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An Effective Digital Video Water Marking Using Transform Technique

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ABSTRACT

A novel method for generic visible watermarking with a capability of lossless video recovery is proposed. The method is based on the use of deterministic one-to-one compound mappings of image pixel values for overlaying a variety of visible watermarks of arbitrary sizes on cover video. The compound mappings are proved to be reversible, which allows for lossless recovery of original images from watermarked videos. The mappings may be adjusted to yield pixel values close to those of desired visible watermarks. Different types of visible watermarks, including opaque monochrome and translucent full color ones, are embedded as applications of the proposed generic approach. A two-fold monotonically increasing compound mapping is created and proved to yield more distinctive visible watermarks in the watermarked image. Security protection measures by parameter and mapping randomizations have also been proposed to deter attackers from illicit image recoveries. Experimental results demonstrating the effectiveness of the proposed approach are also included.

INTRODUCTION

The advance of computer technologies and the proliferation of the Internet have made reproduction and distribution of digital information easier than ever before. Copyright protection of intellectual properties has, therefore, become an important topic. One way for copyright protection is digital watermarking, which means embedding of certain specific information about the copyright holder (company logos, ownership descriptions, etc.) into the media to be protected. Digital watermarking methods for images are usually categorized into two types: invisible and visible.

The first type aim is to embed copyright information imperceptibly into host media such that in cases of copyright infringements, the hidden information can be retrieved to identify the ownership of the protected host. It is important for the watermarked image to be resistant to common image operations to ensure that the hidden information is still retrievable after such alterations. Methods of the second type, on the other hand, yield visible watermarks which are generally clearly visible after common image operations are applied. In addition, visible watermarks convey ownership information directly on the media and can deter attempts of copyright violations. Embedding of watermarks, either visible or invisible, degrade the quality of the host media in general. A group of techniques, named reversible watermarking, allow legitimate users to remove the embedded watermark and restore the original content as needed.

In this project, a new method for lossless visible watermarking is proposed by using appropriate compound mappings that allow mapped values to be controllable. The mappings are proved tube reversible for lossless recovery of the original image. The approach is generic, leading to the possibility of embedding different types of visible watermarks into cover images. Two applications of the proposed method are demonstrated, where opaque monochrome watermarks and no uniformly translucent full-color ones are respectively embedded into color images. More specific compound mappings are also created and proved to be able to yield visually more distinctive visible watermarks in the watermarked image. To the best knowledge of the authors, this is the first method ever proposed for embedding removable translucent full-color watermarks which provide better advertising effects than traditional monochrome ones.

NEW APPROACH TO LOSSLESS VISIBLE WATERMARKING

In this section, we describe the proposed approach to lossless reversible visible watermarking, based on which appropriate one-to-one compound mappings can be designed for embedding different types of visible watermarks into images. The original image can be recovered losslessly from a resulting watermarked image by using the corresponding reverse mappings.

EXISTING METHOD OF DISCRETE COSINE TRANSFORM

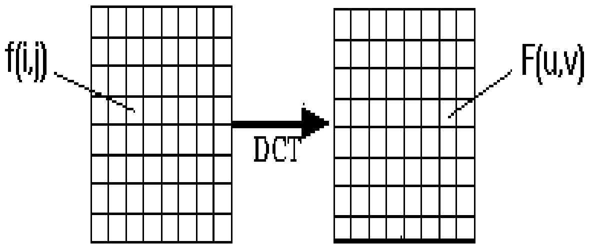
The image taken is in the format of JPEG consisting of a large number of elements. The source image is then block processed for taking an (8x 8) matrix. Each block is then passed to the Transformation block for performing the image transformation.

The discrete cosine transform (DCT) represents an image as a sum of sinusoids of varying magnitudes and frequencies. The dct2 function in the Image Processing Toolbox computes the two-dimensional discrete cosine transform (DCT) of an image. The DCT has the property that, for a typical image, most of the visually significant information about the image is concentrated in just a few coefficients of the DCT. For this reason, the DCT is often used in image compression applications. For example, the DCT is at the heart of the international standard lossy image compression algorithm known as JPEG. (The name comes from the working group that developed the standard: the Joint Photographic Experts Group.)

The cosines transform converts each block of spatial information into an efficient frequency space representation that is better suited for compression. Specifically, the transform produces an array of coefficients for real-valued basis functions that represent each block of data in frequency space. The magnitude of the DCT coefficients exhibits a distinct pattern within the array, where transform coefficients corresponding to the lowest frequency basis functions usually have the highest magnitude and are the most perceptually significant. Similarly, cosine transform coefficients corresponding to the highest frequency basis functions usually have the lowest magnitude and are the least perceptually significant.

The values are called the DCT coefficients of a Image Matrix A. DCT is an invertible transform, and its inverse is given by the inverse DCT equation, can be interpreted as meaning that any M-by-N matrix A can be written as a sum of functions of the form These functions are called the basis functions of the DCT. The DCT coefficients, then, can be regarded as the weights applied to each basis function.

The discrete cosine transform (DCT) helps separate the image into parts (or spectral sub-bands) of differing importance (with respect to the image's visual quality). The DCT is similar to the discrete Fourier transform: it transforms a signal or image from the spatial domain to the frequency domain.



PROPOSED METHOD

The Discrete Wavelet Transform:

Calculating wavelet coefficients at every possible scale is a fair amount of work, and it generates an awful lot of data. What if we choose only a subset of scales and positions at which to make our calculations? It turns out rather remarkably that if we choose scales and positions based on powers of two—so-called dyadicscales and positions—then our analysis will be much more efficient and just as accurate. We obtain such an analysis from the discrete wavelet transform (DWT).

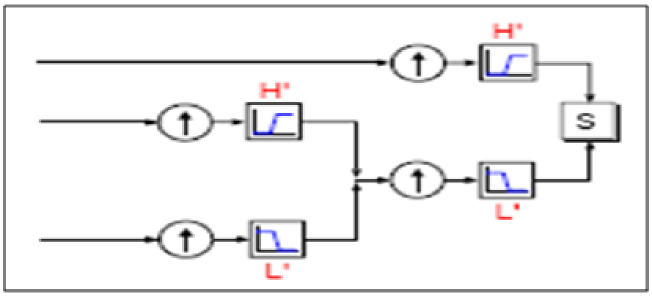
An efficient way to implement this scheme using filters was developed in 1988 by Mallat. The Mallat algorithm is in fact a classical scheme known in the signal processing community as a two-channel sub band coder. This very practical filtering algorithm yields a fast wavelet transform— a box into which a signal passes, and out of which wavelet coefficients quickly emerge. Let’s examine this in more depth.

Number of Levels:

Since the analysis process is iterative, in theory it can be continued indefinitely. In reality, the decomposition can proceed only until the individual details consist of a single sample or pixel. In practice, you’ll select a suitable number of levels based on the nature of the signal, or on a suitable criterion such as entropy.

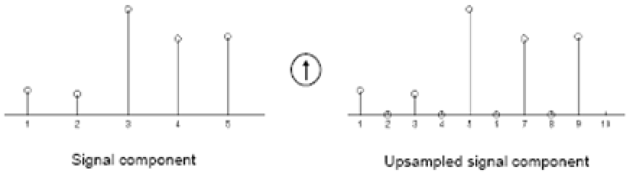
Wavelet Reconstruction:

We’ve learned how the discrete wavelet transform can be used to analyze or decompose signals and images. This process is called decomposition or analysis. The other half of the story is how those components can be assembled back into the original signal without loss of information. This process is called reconstruction, or synthesis. The mathematical manipulation that effects synthesis is called the inverse discrete wavelet transforms (IDWT). To synthesize a signal in the Wavelet Toolbox, we reconstruct it from the wavelet coefficients:



IDWT

Where wavelet analysis involves filtering and down sampling, the wavelet reconstruction process consists of up sampling and filtering. Up sampling is the process of lengthening a signal component by inserting zeros between samples:

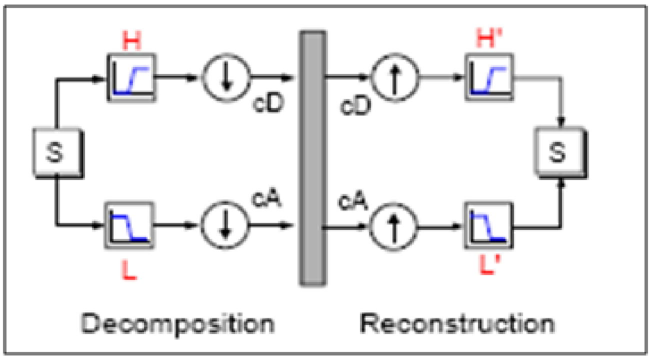


The Wavelet Toolbox includes commands like idwt and waverec that perform single-level or multilevel reconstruction respectively on the components of one-dimensional signals. These commands have their two-dimensional analogs, idwt2 and waverec2.

Reconstruction Filters:

The filtering part of the reconstruction process also bears some discussion, because it is the choice of filters that is crucial in achieving perfect reconstruction of the original signal. The down sampling of the signal components performed during the decomposition phase introduces a distortion called aliasing. It turns out that by carefully choosing filters for the decomposition and reconstruction phases that are closely related (but not identical), we can “cancel out” the effects of aliasing.

The low- and high pass decomposition filters (L and H), together with their associated reconstruction filters (L' and H'), form a system of what is called quadrature mirror filters:



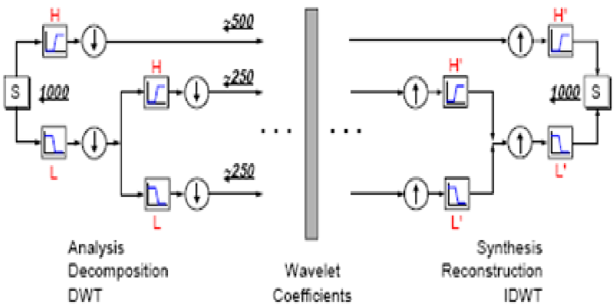
The Scaling Function:

We've seen the interrelation of wavelets and quadrature mirror filters. The wavelet function is determined by the high pass filter, which also produces the details of the wavelet decomposition.

There is an additional function associated with some, but not all wavelets. This is the so-called scaling function . The scaling function is very similar to the wavelet function. It is determined by the low pass quadrature mirror filters, and thus is associated with the approximations of the wavelet decomposition. In the same way that iteratively up- sampling and convolving the high pass filter produces a shape approximating the wavelet function, iteratively up-sampling and convolving the low pass filter produces a shape approximating the scaling function.

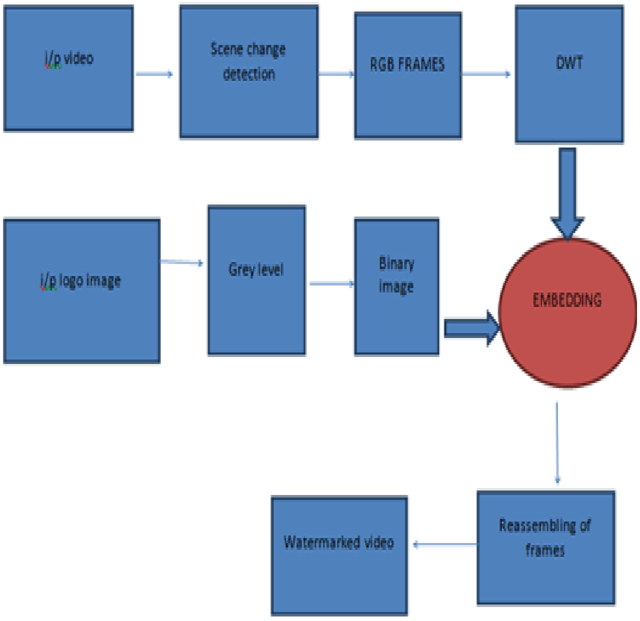
Multi-step Decomposition and Reconstruction:

A multi step analysis-synthesis process can be represented as:



This process involves two aspects: breaking up a signal to obtain the wavelet coefficients, and reassembling the signal from the coefficients. We've already discussed decomposition and reconstruction at some length. Of course, there is no point breaking up a signal merely to have the satisfaction of immediately reconstructing it. We may modify the wavelet coefficients before performing the reconstruction step. We perform wavelet analysis because the coefficients thus obtained have many known uses, de-noising and compression being foremost among them. But wavelet analysis is still a new and emerging field. No doubt, many uncharted uses of the wavelet coefficients lie in wait. The Wavelet Toolbox can be a means of exploring possible uses and hitherto unknown applications of wavelet analysis. Explore the toolbox functions and see what you discover.

Block diagram



Block diagram of dwt

RESULTS:

Comparision of Watermarking in Tranform Techniques

Input video	Water marked vedio size	Mean square error		Peak signal to noise ratio	
		dct	dwt	dct	dwt
1	196*144	0.3	0.25	27.03	33.047
2	256*256	0.43	0.32	25.02	28.743
3	320*240	0.7	0.57	19.34	23.437

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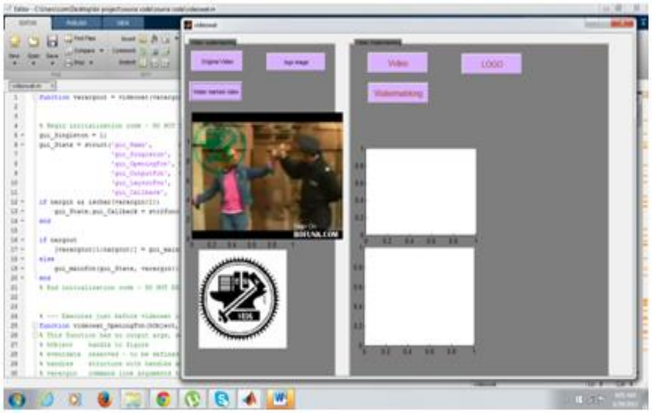
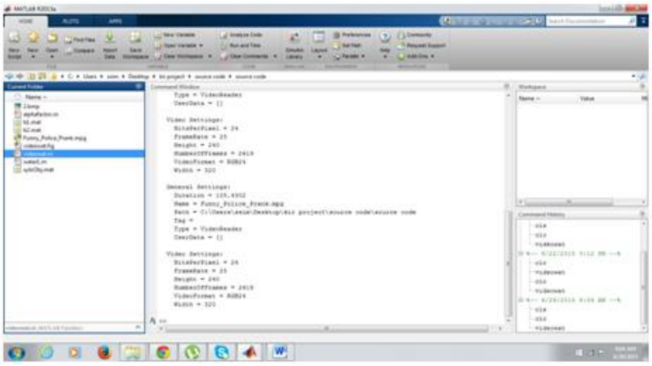
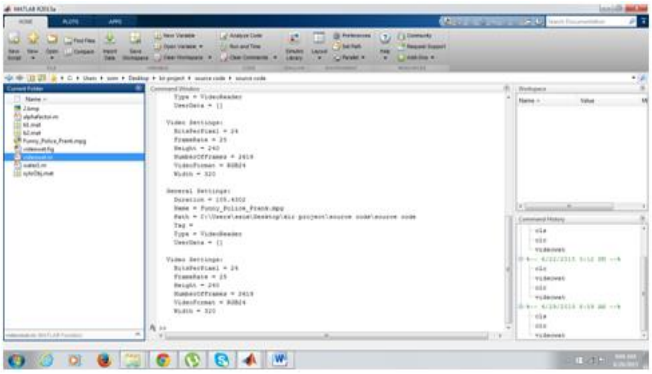
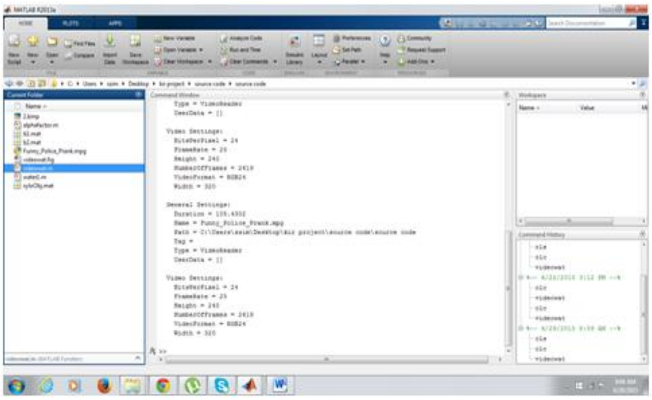
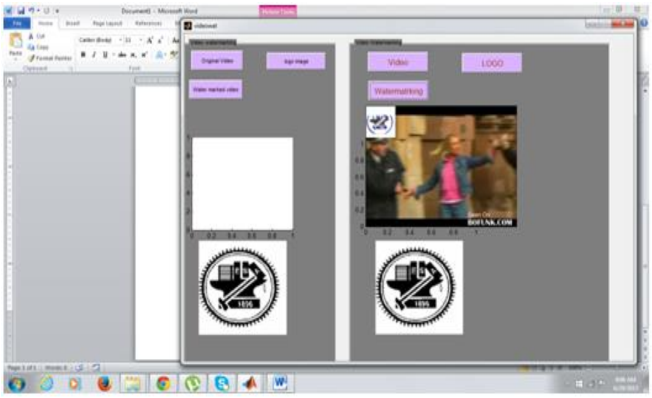
SIMULATION RESULTS











CONCLUSIONS AND FUTURE WORK

In this project a new method for reversible visible watermarking with lossless image recovery capability has been proposed. The method uses one-to-one compound mappings that can map image pixel values to those of the desired visible watermarks. Relevant lemmas and theorems are described and proved to demonstrate the reversibility of the compound mappings for lossless reversible visible watermarking. The compound mappings allow different types of visible watermarks to be embedded, and two applications have been described for embedding opaque monochrome watermarks as well as translucent full-color ones. A translucent watermark isclearly visible and visually appealing, thus more appropriate than traditional transparent binary watermarks in terms of advertising effect and copyright declaration. The two-fold monotonically increasing property of compound mappings was defined and an implementation proposed that can provably allow mapped values to always be close to the desired watermark if color estimates are accurate. Also described are parameter randomization and mapping randomization techniques, which can prevent illicit recoveries of original images without correct input keys. Experimental results have demonstrated the feasibility of the proposed method and the effectiveness of the proposed security protection measures. Future research may be guided to more applications of the proposed method and extensions of the method to other data types other than bitmap images, like DCT coefficients in JPEG images and MPEG videos.

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