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AN IMPROVED FULL-SEARCH SCHEME FOR THE VECTOR QUANTIZATION ALGORITHM BASED ON TRIANGLE INEQUALITY

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Abstract. *In order to speed up the computation time of searching the closest codeword in VQ compression algorithm, Mielikainen proposed an efficient full-search scheme based upon the law of cosines. However, some computational redundancies still exist in Mielikainen's scheme. Hence, Pan et al. developed a scheme based upon triangle projection to improve Mielikainen's scheme. In this paper, we introduce a scheme based upon triangle inequality to speed up the encoding time of the VQ algorithm. The experimental results show that the proposed method can significantly decrease the computation time and maintain the same coding quality as the full-search VQ algorithm. Furthermore, the memory storage used in the proposed scheme is less than those in Mielikainen's and Pan et al.'s schemes.*
Keywords: Vector quantization, Euclidean distance, Triangle inequality, Full search

1. **Introduction.** In order to reduce the storage of an image and speed up transmission time, many image compression methods, such as JPEG, wavelet transform, discrete cosine transform (DCT), and vector quantization (VQ), have been proposed to eliminate redundant information of the image [5]. VQ is one of the image compression methods that can reduce the size of an image [7,8,11]. The technique has been widely used in many applications [4,10,15]. In a VQ system, an input image is first segmented into a set of non-overlapping k-dimensional blocks, which are so-called vectors. Let $v = \{v_1, v_2, \cdots, v_k\}$ be a vector, where v_j denotes the j-th component of v. Then, each vector is mapped onto the corresponding index that indicates the location of the reference vector in a finite set (codebook). Let $CB = \{u_1, u_2, \cdots, u_{NCW}\}$ be a codebook, in which u_i is the i-th codeword and NCW is the size of the codebook. In general, the measurement to determine which codeword a vector maps onto is evaluated by the minimum Euclidean distance criteria that is expressed by

$$d^2(v, \hat{u}) = \min_{i=1}^{NCW} \left\{ d^2(v, u_i) \right\} \tag{1}$$

where $\hat{u}$ is the closest codeword. The Euclidean distance is computed by

$$d^2(v, u_i) = \|v - u_i\|^2 = \sum_{j=1}^{k} (v_i - u_{ij})^2 \tag{2}$$