Chapter 4
Detection of Seam-Carving Image Based on Benford's Law for Forensic Applications

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ABSTRACT

Seam-Carving is widely used for content-aware image resizing. To cope with the digital image forgery caused by Seam-Carving, a new detecting algorithm based on Benford's law is presented. The algorithm utilize the probabilities of the first digits of quantized DCT coefficients from individual AC modes to detect Seam-Carving images. The experimental result shows that the performance of proposed method is better than that of the method based on traditional Markov features and other existing methods.

1. INTRODUCTION

With the fast development of digital image processing techniques, more and more image processing software like GIMP and Adobe Photoshop appeared and provided more and more powerful abilities to process digital images. As such software affording the convenience of processing digital image, they also generate the possibility of image tampering and misusing. If tampered images are used in the news media, scientific discovery, insurance and the court evidence, the social order and living order will be destroyed. False image change the true face of the world, even influence the judicial justice. Therefore, it becomes more and more important to confirm the authenticity of an image. The image forensics technique offers a favorable means for image tampering detection.

The image forensic techniques can be divided into two categories: proactive forensics and passive forensics. For proactive forensics, special information such as watermark is embedded into original image. When checking the authenticity of an image, such information will be extracted and compared with original embedded information to draw the conclusion. The main technique of proactive forensics is watermarking (Reyc, 2003; Potdar, 2005; Weng, 2013; Liu, 2010), which takes advantage of redundant information in digital images. Nowadays, some digital cameras support embedding watermark into digital image automatically when taking pictures. The main limitation of this kind of forensic is that, when facing large amounts of digital images, people usually can't know which image should be checked in advance. On the contrary, the passive forensics can judge the authenticity of an image without any embedded information in advance. The wide application of this kind of technique motivated many researchers focus on this domain.

The main image tamping methods include copy-move, splicing, resampling and so on. Copy-move means copying one part of the original image and then pastes it to the other part of the same image. This kind of method is usually for the purpose of hiding or duplicating special contents such as a special object or people. One of the main corresponding forensic methods aiming at copy-move tamping is to find if there are homogeneous regions in the image, which can be achieved by using characteristics in frequency domain of the image (Fridrich, 2003; Amerini, 2011; Amerini, 2013).. Image splicing means compounding two or more images into one, the corresponding forensic methods aiming at this respect are mainly achieved with the help of analysis of image features such as high order moment and bicoherence spectrum (Shi, 2007; Fu, 2006). Image resampling includes operations such as resizing, rotating and scaling. This kind of operation will resample the original image and cause periodic correlation which can be detected for forensic purpose.

A novel and efficient content-aware image resizing technique, named Seam-Carving and Seam-Insertion (hereinafter "Seam-CI") was proposed by Avidan, Shai (2007). This method can resize the original image, and in the meantime, it can minimize the distortion to the main content of the image. This technique has been added to Adobe Photoshop CS4 as its optional function, and it also has been added to GIMP as plug-in unit. It can be used to execute malicious image tamping, for example, it can be used to remove special object or people from the original image. Till now, a few forensic research have been proposed aiming at this kind of image tampering: Min Wu (2011) proposed a detecting method based on hash, which was a proactive forensic and so the applications are limited; Fillion C(2010) proposed a multi-features fusion based method which can do well when the resizing ratio is not so high; Sarkar(2009) proposed a traditional Markov feature based method however the detecting accuracy was not so satisfying.

With adequate consideration in various tamping methods of Seam-CI, a detecting method based on Benford's law is proposed in this paper. Experimental results based on 11 different categories of grayscale images show that the proposed method is more sensitive to Seam-CI operations.

2. INTRODUCTION TO SEAM CARVING AND SEAM INSERTION

Seam-CI is a kind of content-aware image resizing technique proposed by Avidan, Shai. Normally, image cropping and image scaling are two ways to change an image's size. Image cropping can reduce the size of the image by cropping the pixels on the boundary while the remaining part is exactly the same as the original image. Cropping may remove some important contents of the image, which is probably on the boundary area. Image scaling also ignore the contents of the image, change the image size by interpola-

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