarking as a way out of authentication. The major objective of this scheme is to design and implement the fragile watermarking in transform domain that can be used to verify the authenticity of color images. Existing schemes are lacking due to the following issues: severe quality degradation, fixed as well as reduced payload and the inability of choosing color image as the cover. To address the above mentioned problems, a novel watermarking scheme in one dimensional Discrete Hartley Transform (1D-DHT) has been proposed that can deal with the authenticity of color images. The scheme provides variable payload that offers a spread from 0.5 to 3 bpB (bits per Byte) with the permissible visual imperceptibility. Moreover, the genetic algorithm (GA) based optimization scheme optimizes the embedded components in transform domain to ensured substantial quality distortion in the watermarked images.

BACKGROUND

A lots of research work has been carried out in transform domain so far; however, the discrete transformations such as Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) and Discrete Fourier Transform (DFT) are three widely used transformations for watermarking that offered better experimental results in terms of transparency and robustness. The non-overlapping blocks of the carrier image are successively converted into the transform domain based on the aforementioned transformations. The least significant parts of the transformed coefficients are modified to fabricate the watermark data. The inverse transformation is applied over the non-overlapping blocks of the embedded coefficients to re-construct the pixel components in spatial domain. The major application of watermarking is to verify the authenticity and robustness of the digital images. To demonstrate the effectiveness of watermarking in Discrete Cosine Transform (DCT) domain (Huang & Shi, 1999), a quantitative analysis is made on the basis of magnitude of DCT components to embed the watermark bits into the DC components. In contrast, Discrete Wavelet Transform (DWT) mainly concerned about the multi-resolution property of the human visual system (HVS). In order to achieve uniform fabrication in wavelet domain, the coefficients of HH, LH, HL and LL sub-bands are utilized (Kim & Moon, 1999). A level-adaptive threshold scheme ensured the selection of perceptually significant coefficients for each sub-band. The watermark is embedded into the selected coefficients of different scale factors based on the level of decomposition. The vector projection is used for detection purpose. The scheme is robust to different attacks viz. image compression, image filtering, geometric transformations and noises respec-

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