Chapter 13

Fast and High Capacity Digital Image Watermarking Technique Based on Phase of Zernike Moments

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ABSTRACT

Zernike Moments (ZMs) are used in many image processing applications, due to their resistance against various signal processing and geometric attacks. Digital image watermarking is one of those application areas, where ZMs are widely used to insert and extract the watermark bits for digital media authentication. In all the existing ZM based watermarking techniques, magnitude of moments is used to insert and extract the watermark. In this paper, the authors have proposed a semi blind watermarking technique in which phase of ZMs is used for watermark insertion and extraction. Due to the use of phase of ZMs, 100% detection ratio is achieved against any geometric and other signal processing attacks. To make the proposed technique fast, q-recursive method is used to compute the Zernike polynomials. The use of q-recursive method has also increased the transparency of watermark due to its better reconstruction ability as compared to traditional moment computation method. Through detailed experimentation, it has been confirmed that the proposed watermarking technique is fast, has more imperceptibility, less Bit Error Rate (BER) and more capacity as compared to traditional ZMs magnitude based watermarking technique.

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INTRODUCTION

Zernike Moments (ZMs) are the complex polynomials that are very widely used in many image processing applications like digital image watermarking (Kim et al., 2003; Xin et al., 2004) face recognition (Wiliem et al., 2007) and edge detection (Zhang et al., 2010; Amandeep et al., 2011), etc. In digital image watermarking, watermark bits can be inserted locally or globally either in spatial or frequency domain (Ibrahim et al., 2007). In many local region based watermarking techniques, magnitude of ZMs are selected and modified using dithering (Yongqing et al., 2011) or odd even quantization (Palak et al., 2004) technique. After modification of moments, watermarked image is reconstructed. The visibility of watermark in the watermarked image can be controlled.

Yongqing et al. (2011) have analyzed the invariance property of ZMs and proposed magnitude based watermarking technique. In this watermarking technique, magnitude of selected moments is quantized to insert the watermark bits. The authors have computed ZMs up to high order to support high payload to be embedded as watermark. The watermarking technique proposed by them is robust against rotation, scaling, flipping, additive noise and lossy compression. They have concluded that as the number of embedded watermark bits increases, the Peak Signal to Noise Ratio (PSNR) decreases and hence quality of watermarked image degrades. In the proposed digital image watermarking technique, before the extraction of watermark bits, phase of the transformed watermarked image is corrected using the method proposed by Shan et al. (2009) and Singh et al. (2011). To correct the phase of transformed watermarked image, moments of original watermarked image and transformed watermarked image are required. Further, in order to reduce the time required to compute ZMs, q-recursive method proposed by Chong et al. (2003) is used in our proposed watermarking technique. Also using the q-recursive method, moments remain stable up to high order as compared to the traditional ZMs computation method as proved by Singh et al. (2011). Due to the stability of moments high order, more moments