DOCTORAL DISSERTATION INFORMATION

Title:	D**evelop the algorithms of image forensics for Copy-Move images using Multi-resolution analysis**
Major:	**Electronics Engineering**
Major code:	**62520203**
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Contributions of the dissertation

The dissertation presents contents of the research process, from doing survey on Copy-Move forgery detection (CMFD) to proposing the suitable image forensics algorithms, oriented to applying multi-resolution analysis to balance the accuracy and processing time, which meets the given requirements and objectives. With research studies on the field of Copy-Move image forensics, the dissertation builds a general diagram to solve the problem. Identifying the similar areas, which is the basis of the Copy-Move operation, is used based on the analysis of the characteristics of the small blocks that constitute the replication area. On that basis, the dissertation proposes the first algorithm for the CMFD algorithm by finding the copied regions after eliminating the background using histogram analysis. The fact that the algorithm separates the background from the foreground before finding the replication region reduces the computing redundant of backgournd in case of relatively uniform background images and simple objects.

In an arbitrary image, feature extraction using modified Zernike Moments (MZMs) to maximize the number of pixels mapped to the unit circle, which is suggested in the second proposed algorithm, reduces the geometric and numerical error when searching the duplicated regions. The first two algorithms suggested from investigational studies not only improve the complexity (for the first algorithm) and accuracy (for the second algorithm) by processing directly in the tested image but also show the necessary to develop a multiresolution analysis in building the effective CMFD algorithms.

From the above suggestion, the dissertation studies on theory of multiresolution analysis of wavelets and curvelets; and also build the third algorithm from which wavelets

is proved to be more suitable candidate in image forensics. In addition, comparisons of image block size, wavelets filters, order of Zernike Moments (ZMs) are also discussed in this algorithm.

The fourth algorithm proposes a CMFD solution by detecting the similar regions from the characteristic vectors using MZMs at the LL1 approximation of Discrete Wavelet Transforms, which balances between processing time and accuracy in the more diverse set of images. The algorithm also identifies the original and copied regions based on the comparison of the value of the sharpness in the detected areas, which have not been previously mentioned.

In order to take advantage of high frequency components, the dissertation builds the fifth algorithm which proposes for the Copy-Move image detection by comparing properties from the approximation component and estimating the sharpness at high frequency components of DWT. Sharpness estimation at high frequency components to identify the locations of suspected copied-pasted regions, coupled with similar regions detected from the comparison of characteristics using the Run Difference Method (RDM) at the approximation component, can limit the copied areas and improve the accuracy.

With the fact that the sharpness at the pasted position is very clear and different from the edges of the image, the dissertation proposes the sixth algorithm for the Copy-Move or Splicing counterfeit detection by sharpness estimation at high frequency components, combined with Copy-Move faked region reconstruction from the approximate component of the DWT transform. In this research, the algorithm firstly determines whether the image is tampered; and in the case of tampering, the manipulation of tampering (including Copy-Move and Splicing) and corresponding fake objects will be defined. Determining the Splicing manipulation is only one of the points involved in determining the manipulations, and the dissertation does not study the algorithm for the Spliced images. An embedded system using Raspberry Pi3B to implement the proposed algorithm has confirmed the efficiency and applicability of the algorithm.

The algorithms deploying multi-resolution applications are tested on the Copy-Move images from a set of benchmark images [1], from natural images with Photoshop manipulations, or from the dbforgery [2] in case of Splicing (for algorithm 6) by Matlab 2013a, on Windows 7 Ultimate 64-bit, Intel Core i5 processor @ 1.8GHz and 4GB RAM. The results of proposed algorithms are compared in accuracy, recall and F with related methods at pixel level.

The dissertation is a collection of 13 papers, of which 05 papers are published in prestigious journals, 01 book chapter and 07 scientific papers presented at the International Conferences.

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