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Median Filter Detection Through Streak Area Analysis

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Abstract

Median filter (MF) is a content preserving nonlinear filter, employed to hide traces of image manipulations, affecting the reliability of manipulation detection techniques. Thus, median filter detection is a major concern for digital image forensics (DIF) experts. The methods used for median filter detection (MFD) are computationally expensive as high dimensionality of feature vectors are employed. This paper proposes an effective method for blind median filter detection based on streaking effect of the median filter. The method offered in the paper is built on experimental observation that the percentage streak area (psa) of an image increases on repetitive median filtering of the image, the rate at which *psa* increases for median filtered images is different from the rate at which *psa* increases for unfiltered images. A feature vector based on the observation is extracted from three different image datasets UCID, BOSS and Dresden and feed to Support Vector Machine (SVM) to perform 10-fold cross validation using linear kernel. The results obtained, using a three-dimensional feature vector, demonstrates efficacy of the proposed method.

Index Terms

Digital Image forensics, Operator detection, Median filter detection, Streaking Effect, repetitive median filtering.

I. INTRODUCTION

IN TODAYS world, creation of multimedia or other digital content is very easy. The availability of hardware and software and the ease with which digital content can be created and manipulated has given rise to a lot of information security challenges such as establishing authenticity of digital content originating from unreliable or an untrusted source. In fact a huge amount of digital contents originate form unreliable or untrusted sources. The authenticity of such digital contents must be established before consuming them. One such important digital contents is digital images. Digital images are an important digital content whose authenticity check is very challenging [1]. Every day, we are exposed to a variety of images in various forms. With sophisticated digital technologies available today, forging an image is very easy. Numerous tools are available such as Photoshop, which can be used by even an inexperienced user to manipulate images. As a result, it is easy to tamper with images rightly pointed out in [2] and [3]. To restore trust in digital images a new area has emerged know as Digital Image Forensics (DIF). DIF rely on intrinsic fingerprints left by image manipulation techniques for checking the authenticity of an image without need of any other a priori information. A survey of techniques in digital image forensics may be found in [4]. DIF involve detection of various type of manipulations such as copy move, image composition [5], median filtering [6], resampling [7], JPEG compression [8], and contrast enhancement [9].

Median filter may be exploited by image forgers to remove the fingerprints of manipulation techniques as detection of such techniques depends on the assumption that neighboring pixels are linearly correlated. Median filter destroys nonlinear relation among pixels particularly neighboring ones and thus may be employed as a tool against such manipulation detection techniques [10]. Therefore, median filter detection (MFD) has become an important task for experts in DIF. The techniques in current state of art, discussed in detail in section III, are very computationally expensive because of large size of feature vector used for classification purpose. The paper proposes a very simple and effective method for blind Median filter detection based on the experimental observation that repeated median filtering of an image will lead to increase in number of pixels involved in streaks. Streaking is further defined section II-B.

The paper is organized into five Sections, Section II and III covers background and prior work, in Section IV proposed method is discussed, Section V contains experiments and result. Finally, the paper is concluded in Section 5.

II. BACKGROUND

A. Median filter

Median filter (MF) is a popular nonlinear signal processing filter proposed by Tukey in [11]. MF replaces the target sample value on which it acts by the median of a window of samples centered around the target sample. An odd valued square window size is the most popular choice of window geometry though other shapes such as star and cross shapes are also possible. Two