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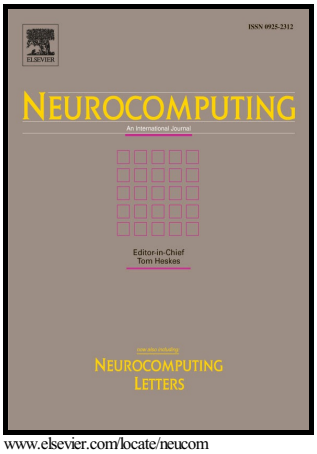

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Lossless Image Compression Based on Integer Discrete Tchebichef Transform

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Abstract:

Transform coding plays a very important role in image and video compression. Discrete Cosine Transform (DCT) is used as standard scheme (i.e. JPEG) in lossy image compression. Consequently, integer Discrete Cosine Transform (iDCT) is presented to achieve lossless compression for the compatibility of JPEG. Presently, with the investigation of new and well performed image transform techniques, there is an undeniable need for novel transform coding technologies to improve the compression rates and reduce computational complexity in the field of transform based lossless image compression. Discrete Tchebichef Transform (DTT) is a potentially unexploited orthogonal transform, and has shown a number of valuable properties like energy compaction and recursive computation. It has been preliminarily introduced in lossy image compression and shown the superiority in the compression rates. However, the DTT has not been investigated in lossless image compression. In this paper, we study DTT and matrix factorization theory firstly, and then factorize the $N \times N$ DTT matrix into $N+1$ single-row elementary reversible matrices (SERMs) with minimum rounding errors. On this base, we introduce a novel algorithm, named integer DTT (iDTT), to achieve integer to integer mapping for efficient lossless image compression. A series of experiments are carried out and results show that the proposed iDTT algorithm not only has higher compression ratio than iDCT method, but also is compatible with the widely used JPEG standard.

Keywords: Discrete Tchebichef Transform; discrete cosine transform; lossless image compression; JPEG; matrix factorization; image transform.

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1. Introduction

Image and video compression (coding) has played an important role in the application of image transmission and storage. The scheme of image coding can be categorized into two distinct kinds, lossless and lossy coding. Lossy coding which provides great compression gains at the expense of information integrity has been widely used in digital camera, World Wide Web, mobile device and so

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