ABSTRACT

In vector quantization, euclidean distance is widely used as a distance measure. Many fast algorithms were proposed based on this measure and can be classified into two groups. The first group do not solve the nearest neighbor problem itself but instead seek a suboptimal solution that is almost as good in the sense of mean squared error ($\text{MSE}$). Usually they rely on the use of data structures which facilitate fast search of the codebook such as TSVQ, K-d tree.

Whereas the second group addresses an exact solution of the nearest neighbor encoding problem. A very simple but effective method is the partial distortion search (PDS) method reported by Bei and Gray. It is important to note that this method requires no memory overhead, but provides only moderate acceleration.

With some memory overhead, the fast nearest neighbor search (FNNS) algorithm and the projection method saves great deal of computation time. FNNS algorithm uses the triangle inequality and can reject a great many unlikely codewords. However, this algorithm requires an additional memory of size $N(N-1)/2$ to store the distances of all pairs of codewords, where $N$ is a codebook size. When $N$ is large, the memory requirement can be a serious problem.

The projection method such as equal-average nearest neighbor search (ENNS) algorithm uses the mean of an input vector to cancel the unlikely codeword. This method shows a great deal of computation time.
savings over conventional full search algorithm with only $N$ additional memory. The improved algorithm using the variance as well as the mean of an input vector - we will call it ENNSV(Equal-average Nearest Neighbor Search with Variance) algorithm - shows more computation time savings with $2N$ additional memory.

In this paper, we propose a fast encoding algorithm using the mean and variance simultaneously instead of dealing with both information separately. In addition to it, we present a fast encoding algorithm using multiple projection axes and a fast algorithm using absolute sum of vector difference which gives best performance on low end DSP chip with fixed point arithmetic unit. Lastly, we present a fast encoding algorithm for vector quantization which uses eigenvalue decomposition(EVD), which can be applied to such as MRVQ where projection algorithms like ENNS, ENNSV fail.

At the last section in each chapter, experimental results are given to evaluate the performance of the proposed algorithm. Image data is mainly used in the experiment and occasionally speech data is used additionally. According to the experimental results, we can find that the proposed algorithms show better performance than the exhaustive search, ENNS, and ENNSV algorithm.

Keywords : vector quantization, fast encoding, eigenvalue decomposition