ISSN:0975-9646

Pranjal Shrivastava et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 7 (2) , 2016, 626-630

An Improved Reversible Data Hiding Scheme Using AMBTC Compression (IRSAC)

Pranjal Shrivastava
Research Scholar,M-tech,OIST Bhopal

Sandeep Pratap Singh
Assistant Professor,CSE Dept.,OIST Bhopal

Abstract-It is the most popular topic in the design of information hiding algorithm to develop a technique that is the combination of compression technique and data hiding algorithm. This paper proposed an improved reversible data hiding scheme using AMBTC Compression (IRSAC). The technique proposed here offer the benefits of high embedding capacity and high PSNR value with low execution time. The experimental results demonstrate that the improved reversible data hiding scheme using AMBTC Compression(IRSAC) has superior performance than reversible data hiding scheme(RSAC).

1 .INTRODUCTION

Steganography can be stated as the art of hiding the fact that communication is taking place. It is defined as the study of invisible communication. Hiding information introduces inevitably image some distortion[1]. In some applications of military images and medical images, any distortion produced is not acceptable. So, reversible information hiding techniques are proposed to solve the problem

2. RELATED WORK

Barton proposed the initial reversible information hiding [2] . The algorithm showed that if and if it was authenticated, the digital information block might be restored to its original image. Celik et al.[3] presented a novel reversible (lossless) information hiding (embedding) method, which enabled the exact recovery of the original image on the process of the embedded information extraction.Tian[4] presented a novel reversible information embedding algorithm for digital images. The method explored the redundancy in digital images to gain very high embedding capacity when keeping the distortion low.Ni et al.[5] proposed a novel reversible information hiding algorithm. The method used the minimum or the zero points of the histogram of image and slightly changed the pixel grayscale values to hide information into the image. Based on a binary tree structure, Tai et al.[6] solved the problem of communicating pairs of peak points. While keeping the distortion low, the method obtained large hiding capacity by utilizing distribution of pixel differences. Li et al [7] proposed a new reversible watermarking method which uses prediction-error expansion (PEE), pixel selection and adaptive embedding. By calculating the absolute difference of its neighboring pixels, Chang et al. [8] proposed a reversible information hiding method which could judge whether a pixel is embeddable or not. Tang et al. [9] proposed a high capacity information hiding scheme using multi layer embedding (CRS), which could enhance the performance of information hiding system while keeping the distortion low. But, they all used raw image formats rather than the compressed image formats. In the network transmission, the transmission efficiency is also very important due to the lack of bandwidth. The above methods have made some achievements. Therefore, it is meaningful to explore reversible
information hiding in compressed domain because the transmission bandwidth is restricted.So far, there are a number of compression algorithms or techniques proposed, including discrete wavelet transform (DWT) , discrete cosine transform (DCT), number theoretic transform (NTT), vector quantization (VQ) and side match vector quantization (SMVQ). These methods can reduce the transmission size of multimedia files, such as image and so on, on the Internet. The latter two are two famous block-based image compression techniques. In 2005, Yang et al.[10] first presented a reversible images watermarking method using VQ compressed by modifying fast correlation VQ (MFCVQ). However, very low hiding capacity was the lack of Yang et al.'s method. To make up for the shortcoming of Yang et al.'s scheme, Lu et al [11]. designed a reversible information hiding method which using the VQ-index residual value coding technique. Lee et al[12]. proposed a novel highly efficient lossless information hiding scheme to achieve the aim of hiding secret information into vector quantization (VQ)-compressed images which could be losslessly recreated when the secret information was extracted in the receiver.Delp et al.[13] proposed the block truncation coding (BTC) which was another efficient lossy block-based image compression scheme besides VQ compression technique and SMVQ compression technique in 1979. High efficiency and an acceptable compression rate were obtained for image compression using BTC transforms technique.Chang et al.[14] proposed reversible information hiding method for block truncation coding compressed (BTC-compressed) color images. In order to increase the compression rate, the original three was replaced by an approximate optimal common bitmap using a genetic algorithm (GA).By introducing the joint neighboring coding (JNC) to BTC-compressed images, Sun et al.[15] presented a reversible data hiding scheme to enhance the hiding capacity. The extra information is needed in the process of their reconstructed images and cannot be obtained by a conventional BTC-decoding scheme directory for Chang et al.'s method and Sun et al.'s scheme. This made a hidden secret information insecure.Li et al [7] proposed a reversible data hiding scheme for BTC-compressed images in order to improve the security of

embedded confidential information. The flipping and histogram shifting bitmap are used for the high mean values and low mean values. But, hiding capacity is not acceptable.Maximo and Mitchell [16] presented an absolute moment block truncation coding technique (AMBTC technique) in 1984. AMBTC technique is an optimizational variant of BTC technique. It can further deflate the size of the compression codes while providing the same image quality for the compressed image by BTC. To improve the hiding capacity and obtain the good quality of the stego image after embedding secret information, Lin et al.[17] presented a reversible data hiding scheme that is based on the absolute moment block truncation coding compression (AMBTC compression) domain(RSAC). The method could judge whether the block is embeddable or non-embeddable by utilizing the redundancy in a block of AMBTC-compressed images. The method designed four disjoint sets, including scenario (00), scenario (01), scenario (10) and scenario (11). By using different combinations of the mean value and the standard deviation, four disjoint sets are constructed for embeddable blocks to embed information. The method can not only achieve very high embedding capacity, but also keep the distortion low.

3. Reversible Data Hiding Scheme Based On AMBTC Compression Technique (RSAC)

Lin et al[17]. used the AMBTC-compressed instead of the BTC compressed in image information hiding method in RSAC scheme. RSAC scheme uses the mean value $Avg_{(p)}$ and the standard deviation $Var_{(p)}$ produced by AMBTC-compressed to develop information hiding strategies.Each k × k cover sub-block of an AMBTC-compressed image contains one bitmap BM(i,j), the mean value $Avg_{(p)}$ and the standard deviation $Var_{(p)}$. k × k stego sub-block bits are combined with k × k bits of the bitmap one-by-one based on RSAC designing four information hiding strategies. There are four different scenarios for each pixel of a given cover sub-block based on the rules listed in Table 1. For example, if the secret bit is "1" and the bit in bitmap is "0", then the corresponding position belongs to Scenario (10).The detailed descriptions of embedding strategy for all of scenarios are listed as follows in RSAC scheme: **Scenario (00):** If the secret bit is "0" and the corresponding bit in the current bitmap BM(i,j) is "0", then the current processing position belongs to Scenario (00). The corresponding pixel value will be substituted by $Avg_{(p)} - Var_{(p)}$ in a given cover sub-block. **Scenario (01):** If the secret bit is "0" and the corresponding bit in the current bitmap BM(i,j) is "1", then the current processing position belongs to Scenario (01). The corresponding pixel value will be substituted by $Avg_{(p)} + Var_{(p)}$ in a given cover sub-block. **Scenario (10):** If the secret bit is "1" and the corresponding bit in the current bitmap BM(i,j) is "0", then the current processing position belongs to Scenario (10). The corresponding pixel value will be substituted by $Avg_{(p)} - Var_{(p)} - 1$ in a given cover sub-block. **Scenario (11):** If the secret bit is "1" and the corresponding bit inthe current bitmap BM(i,j) is "1", then the current processing position belongs to Scenario (11). The corresponding pixel value will be substituted by $Avg_{(p)} + Var_{(p)} + 1$ in a given cover sub-block.

Scenarios	Scenarios (00)	Scenarios (01)	Scenarios (10)	Scenarios (11)
Secret bit m	0	0	1	1
Bit in Bitmap	0	1	0	1

Table 1: Four different scenarios for each pixel in a given sub-block

Scenarios	Scenarios (00)	Scenarios (01)	Scenarios (10)	Scenarios(11)
Corresponding Pixel Values	$Avg_{(p)}-Var_{(p)}$	$Avg_{(p)}+Var_{(p)}$	$Avg_{(p)}-Var_{(p)}-1$	$Avg_{(p)}+Var_{(p)}+1$

Table 2: Summary of the four embedding strategies.

4. The Proposed Improved Reversible Data Hiding Scheme using AMTC Compression(IRSAC)

By applying a new design idea of the image hiding technique which combines AMBTC Compression technique with Reversible data hiding scheme, we introduce Improved reversible data hiding scheme using AMBTC Compression.This paper improves the Hiding capacity ,reduces the time required to hide any message and also improves the PSNR value.

4.1 Absolute Moment Block Truncation Coding (AMBTC)

In 1984, to enhance the performance of compression, Maximo and Mitchell suggested a performance optimization variation of Block Truncation Coding called absolute moment block truncation coding. The AMBTC compression preserves the first absolute moment along with the mean value instead of using the standard deviation.In AMBTC compression scheme,an image is first segmented into some non-overlapping k x k- sized sub blocks, such as 2 x 2, 3 x 3 or 4 x 4 and so on.'k' is mostly set as 4 in the traditional AMBTC encoding phase.For every pth sub-block,its sample mean pixel value $Avg_{(p)}$ and its sample absolute central moment $Var_{(p)}$ are then described in Eq.(1)

$$Max=\left\lfloor \frac{W}{K} \right\rfloor \times \left\lfloor \frac{R}{K} \right\rfloor$$

$$Avg=\frac{\sum_{i,j}^{k,k} O(i,j)}{k\times k}$$

$$Var_{(p)}=\frac{\sum_{i,j}^{k,k} | O(i,j)-Avg(p)|}{k\times k}$$

$$k=2,3,4,\ldots\ldots \quad (1)$$

Where $O_{i,j}$ represents the j^{th} pixel value on line i^{th} in the p^{th} subblock in original image O, $Avg_{(p)}$ represents the pixel mean for the p^{th} subblock,k denotes the size of the encoding sub-block and $Var_{(p)}$ defines the standard deviation for the p^{th} sub-block.

During the coding and decoding stages, the low mean values $LM_{(p)}$ which represents "0" is described in

Eq.(2).The same is that the high mean values $HM_{(p)}$ which represents "1" is described in Eq(2).

$$HM_{(p)} = Avg_{(p)} + \frac{k\times k\times Var(p)}{2\times q}$$

$$LM_{(p)} = Avg_{(p)} - \frac{k\times k\times Var(p)}{2\times(k\times k-q)}$$

K=2,3,4……..; p=0,1,……..Max-1 (2)

where q represents the number of pixels that are greater than or equal to $Avg_{(p)}$ derived by using Eq.(1) in the bitmap of the p^{th} sub-block.With the computation of two mean values $HM_{(p)}$ and $LM_{(p)}$ obtained in the sub-block, the corresponding reconstructed image sub-block can be easily produced from the received bitmap BM_p by replacing each "0" of bitmap BM_p with a low mean value $LM_{(p)}$ and each "1" of bitmap BM_p with a high mean value $HM_{(p)}$.

108	139	70	143
111	75	68	148
125	153	118	161
102	172	84	94

Original cover image

0	1	0	1
0	0	0	1
1	1	1	1
0	1	0	0

Bitmap Representation

Encoding :

$$Avg_{(p)} = \frac{\sum_{i,j}^{k,k} O(i,j)}{k\times k}$$

$$Var_{(p)} = \frac{\sum_{i,j}^{k,k} | O(i,j)-Avg(p)|}{k\times k}$$

Avg=116 Var=27

$$HM(p) = Avg(p) + \frac{k\times k\times Var(p)}{2\times q}$$

$$LM(p) = Avg(p) - \frac{k\times k\times Var(p)}{2\times(k\times k-q)}$$

HM=143 LM=89

89	143	89	143
89	89	89	143
143	143	143	143
89	143	89	89

Reconstructed Image Block

Decoding:

Replace LM by 0 and HM by 1

0	1	0	1
0	0	0	1
1	1	1	1
0	1	0	0

Decoded Image block

4.2 Improved Reversible Data Hiding Scheme using AMBTC Compression(IRSAC)

The proposed algorithm is as follows:

Step 1: Conversion of image into its original image block representation:

Here the image is converted into original image block representation,which is used for further processing.

Step 2 : Decomposition of Original image block into Sub-blocks:

The Original image block representation of image is then divided into some non-overlapping blocks of size k×k (here k is taken as 4).So the block representation is divided into blocks of size 4×4 each.

Step 3: Conversion of sub-block into its bitmap representation:

Here the decomposed sub block is converted into its corresponding bitmap representation.

Step 4: Inserting secret Message Block into Bitmap Representation:

Here the Secret message which is first converted into binary bit form represented in the 4×4 block is inserted into the Bitmap representation of the block to be processed.

Step 5 : Generation of $k\times\frac{k}{2}$ block:

Here embedded k×k size block is used to generate $k\times\frac{k}{2}$ size block.It is done by combining two rows together so as to obtain four bit data in each of the cell.

Step 6 : Computation of Mean and Standard Deviation :For every p_{th} sub block ,its sample mean pixel value $Avg_{(p)}$, and its sample absolute central moment $Var_{(p)}$ is calculated

$$Avg_{(p)} = \frac{\sum_{i,j}^{k,k} O(i,j)}{k\times k}$$

$$Var_{(p)} = \frac{\sum_{i,j}^{k,k} | O(i,j)-Avg(p)|}{k\times k} \qquad k=2,3,4,\ldots\ldots;$$

p=0,1,……Max-1

Where $O_{i,j}$ represents the jth pixel value on line ith in the pth subblock in original image O, $Avg_{(p)}$ represents the pixel mean for the pth subblock, k denotes the size of the encoding sub-block and $Var_{(p)}$ defines the standard deviation for the p-th sub-block

Step 7 : Identification of scenario:

There are four different scenarios for each pixel of a given cover sub-block based on the rules listed in Table. For example, if the secret bit is "1" and the bit in bitmap is "0", then the corresponding position belongs to Scenario (10).

Step 8: Pixel Value Identification :

The detailed descriptions of embedding strategy for all of scenarios are explained in section 3 .

The flowchart of proposed Improves reversible data hiding scheme using AMBTC Compression is shown in figure 1.

5. EXPERIMENTAL RESULTS AND PERFORMANCE EVALUATION

In this section, the experimental results are presented. By comparing with RSAC, the performance of the proposed Improved reversible data hiding scheme using AMBTC compression(IRSAC) is proved to be better. The tool of experiment is Matlab and its version is R2012b.To give a better understanding of how different images influence the performance of our proposed scheme ,some results in a graphical form are shown in the paper.

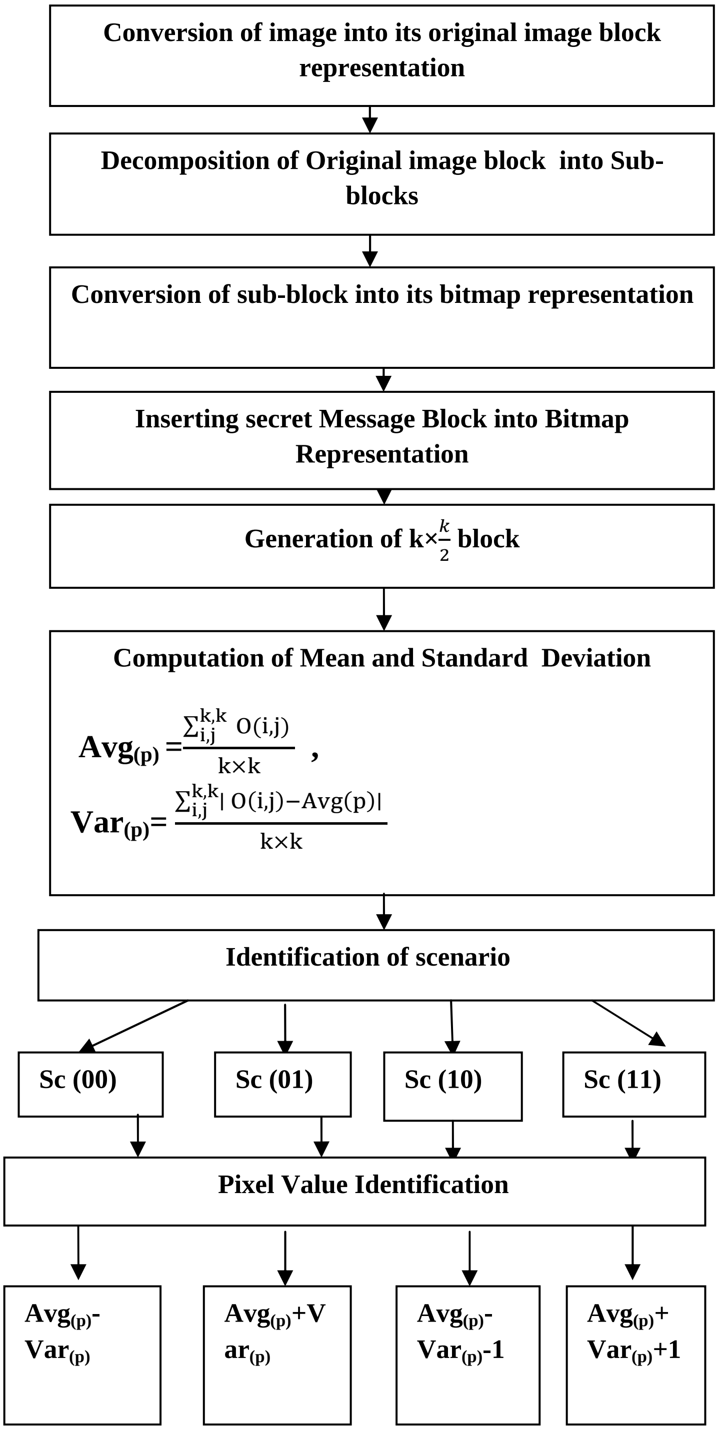
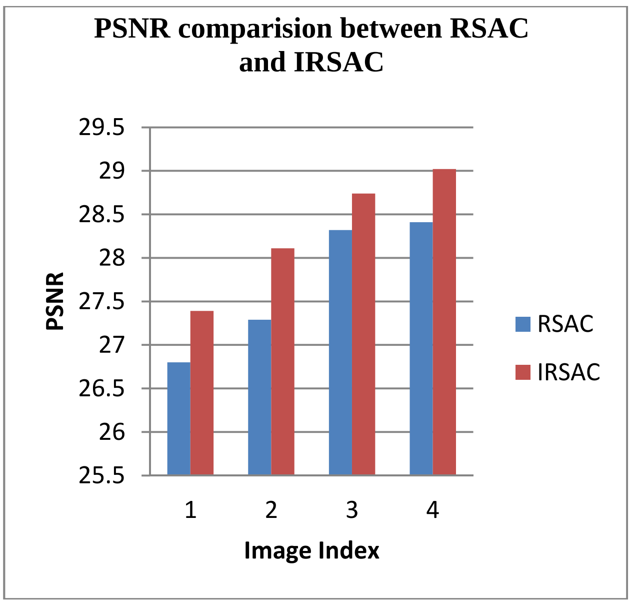
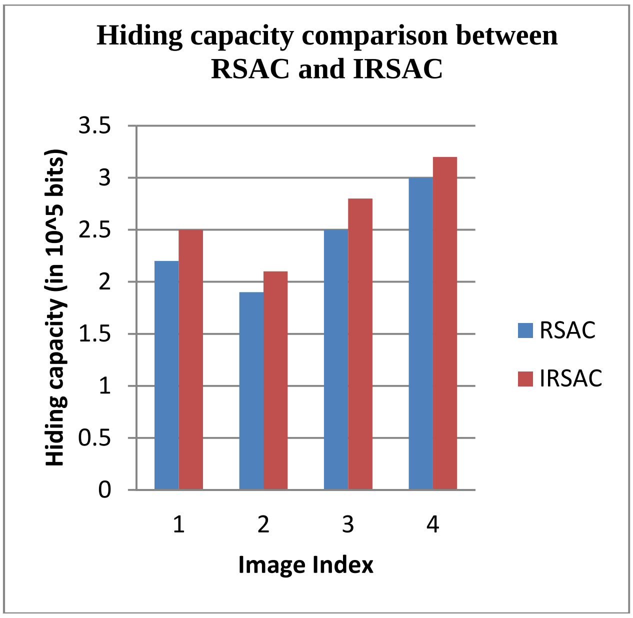


Figure 1:Flowchart of Improved Reversible Data Hiding Scheme Using AMBTC Compression

The experiment was performed with four commonly used images shown in figure 2.The sub block size used in AMBTC Compression is set to 4×4 pixels.After AMBTC Compression, the proposed scheme is implemented by using MATLAB programming languagewas applied to the compressed images.The visual quality of the stego images generated is measured in metrics like the peak signal to noise ratio.The PSNR ,hiding capacity and time required to embed any secret message is used as a measure to prove the efficiency of our scheme.These measures are used to compare our scheme with Reversible data hiding scheme(RSAC).[17]And when compared we can see that proposed technique can embed more bits than RSAC scheme.The hiding capacity of RSAC was upto maximum of 16 bits per 4×4 block,however in our proposed scheme we increased the number of bits to 24 bits per 4×4 block.Other than increasing hiding capacity ,proposed technique also offered superior PSNR value and less time to hide any particular message as compared to the ones offered by RSAC.

Figure 2:Test Images





6. CONCLUSION

The paper proposed an improved reversible data hiding scheme using AMBTC Compression.It combines AMBTC Compression with Reversible data hiding scheme.It not only reduces the transmission size of multimedia files while transmitting them over the Internet, but also offers higher hiding capacity and better image quality that too with reduced execution time required.In future work ,we will continue to optimize the algorithmby designing new idea based on AMBTC Compression,or propose some algorithms which can apply other techniques to compression domain.

ACKNOWLEDGEMENT

We thank everyone who gave support and ideas in bringing out this paper.

REFERENCES

[1] Mingwei Tang, Shenke Zeng , Xiaoliang Chen , Jie Hu , Yajun Du, An adaptive image steganography using AMBTC compression and interpolation technique

[2] J. M. Barton, Method and apparatus for embedding authentication information within digital data, US Patent 5646997, 1997.

[3] M.U. Celik, G. Sharma, A.M. Tekalp, E. Saber, Reversible data hiding, in: International Conference on Image Processing, 2002, pp. 157–160.

[4] J. Tian, Reversible data embedding using a difference expansion, IEEE Trans. Circuits Syst. Video Technol. 13 (8) (2003) 890–896, http://dx.doi.org/10.1109/TCSVT.2003.815962, ISSN: 1051-8215.

[5] Z. Ni, Y. Shi, N. Ansari, W. Su, Reversible data hiding, IEEE Trans. Circuits Syst. Video Technol. 16 (3) (2006) 354–362.

[6] W. Tai, C. Yeh, C. Chang, Reversible data hiding based on histogram modification of pixel differences, IEEE Trans. Circuits Syst. Video Technol. 19 (6) (2009) 904–908, http://dx.doi.org/10.1109/TCSVT.2009.2017409, ISSN: 1051-8215.

[7] X. Li, B. Yang, T. Zeng, Efficient reversible watermarking based on adaptive prediction-error expansion and pixel selection, IEEE Trans. Image Process. 20 (12) (2011) 3524–3533, http://dx.doi.org/10.1109/TIP.2011.2150233, ISSN: 1057-7149.

[8] C. Chang, Y. Huang, H. Tsai, C. Qin, Prediction-based reversible data hiding using the difference of neighboring pixels, AEU Int. J. Electron. Commun. 66 (9) (2012) 758–766.

[9] M. Tang, J. Hu, W. Song, A high capacity image steganography using multi-layer embedding, Int. J. Light Electron Optik 125 (15) (2014) 3972–3976, http://dx. doi.org/10.1016/j.ijleo.2014.01.149, ISSN: 0030-4026.

[10] B. Yang, Z. Lu, S. Sun, Reversible watermarking in the VQ-compressed domain, in: Visualization, Imaging and Image Processing, 2005, pp. 273–480, ISSN: 1482-7921

[11] Z. Lu, J. Wang, B. Liu, An improved lossless data hiding scheme based on image VQ-index residual value coding, J. Syst. Softw. 82 (2009) 1016–1024.

[12] J. Lee, Y. Chiou, J. Guo, Information hiding based on block match coding for vector quantization-compressed images, IEEE Syst. J. 8 (3) (2014) 737–748, http://dx.doi.org/10.1109/JSYST.2012.2232551, ISSN: 1932-8184.

[13] E.J. Delp, O.R. Mitchell, Image compression using block truncation coding, IEEE Trans. Commun. 27 (9) (1979) 1335–1341.

[14] C.-C. Chang, C.-Y. Lin, Y.-H. Fan, Lossless data hiding for color images based on block truncation coding, Pattern Recognit. 41 (7) (2008) 2347–2357, http://dx.doi.org/10.1016/j.patcog.2007.12.009, ISSN: 0031-3203.

[15] W. Sun, Z. Lu, Y. Wen, F. Yu, R.-J. Shen, High performance reversible data hiding for block truncation coding compressed images, Signal Image Video Process. 7 (2) (2013) 297–306, http://dx.doi.org/10.1007/s11760-011-0238-4, ISSN: 1863-1703.

[16] D.L. Maximo, O. Mitchell, Absolute moment block truncation coding and its application to color images, IEEE Trans. Commun. 32 (10) (1984) 1148–1158.

[17] C. Lin, X. Liu, W. Tai, S. Yuan, A novel reversible data hiding scheme based on AMBTC compression technique, Multimed. Tools Appl. (2013) 1–20, http://dx. doi.org/10.1007/s11042-013-1801-5.