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An Improved Image Compression Algorithm Using Binary Space Partition Scheme and Geometric Wavelets
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Abstract—Geometric wavelet is a recent development in the field of multi-scale nonlinear geometric approximation. The present study improves the geometric wavelet (GW) image coding method by using the single bit-integer representation of the straight line in the binary space partition scheme. The performance of the proposed algorithm is compared with the wavelet transform-based compression methods such as the orthogonal wavelet method (OW), the set partitioning in hierarchical trees (SPIHT) and the orthogonal block coding with optimized transition (OBCT), and other recently developed "sparse geometric representation" based compression algorithms. The proposed image compression algorithm outperforms the OW, the OBCT and the SPIHT algorithms. The proposed algorithm requires the compression ratio of 80 for the

Index Terms—Binary space partitioning, geometric wavelet, image compression.

1. INTRODUCTION

Digital images are ubiquitous in our daily lives. In many applications, such as internet browsing, medical diagnosis, scientific data visualization, etc., the capacity to display, manipulate, process or digital images, people started to seek methods for efficient representation of these digital pictures in order to simplify their transmission and save disk space. As the years pass, image compression became very important and highly applicable and since then it has been the researchers favorite. The field of image compression has a wide spectrum ranging from classical lossless techniques and popular transform approaches to the more recent segmentation based (or neural) generational coding methods. Further, compression techniques can be classified into lossless and lossy techniques [1]. The lossless techniques allow to compress an image without losing any information while the images represented by the lossy techniques are not very perfect.

In the past decades, the discrete cosine transform (DCT) has been the most popular for compression because it provides optimal performance and can be implemented at a reasonable cost. Several compression algorithms, such as the JPEG standard [2] for still images and the MPEG standard [3] for video images are based on DCT. However, the EZW [4], the SPIHT [5], the SPHCT [6], the SBCT [7] algorithms and the current JPEG 2000 [8] standard are based on the discrete wavelet transform (DWT) [9]. DWT has the ability to reduce the blocking effect introduced by DCT, it also reduces the correlation between the neighboring pixels and gives multi-scale sparse representations of the image. In spite of providing excellent results in terms of rate-distortion compression, the transform-based coding methods do not take an advantage of the underlying geometry of the edge singularities in an image. From

TABLE II
Revised Test Compression Ratios (CR) and the Proposed Methods

Method	256 × 256	512 × 512
Geometric image	2.8	12.1
Color image	10.1	36.4
	8.2	18.3

20 Conclusion

The proposed modification in this comment achieves better denoising results than [1], especially the changing of the DCT to make the algorithm more consistent and introduce less artifacts than original method. Due to the decrease in block size, the time complexity is also lower in the proposed method.

Acknowledgment

The authors would like to thank X. Gu (Xiamen University) and A. Chelvanathan (University of Illinois at Urbana-Champaign) for their helpful discussions and the anonymous reviewers for their insightful reviews.

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