Chapter 2
Identification of Natural Images and Computer Generated Graphics Based on Hybrid Features

Fei Peng
Hunan University, China

Juan Liu
Hunan University, China

Min Long
Changsha University of Science and Technology, China

ABSTRACT

Examining the identification of natural images (NI) and computer generated graphics (CG), a novel method is proposed based on hybrid features. Since the image acquisition pipelines are different, some differences exist in statistical, visual, and noise characteristics between natural images and computer generated graphics. Firstly, the mean, variance, kurtosis, skew-ness, and median of the histograms of grayscale image in the spatial and wavelet domain are selected as statistical features. Secondly, the fractal dimensions of grayscale image and wavelet sub-bands are extracted as visual features. Thirdly, considering the shortage of the photo response non-uniformity noise (PRNU) acquired from wavelet based de-noising filter, a pre-processing of Gaussian high pass filter is applied to the image before the extraction of PRNU, and the physical features are calculated from the enhanced PRNU. In the identification, a support vector machine (SVM) classifier is used in experiments and an average classification accuracy of 94.29% is achieved, where the classification accuracy for computer generated graphics is 97.3% and for natural images is 91.28%. Analysis and discussion show that the method is suitable for the identification of natural images and computer generated graphics and can achieve better identification accuracy than the existing methods with fewer dimensions of features.

DOI: 10.4018/978-1-4666-4006-1.ch002

INTRODUCTION

With the development of information technology, digital images have been widely used in daily life and work. Many devices such as digital cameras, scanners, computer software and so on can be used to produce digital images. What's more, digital image processing is becoming increasingly convenient, which greatly challenges the authenticity of digital images. If altered or forged digital images are used in news report, research results, insurance or court evidence by counterfeiters, serious implications to the authenticity of news, scientific research and the stability of country's politics and society will be triggered. Hence, the study of digital image forensics technology is becoming a research hotspot.

Generally, digital image forensics can be divided into two categories: active forensics and passive forensics. Active forensics mainly includes digital signature (Swaminathan, 2006) and digital watermarking (Chandra, 2010). In active forensics, additional information needs to be inserted into the host in advance, which requires that the acquisition device should have the corresponding functionality. However, most of the existing devices don't have. At the same time, the additional information embedded will reduce the quality of images. Nowadays, all these problems have limited the practical application of active forensics. As a novel and an advanced technology, passive forensics technology occurred. It is a kind of blind forensics method and can identify the authentication or source of an image only based on the characteristics of the image itself without embedded additional information, which makes it more practical. According to its applications in different research fields, passive forensics can be classified into tampering detection (Popescu, 2005), steganalysis (Lyu & Farid, 2006) and source identification (Lukas & Fridrich, 2005a, 2005b, 2006a, 2006b; Ng, 2005; Chen & Li, 2009; Lyu & Farid, 2005; Dehnie, 2006).

The identification of natural images and computer generated graphics belongs to the field of source identification. Natural images and computer generated graphics are acquired from two different pipelines. Natural images are obtained by cameras, which reflect the real world, while computer generated graphics are created by computer software, which are rendered from different geometric models. To our best knowledge, the research progress on the identification of natural images and computer generated graphics is relatively slow in recent years. Existing methods are mainly based on statistical properties of images (Lyu & Farid, 2005) or physical model of image processing (Lukas & Fridrich, 2005a, 2005b, 2006a, 2006b; Ng, 2005; Chen & Li, 2009; Dehnie, 2006). Although statistical properties can reflect the inherent differences of images to some extent, the identification accuracy is still limited even though the dimension of the features is more than several hundreds. The algorithms based on physical model generally discriminate the images by using the imperfection generated by the physical equipments such as lens, a color filter array (CFA) and charged coupled device (CCD) sensor. Compared with the methods based on statistical characteristics, it generally requires much fewer features. However, since the key features for the different image acquisition pipelines are still uncertain, the detection accuracy of the existing methods still needs to be improved. In this paper, the intrinsic properties and the essential differences in both image acquisition pipelines are studied, and consequently an identification algorithm is proposed.

RELATED WORK

Natural image is the reflection of natural light and recorded by image acquisition devices. Firstly, the light passes through the lens and subsequently is converted to electrical signal by an image sensor.