出國報告（出國類別：國際會議）

參加 The 16th International Conference on Information & Knowledge Engineering 發表論文

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摘要

此次前往美國參加第十六屆 International Conference on Information & Knowledge Engineering (IKE2017)的主要目的為發表論文及蒐集與資訊科技研究領域相關的知識與研究方向。該國際研討會是由AMERICAN COUNCIL on SCIENCE and EDUCATION機構所舉辦。IKE2017國際研討會與其他二十個資訊科技相關研究主題的研討會在同一時間及地點舉辦，場面相當盛大。個人所投稿的論文題目為 “A Steganographic Scheme Implemented on BTC-Compressed Image by Histogram Modification”。此研究領域的主要目標是研發可以應用於隱密通訊上的策略及方法。本次發表的論文將收錄於具有ISBN的論文集。在論文發表的過程中，有多位國際學者表達對此研究題目的興趣。在簡報結束後，更有兩位學者留下來與個人討論此研究成果的細節及流程。其中一位學者提供了可將此研究由單張影像擴展到多張影像或視訊的建議。在與現場的學者仔細討論之後，大家一致確認了該建議的可行性及可實現性，個人覺得獲益良多。

目次

本文

目的：

個人此次前往美國參加第十六屆 International Conference on Information & Knowledge Engineering (IKE2017)的主要目的為發表研究成果及蒐集與資訊科技研究領域相關的知識與研究方向。IKE2017 國際研討會是由 AMERICAN COUNCIL on SCIENCE and EDUCATION 機構所舉辦。此國際研討會與其他二十個資訊科技相關的研討會在同一時間及地點舉辦。二十一個研討會名稱如下所列：

- 4th Annual International Conference on Advances in Big Data Analytics
- 1st Annual International Conference on Applied Cognitive Computing
- 18th Annual International Conference on Bioinformatics & Computational Biology
- 3rd Annual International Conference on Biomedical Engineering and Sciences
- 15th Annual International Conference on Scientific Computing
- 13th Annual International Conference on Data Mining
- 16th Annual International Conference on e-Learning, e-Business, Enterprise Info Systems, & e-Government
- 15th Annual International Conference on Embedded Systems, Cyber-physical Systems, and Applications
- 3th Annual International Conference on Foundations of Computer Science
- 13th Annual International Conference on Frontiers in Education: Computer Science and Computer Engineering
- 13th Annual International Conference on Grid, Cloud, and Cluster Computing
- 3rd Annual International Conference on Health Informatics and Medical Systems
- 19th Annual International Conference on Artificial Intelligence
- 18th Annual International Conference on Internet Computing and Internet of Things
- 16th Annual International Conference on Wireless Networks
- 16th Annual International Conference on Information & Knowledge Engineering
- 21th Annual International Conference on Image Processing, Computer Vision, & Pattern Recognition
- 14th Annual International Conference on Modeling, Simulation and Visualization Methods

- 23rd Annual International Conference on Parallel and Distributed Processing Techniques and Applications
- 16th Annual International Conference on Security and Management
- 15th Annual International Conference on Software Engineering Research and Practice

過程：

IKE2017 研討會會議議程總共安排了四天，個人的論文發表時間被安排在第三天下午，所發表之論文內容摘要如下敘述。

影像藏密技術(image steganography)是一種可行的隱密通訊(covert communication)機制。此技術已經成功地實作在各種數位媒體之上，尤其是數位影像。影像藏密技術除了可以直接地實作於數位影像的空間域(spatial domain)與頻率域(frequency domain)之外，亦可以實作於數位影像的壓縮域(compression domain)。相較於在空間域或頻率域上實作之藏密技術，在壓縮域上實作之藏密技術面臨了更多的挑戰。在資料隱藏量(payload)方面，由於影像壓縮去除了原始影像大部分的重複資訊(redundancy)，因此可用來作為藏密的空間將會大大地減少。在影像的視覺品質方面，由於影像壓縮與資料藏入的效應，在取密端獲得之掩護影像的視覺品質將會明顯地降低。此外，就掩護影像之壓縮碼本身而言，其位元率(bit rate)亦可能因為機密資料的藏入而增加。然而，在影像的壓縮域上實作藏密技術亦有其優點。此類型之藏密技術不但可以增加機密資訊在傳遞時的便利性；同時，藉由數位影像壓縮碼的掩護，機密資訊的安全性更可以獲得提升。

區塊截短編碼技術(Block Truncation Coding, BTC)是一種可以有效達成低位元率壓縮的影像編碼技術。此篇論文提出一種基於區塊截短編碼之可逆的資料隱藏技術。首先把影像切割成 n×n 大小不重疊的區塊做區塊截短編碼，根據區塊截短編碼特性，編碼後的每個區塊會產生一對重建階值 X_H 與 X_L 和一個位元圖(Bitmap)。格雷碼(Gray code)在 1940 年由 Frank Gray 學者所提出來，並於 1953 年取得美國專利。格雷碼最早被使用於脈衝編碼調變(Pulse Code Modulation, PCM)方法上，用以避免傳送訊號時產生的錯誤。直方圖是一種把數值量化後統計在圖表上的圖示。Ni 等學者在 2006 年針對直方圖做修改，提出一種以直方圖為基礎的可逆式資料隱藏技術。該方法首先統計影像的像素值出現的次數，然後以直方圖的統計方法表示出來。之後，在直方圖中找出出現次數最多的像素值，這裡稱為峰值點(Peak Point)以及找出出現次數最少的像素值，這裡稱為低值點(Low Point)。最後，藉由輕微調整影像像素值的方

式達到直方圖位移的現象同時將機密位元藏入於影像像素之中。

此論文提出的資料隱藏技術在機密資料藏入部份分成二個階段。第一階段之藏入方法為把機密資料藏入於每個區塊的重建階值 X_H 與 X_L 裡。第二階段之藏入方法為本論文所提出之利用格雷碼(Gray code)與直方圖位移(Histogram Shifting)技術的資料隱藏法。此方法把機密資料藏入於位元圖裡。本方法所使用的直方圖位移技術有做些改良，改良之方法會選擇最適合的峰值點與低值點進行位移及機密資料藏入。運用直方圖位移技術主要可以達到可逆性的目的，而應用格雷碼主要可以提高偽裝影像的品質。實驗結果證明提出的方法具有不錯的資料藏入量與視覺品質良好的重建影像。整體的效能分析結果顯示提出的方法在傳送端可以提升機密資料之藏入量、在傳輸通道上(communication channel)可以維持影像壓縮碼之位元率以及在接收端可以完整地取出機密資料並且無失真地重建(losslessly restore)壓縮影像。

本次發表的論文將收錄於具有 ISBN 的論文集。在論文發表的過程中，有多位國際學者表達對此研究題目的興趣。在簡報結束後，更有兩位學者留下來與個人討論此研究成果的細節及流程。其中一位學者提供了可將此研究由單張影像擴展到多張影像或視訊的建議。在與現場的學者仔細討論之後，大家一致確認了該建議的可行性及可實現性，個人覺得獲益良多。在參加其他 Session 的過程中，個人聽了不少與個人研究有關的論文報告，也與部分論文作者交換了意見。在溝通過程中，個人獲得不少在研究上的新觀念。在此國際會議中所接觸到的討論與報告經驗令個人覺得相當寶貴。

心得及建議事項：

IKE2017 國際研討會是由 AMERICAN COUNCIL on SCIENCE and EDUCATION 機構所舉辦，今年為第十六年舉辦。IKE2017 國際研討會與其他二十個資訊科技相關研究主題的研討會在同一時間及地點舉辦，場面相當盛大。因此，在此次國際會議中能見識到許多在資訊科技不同研究領域之研究成果與未來的研究趨勢及應用。由主辦單位所邀請之專題講座、議程委員以及參與會議之研究學者得知，此國際會議廣受世界各國相關研究領域之學者所重視。也因此個人發現，在會議中被宣讀論文之研究題目差異性頗大，由此可知資訊科技研究領域範圍之浩翰。個人在論文報告過程中，曾有學者根據個人所提出論文之方法討論其在不同環境下之應用。個人覺得這是一個很好的意見交流，個人將在未來的研究中參考他國學者的意見，這也是個人認為參與此次國際會議收穫最大的部分。

A Steganographic Scheme Implemented on BTC-Compressed Image by Histogram Modification

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Abstract: An image steganographic scheme implemented on block-truncation-coding (BTC) compressed image is proposed. In the proposed scheme, the first stage hides secret data into the reconstructed X_H and X_L values of image block and the second stage uses histogram techniques and gray code principles to hide the secret data into the bitmap of block. Experimental results show that the proposed scheme allows for the hiding of large amounts of data, and the reconstituted image has good image quality. Moreover, the proposed scheme is a reversible image steganographic scheme.

KeyWords: Steganography, Block Truncation Coding, Histogram Modification, Data Hiding, Image.

1. Introduction

Recently, many image steganographic techniques using block truncation coding have been proposed. Chuang and Chang [1] applied the characteristics of BTC techniques to set a threshold value for the XH and XL reconstruction values for each block. If the difference between the reconstruction values does not exceed the threshold, the encrypted data is hidden in a bitmap which is then incorporated into the reconstructed video file according to the X_H and X_L reconstruction values. In 2008, Chang et al. [2] proposed a BTC-based method for hiding data in lossless color images. Previous color image compression required three bitmaps and three pairs of reconstruction values. Genetic algorithms were then used to identify common RGB common bitmaps among the three bitmaps. Side match (SM) techniques were then used, according to X_H and X_L reconstruction values of the code compression and the bitmap to hide the confidential information in the common bitmaps for reconstruction. In 2012, Lin et al. [3] proposed a reversible BTC method for hiding data in histograms in two stages. The first stage hides the X_H and X_L reconstruction values for each block based on the approach proposed by Chang and Lin [2]. The second stage applies histogram displacement techniques to hide the confidential data in a bitmap. The proposed scheme focuses on improving the methods proposed by Lin and Liu, by proposing a new BTC reversible data hiding technique in two stages. The first stage follows the method proposed by Chang and Lin [2], in which the confidential data is hidden in the X_H and X_L reconstruction values according to the compressed code X_H and X_L and bit map sequence. In the second stage, we propose using a histogram displacement technique and gray code characteristics for data hiding in a bitmap.

2. Proposed method

The proposed image steganographic technique is divided into two stages. The first stage is based on the method proposed by Lin and Liu [2]. In the second stage, this paper proposes using gray coding and histogram displacement techniques to accomplish data concealment. Four pixels in a 2x2 block bitmap are grouped and transformed to a gray coding, where gray code 0000~1000 for the pixels corresponds to 16 different types of gray code (0~15), and is referred to as Type_Gray.

2.1 Data hiding in the reconstruction values X_H and X_L

In the first stage, the proposed steganographic method is identical to that proposed by Lin and Liu [3].

2.2 Data hiding in the bitmap

The BTC bitmaps for each 4x4 block are subdivided into 2x2 block bitmaps, each of which is transformed into a Type_Gray. Histogram statistics are then applied to determine the frequency of each Type_Gray, referred to as Type_Gray(x). Finally, we use histogram displacement techniques to hide the secret data. Experimental results show that the peaks for nearly all images are in Type_Gray(0) or Type_Gray(10), while the low points are in Type_Gray(4) or Type_Gray(14).

2.3 Retrieving secret data from reconstruction values X_H and X_L

In the proposed scheme, BTC is cut into 4x4 non-overlapping blocks. We first scan each 4x4 block bitmap. If the bits in the bitmap for a given block are all the same, then it contains no secret information for retrieval. If the bits are all different, then it does contain secret data to be recovered according to the X_H and X_L sequence. Assuming the receiver receives a compressed code sequence $X_L||X_H||BM$, the recovered secret bit is 1. If the sequence is $X_H||X_L||BM$, then the recovered secret bit is 0. The hidden data and the recovered data all accord with the X_H and X_L sequence sent from the sender to the receiver, so the X_H and X_L frequencies are not updated. Therefore, image reconstruction proceeds without distortion. Stage 1 extracts the hidden data and the reconstructed image.

2.4 Extract secret data from the bitmap

BTC is cut into 4x4 non-overlapping blocks. First we subdivide the bitmaps into 2x2 block bitmaps, and conduct Z-type scans to convert all 2x2 block bitmaps into Type_Gray. According to the abovementioned additionally recorded peak Gray_P=0 and low point Gray_L=4 and the low point coordinates (i,j), we extract the secret information and restored original bitmap to achieve the goal of reversible image reconstruction. While converting the 2x2 block bitmap to Type_Gray, if the Type_Gray peak is Gray_P+1, which is Gray_P=0+1=1, then the extracted bit is 1. If the peak is Gray_P=0, then the extracted bit is 0. Completing stage 2 obtains the secret data and recovers the original reconstructed bitmap of image block.

3. Experimental results

Experimental results compared the proposed method with that proposed by Lin and Liu [3]. The BTC was cut into 4x4 non-overlapping blocks. A 512x512 grayscale image was used to compare hiding volume, image quality, and Stego file. Peak Signal to Noise Ratio (PSNR) is most commonly used to evaluate image quality, first calculating the image's Mean Square Error (MSE) as follows:

Ten 512x512 grayscale images were selected from an image bank of 1000 such images as a test sample [5]. When downloaded, the individual images were only identified by serial numbers. Therefore, during the experiment, the images were sorted by serial number, testing was conducted on images 011, 034, 330, 398, 408, 410, 655, 724, 960, and 994. Simulation results show that the proposed scheme outperforms Lin and Liu's scheme [3].

4. Conclusion

This study proposes a block truncation coding based technique to achieve reversible data hiding. The method is divided into two stages. In the first stage, confidential data is concealed in the reconstruction values X_H and X_L in the compressed encoding X_H and X_L bitmap sequence. The second stage applies gray code and uses histogram displacement methods to achieve data concealment. However, in the histogram technique, improvements are made to the peaks and low points by selecting the most appropriate peak and low points for histogram concealment. This is mainly to improve image quality and prevent distortion in the data concealment process. Once the data is concealed in the image, the retrieval process achieves reversibility. Experimental results show that the proposed method produces an improved PSNR over the method proposed by Lin and Liu [3], thus verifying that the proposed method is superior.

5. References

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