On the Analysis of Global and Local Robust Image Watermarking Using Zernike Moments

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ABSTRACT

Digital Watermarking allows an individual to add some hidden copyright notices or other verification messages to digital media, where message is a group of bits describing the information pertaining to the signal or its author. For this purpose, two techniques viz. global watermarking and local watermarking can be used. In this paper, the performance of two feature based global and local watermarking techniques using Zernike Moments (ZMs) have been analyzed by evaluating their robustness against geometric, photometric and other signal processing attacks including rotation, cropping and noise. Experimental results have been provided in order to compare ZMs based global and local watermarking techniques for different types of attacks. Recommendations have been made based on the comparison of these techniques with other existing works.

Keyword: Feature Based Watermarking, Geometric Attacks, Global Watermarking, Local Watermarking, Photometric Attacks, Zernike Moments

1. INTRODUCTION

During the last few years, the use of internet and digital media has been greatly increased. Digital media can be easily copied, so there is a need of protecting the intellectual property rights of the creators and for this an effective marking system is required. Watermarking is the process of embedding some information into another object/signal. Digital Watermarking (DW) is the technique which allows an individual to add hidden copyright notices or other verification messages to digital media, where message is a group of bits describing information pertaining to the signal or its author (Wang & Hou, 2010). Embedded watermark is usually coded in binary format and it should be embedded in a way such that it should not significantly degrade the quality of original host signals. DW is an effective solution to the problem of copyright and data authentication in networked environment (Foo & Dong, 2010). Watermark to be embedded can be visible or
invisible. Invisible watermark can be called robust watermark if it resists a designated class of transformation. Fragile watermarks (Lu, Xu & Sun, 2005) are the watermarks that fail to be detected after the slightest modification and semi fragile are the watermarks that resist benign transformations, but fail detection after malignant transformations (Mohanty, 1999). Watermarking algorithm can be non-blind which implies that it requires original signal/image to extract embedded watermark, semi-blind implies that it does not use original signal/image to extract watermark but uses side information to extract embedded watermark and blind neither uses side information nor original signal/image to extract the embedded watermark (Seo & Yoo, 2006). Local and global watermarking using ZMs is a feature based watermarking technique, because in these techniques Zernike features are modified to embed a watermark. This is a blind watermarking technique because both local and global watermarking do not use original image or side information to extract the watermark.

Many methods of watermarking have been developed based on other techniques. Gao and Jiang (2011) propose a method in which composite chaos is used to scramble the watermark for enhancing the algorithm security. Radial multi-scale block matching (RMSBM) is used to correct the attacked images by local geometric distortion. The watermark is embedded according to the principle of human visual system (HVS) in non subsampled contourlet (NSCT) domain, and the maximum-likelihood (ML) detector is used for the extraction of watermark. The work in Wang, Yang, and Gu (2007) partitions a remote sensing image into sub-block images of suitable sizes, and then decomposes these sub-block images with biorthogonal 7/5 wavelet. Binary watermarking image is embedded into sub-bands except low frequency sub-bands, and finally a blind detection algorithm is realized. The work in Weng, Braeckman, Dooms, Preneel and Schelkens (2012) proposes a novel image authentication system by combining perceptual hashing and robust watermarking. An image is divided into blocks and hash value of block is embedded in the block. Gupta, 2012 propose a cryptography based blind image watermarking technique that embeds more number of watermark bits in the gray scale cover image without affecting the imperceptibility and increase the security of watermarks. In Pandya, Joshi and Jani, (2013), a layered approach of watermarking based on RMI (Random Matrix Image) is proposed. Nikolaidis, (2012) propose a novel method for region based image watermarking that embeds watermark by first performing the inverse DCT of the original watermark and then inversely normalizing watermark which is then embedded in the original image. The work in Bhatnagar G. and Raman B. (2009) proposes a semi-blind reference watermarking scheme based on discrete wavelet transform(DWT) and singular value decomposition(SVD) for copyright protection and authenticity.

In this paper, we draw a comparison of local and global image watermarking through Zernike moments. This paper is organized as follows. Section 2 describes ZMs and their suitability for image watermarking and Local ZMs (LZMs) as well. Global and local watermarking using ZMs are described in Section 3 and Section 4 respectively. Based on the various experimental results, the effect of various attacks on both these feature based watermarking schemes is described in Section 5. Section 6 compares the global and local watermarking techniques using ZMs with other existing works. Finally, conclusions are stated in Section 7.

2. ZERNIKE MOMENTS (ZMS)

Moments are widely used in pattern recognition, image processing, computer vision and multi-resolution analysis. Zernike moments are computed by mapping an image onto a set of complex Zernike polynomials. ZMs consist of a set of complex Zernike polynomials that form a complete orthogonal set over the interior of a unit disk. ZMs are ideal region based shape descriptors and they are invariant against rotation, flipping, scaling and noise addition (Foo & Dong, 2010; Ismail, Shouman, Hosny...
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