

Review of De-Blocking Methods for Highly Compressed Images

Amanjot Singh^{a,b,*} and Jagroop Singh^c

^aI.K.G. P.T.U. – 144603, Punjab, India;

^bSchool of Electronics and Electrical Engineering, Lovely Professional University, Phagwara - 144411, Punjab, India; er.ajotsingh@gmail.com

^cDepartment of Electronics and Communication Engineering, DAVIET, Jalandhar – 144008, Punjab, India;

Abstract:

In the paper, a review has been presented for multiple methods of image de-blocking. There are multiple areas where image compression is required. JPEG is the one of the most famous standard of compression for image storing and transmission. However it shows some artifacts if the compression ratio is very high. In order to restore or to reduce the amount of these artifacts many efforts have already been done. In this paper category wise review of methods has been presented.

Keywords: Compression, blocking artifacts, DCT, Deblocking.

1. Introduction :

In the recent years the digital data originated from images is increasing day by day. However the resources to handle this data are not increasing at that rate. There are images which need to be stored at different places and also need to be transferred at different places. Therefore data is stored in the compressed form. The images are mainly compressed with standards like JPEG (Joint photographic expert group). It is a very well-known standard and it is based on discrete cosine transform. It has been observed that due to increase in compression ratio some artifacts start appearing on images. These artifacts are known as the blocking artifacts and decrease the quality of images. On the other side if the compression ratio is not very high it will increase the cost of transportation, storage and processing. Therefore there is always trade-off between these two. In this paper, section 1 is introduction, section 2 is presenting the concept of compression and blocking artifacts, section 3 providing the categorization of methods and section 4 is conclusion.

2. Compression and Blocking artifacts

There are many standards like Joint Photographic Expert Group (JPEG) for still image, H.26 for videophone/teleconference, and MPEG (Moving Photographic Expert Group) for moving pictures which uses the BDCT (block discrete cosine transform) for the compression. BDCT is easy to implement and has energy compaction property. The BDCT coded images may include

the noisy artifacts called as blocking artifacts, it is because of the independent processing of each block. In the process, block by block each block is transformed, quantized and coded independently. The correlation of the adjacent blocks decreases as the compression is increased. Therefore an artificial boundary starts appearing along the vertical and horizontal sides. These square shaped structures are called as blocking artifacts which increase their appearance as the compression increases. Compression effects of the transformed images can also be categorized as false contours visible in the area of slowly varying intensity, Grid noise in the monotone areas, Corner outliers at the corner points ,Stair case noise along the image edges and Disturbing blocking etc.



Figure 1. Image with Blocking artifacts

3. Categorization of De-blocking Methods

There are various efforts which have been done to remove the blocking artifacts. With reference to literature there are number of methods, but mainly these methods have been categorized as below :

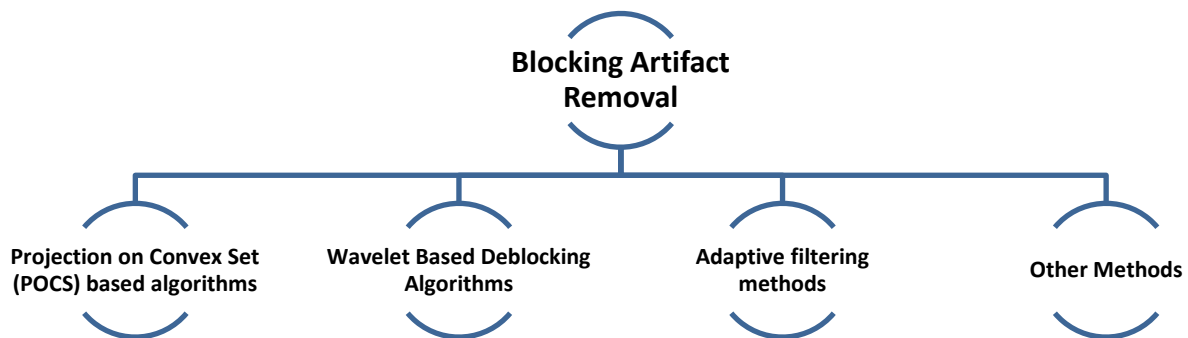


Figure 2. Categorization of Image Deblocking methods

a. Projection on Convex Set (POCS) based Algorithms

It is one of the traditional and classical methods of image restoration. In ref [1] authors have given the initial method of deblocking based on projection onto convex sets. Its performance is based on iterations and a number of iterations are required for satisfactory quality. This method takes around 20 iterations for the removal of artifacts. In other method, Yang et. al. [2] has proposed a spatially adaptive algorithm which works based on human perspective and provides results after multiple iterations. It might include more computation. In ref [3], method based on divide and conquer strategy has been used. In ref [5] correlation property of adjacent blocks has been considered and POCS filtering based approach has been implemented. The method has given the average response. In ref [4] the method is based on the property of correlation between two blocks [4]. In ref [6], fast POCS method has been proposed which converges with computation. This method requires very high computation and complexity as it is recursive in nature.

b. Wavelet Based De-blocking Algorithms

Another method of deblocking is based on wavelet based transforms. In ref [7], Wavelet based algorithm has been used which is based on coefficient selections and a thresholding value has been used to filter the components. An adaptive method could be employed for the selection of threshold values. In ref [8] wavelet based block selection has been used to remove the artifacts. The directional filters have been used to remove the staircase noise and corner outliers, however the performance is average. Alan et. al. [9] has proposed the Blocking artifacts suppression in block-coded images using over complete wavelet representation. The authors have proposed a non-iterative method of image deblocking. The algorithm works in two steps. In the first step it calculates the difference of actual edges and noisy blocks. Blockiness is reduced in the next step by reducing the block boundary differences. The discontinuities have been reduced up to significant level.

c. Adaptive filtering Methods

In this category of methods, the algorithms change their performance as per the conditions so known as adaptive methods. In ref [10], Y. L. Lee et. al. has proposed a method of blocking effect reduction of JPEG images by signal adaptive filtering. The method is one of the initial adaptive approaches to remove the compression noise. The obtained quality is average, in this method. In ref [11], authors have presented an approach of adaptive trade-off between the details of image and smoothing capacity of the filter, the effort is also adaptive as per image conditions. In ref [12], Wang et. al. has introduced the adaptive non local filter for removing the artifacts.

d. Other Methods

In this category of methods, there are a number of methods which are not the part of previous categorized methods; however these methods are useful in removing of blocking effects. Ref [13] has proposed a DCT domain based scheme to for smooth regions. In ref [14], authors have proposed a filter for smooth and non-smooth regions, edges were preserved. In ref [15], separate mode based filter were designed to remove the blocking artifacts. In ref [16] author has designed the modified method based on modes. Ref [18] has proposed an adaptive noise estimation based restoration method for compressed images. Ref [17] has also used the adaptive filtering approach for the reconstruction of decoded image.

4. Conclusion

It has been observed that there are number of methods which are available for image deblocking and also these methods are reducing the blocking artifact, however the original quality is not achievable. Every category of methods have their own benefits and recently adaptive methods are becoming more famous. These methods could be integrated with other noise removal methods for the image restorations. In this presented work an effort to briefly review of methods has been done, which could be helpful in selection of suitable method for image deblocking.

References

- [1] Avidesh Zakhor, "Iterative procedures of reduction of blocking effects in transform image coding", IEEE Transactions on Circuits and Systems for Video Technology, vol.2, no.1, pp. 91-95, March, 1992.
- [2] Yongyi Yang, Nikolas P. Galatsanos and Aggelos K. Katsaggelos, "Projection-based spatially adaptive reconstruction of block-transform compressed images" IEEE Transactions on Image Processing, vol. 4, no. 7, pp. 886-908, July 1995.
- [3] Y. Yang, and N. P. Galatsanos, "Removal of Compression Artifacts Using Projections onto Convex Sets and Line Process Modeling," IEEE Transactions on Image Processing, vol. 6, no. 10, pp. 1345-1357, 1997.
- [4] H. Paek, R. C. Kim, and S. Lee, "On the POCS-based postprocessing technique to reduce the blocking artifacts in transform coded images," IEEE Transactions on Circuits and Systems for Video Technology, vol. 8, no. 3, pp. 358-367, 1998.
- [5] HoonPaek, Rin-Chul Kim and Sang-Uk Lee, "A DCT-based spatially adaptive postprocessing technique to reduce the blocking artifacts in transform coded images", IEEE Transactions on Circuits and Systems for Video Technology, vol. 10, no. 1, pp. 36-41, February 2000.
- [6] Yoon Kim, Chun-Su Park and Sung-JeaKo, "Fast POCS based post-processing technique for HDTV", IEEE Transactions on Consumer Electronics, vol. 49, no. 4, pp.1438-1447, November 2003.
- [7] Shuanhu Wu, Hong Yan and Zheng Tan, "An efficient wavelet-based deblocking algorithm for highly compressed images", IEEE Transactions on Circuits and Systems for Video Technology, vol. 11, no. 11, pp. 1193-1198, November 2001.

- [8] Jongho Kim, "Adaptive blocking artifacts reduction using wavelet-based blockanalysis", IEEE Transactions on Consumer Electronics, vol. 55, no. 2, pp. 933-940, May2009.
- [9] W. Alan, C. Liew and Hong Yan, "Blocking artifacts suppression in block-codedimages using overcomplete wavelet representation", IEEE Transactions on Circuits andSystems for Video Technology, vol. 14, no. 4, pp. 450-461, April 2004.
- [10] Y. L. Lee, H. C. Kim and H. W. Park, "Blocking effect reduction of JPEG images bysignal adaptive filtering", IEEE Transactions on ImageProcessing, vol. 7, no. 2, pp.229-234, February 1998.
- [11] Peter List, Anthony Joch, JaniLainema, GisleBjontegaard and Marta Karczewicz,"Adaptive deblocking filter, IEEE Transactions on Circuits and Systems for VideoTechnology, vol. 13, no. 7, pp. 614-619, July 2003.
- [12] Ci Wang, Jun Zhou and Shu Liu, "Adaptive non-local means filter for imagedeblocking", Signal Processing: Image Communication, vol. 28, pp. 522-530, 2013.
- [13] Y. Luo and R. K. Ward, "Removing the blocking artifacts of block-based DCTcompressed images", IEEE Transactions on Images Processing, vol. 12, no. 7, pp. 838-843, July 2003.
- [14] S. Singh, V. Kumar and H. K. Verma, "Reduction of blocking Artifacts in JPEGcompressed Images", Digital Signal Processing, vol. 17, pp. 225-243, 2007.
- [15] Yen-Yu Chen, Ying-Wen Chang and Wen-Chien Yen, "Design a deblocking filter withthree separate modes in DCT-based coding", Journal of Visual Communication andImage Representation, vol. 19, pp. 231-244, 2008.
- [16] J. Singh, S. Singh, D. Singh and MoinUddin, "A signal adaptive filter for blockingeffect reduction of JPEG compressed image", International journal of Electronics andCommunication (AEU), vol. 65, pp. 827-839, 2011.
- [17] Jin Wang, Zhensen Wu, GwanggilJeon and JechangJeong, "An efficient spatialdeblocking of images with DCT compression", Digital Signal Processing, vol. 42, pp.80-88, April 2015.
- [18] Xinfeng Zhang, Weisi Lin, RuiqinXiong, Xianming Liu, Siwei Ma and Wen Gao, "Low-rank decomposition-based restoration of compressed images via adaptive noiseestimation", IEEE Transactions on Image Processing, vol. 25, no. 9, pp. 4158-4171,September 2016.