Chapter 2

Data Secrecy: An FFT Approach

Tamer Rabie
UAE University, UAE

ABSTRACT

This chapter describes a framework for image hiding that exploits spectral properties of the Fourier magnitude and phase of natural images. The theory is that as long as the Fourier phase of an image is maintained intact, the overall appearance of an image remains specious if the Fourier magnitude of the image is slightly modified. This hypothesis leads to a data hiding technique that promises high fidelity, capacity, security, and robustness to tampering. Experimental results are presented throughout the chapter that demonstrate the effectiveness of this approach.

INTRODUCTION

The proliferation and exchange of multimedia data over the internet and wireless networks has brought with it new prospects for covert communication. Data hiding techniques, commonly known as steganography, when dealing with hiding secret messages in a cover media (Rabie, 2007; Provos and Honeyman, 2003), or watermarking when copyright protection of multimedia data is involved (Wu and Liu, 2003), have received a great deal of attention in recent years (Chan and Cheng, 2004; Solanki et al., 2004; Jain et al., 2002; Marvel et al., 1999; Nozaki et al., 1998).

Techniques for data hiding inside digital images have been generally confined to one popular approach, namely the manipulation of the Least Significant Bit (LSB) of an image pixel value and the rearrangement of image colours to create LSB or parity bit patterns, which correspond to the message being hidden (Curran and Bailey, 2003), with variants that try to improve three different aspects; capacity, security, and robustness (Chen and Wornell, 2001). Capacity refers to the amount of information that can be hidden in the cover medium, security refers to an eavesdropper’s inability to detect hidden information, and robustness refers...
Data Secrecy to the amount of modification the stego medium can withstand before an adversary can destroy hidden information.

This chapter presents a framework for data hiding which exploits spectral properties of the Fourier magnitude and phase of natural images which has allowed for a fresh new approach to image hiding in the frequency domain.

Background

The importance of Fourier magnitude and phase of the carrier image, as related to the problem of data hiding and watermarking, has been rarely discussed in the literature (Tan, 2002; Honsinger, 2000; Ramkumar et al., 1999; O’Ruanaidh et al., 1996). In the early work of Ramkumar et al. (1999) they introduce the notion of data hiding in images in which only the magnitude of the discrete Fourier transform (DFT) coefficients are altered to embed the hidden information bits. While this technique proposes a similar idea to our approach, it differs completely in the actual methodology. In Honsinger (2000), a method of data embedding based on the convolution of the hidden message data with a random phase carrier is presented with results that promise robustness to printing and scanning. The shortcomings of that technique, which bears no resemblance to the novel approach discussed in this chapter, is the requirement of a phase carrier which must be deconvolved from the cover host image to reveal the hidden message.

SIGNIFICANCE OF MAGNITUDE AND PHASE

It is well known that for many images, the phase of the Fourier transform is more important than the magnitude (Huang et al., 1975; Oppenheim and Lim, 1981; Oppenheim et al., 1983; Ramkumar et al., 1999). Specifically if

\[ F(u,v) = |F(u,v)| \exp(j.\theta(u,v)) \]

denotes the two-dimensional (2D) Fourier transform of an image \( f(x,y) \), then the inverse Fourier transform of the phase of this 2D signal \( \exp(j.\theta(u,v)) \) has many recognizable features in common with the original signal, whereas the inverse Fourier transform of the magnitude \( |F(u,v)| \) generally bears no resemblance to the original. This is illustrated in Figure 1 where Figure 1-(a) is an RGB color image and Figure 1-(b) is the phase-only image, i.e., the inverse Fourier transform of \( \exp(j.\theta(u,v)) \).
13 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the product's webpage: www.igi-global.com/chapter/data-secrecy-fft-approach/43466?camid=4v1

This title is available in InfoSci-Books, Business-Technology-Solution, InfoSci-Multimedia Technologies, New Media, Communications, Social Science, and Healthcare, InfoSci-Select, InfoSci-Media and Communication Science and Technology, Advances in Multimedia and Interactive Technologies. Recommend this product to your librarian: www.igi-global.com/e-resources/library-recommendation/?id=1

Related Content

Using Digital Games to Develop Ethical Teachers

Content Adaptation in Mobile Learning Environments
Sergio Castillo and Gerardo Ayala (2010). International Journal of Multimedia Data Engineering and Management (pp. 1-15). www.igi-global.com/article/content-adaptation-mobile-learning-environments/49146?camid=4v1a

K-Means Based Prediction of Transcoded JPEG File Size and Structural Similarity
Steven Pigeon and Stéphane Coulombe (2012). International Journal of Multimedia Data Engineering and Management (pp. 41-57). www.igi-global.com/article/means-based-prediction-transcoded-jpeg/69520?camid=4v1a

Ultra-Wideband Solutions for Last Mile Access Network