"Survey on Vector Quantization for Image Compression"

Pallavi Phadatare[1], Pratibha Chavan[2]

[1]PG Student, Dept. of E&TC, Trinity College of Engineering and Research, Pune, Maharashtra, India,

[2]Assistant Professor, Dept. of E&TC, Trinity College of Engineering and Research, Pune, Maharashtra, India.

Abstract— This paper presents a hybrid (loss less and lossy) technique for image vector quantization. The codebook is generated in two steps and first step is training set is sorted based on the magnitudes of the training vectors and step 2 is from the sorted list, training vector from every nth position is selected to for the code vectors. Followed by that, centroid computation with clustering is done by repeated iterations to improve the optimality of the codebook. The code book thus generated is compressed (Iossy) to reduce the memory needed to store the codebook with the slight degradation in the quality of the reconstructed image. The future wireless networks, such as Centralized Radio Access Network (C-RAN), c will requirement to deliver data rate about 100 times to 1000 times the current 4G technology. For C-RAN based network layout, there is a pressing The future wireless networks, such as Centralized Radio Access Network (C-RAN), will need to deliver data rate about 100 times to 1000 times the ongoing 4G technology. Compression of CPRI data is one of the prospect l enhancements. We introduce a vector quantization used compression algorithm for CPRI links, utilizing Lloyd algorithm.

INTRODUCTION

The amount of wireless IP data traffic is projected to grow by well over 100 times within a decade (from under 3 extra bytes in 2010 to more than 500 extra bytes by 2020) [1]. To address such wireless data traffic demand, there has been increasing efforts to define the 5G network in recent years. It is widely recognized that the 5G network will be required to deliver data rate about 100 to 1000 times the current 4G technology, utilizing radical increase in wireless bandwidths at very high frequencies, extreme network densification, and massive number of antennas [2]. Distributed base station architecture and Cloud Radio Access Network (C-RAN) will continue to be important network architecture well into the future [3]. Therefore, there is a pressing need to drastically enhance the data rate of the Common Public Radio Interface (CPRI) (see Fig. 1), which is the industry standard for the interface between the Baseband Units (BBU) and the Remote Radio Units (RRU). One way to address the significant increase in the CPRI data rate is to deploy more links (typically fibers) connecting the BBUs and the RRUs, but such deployment would incur extraordinary high capital expenditures. An alternative method, which can be much more cost effective, is to employ data compression over CPRI links. It is impossible to utilize only CPRI link compression to meet the CPRI link data rate requirement. Nevertheless, CPRI link compression can greatly reduce the required expenditures when employed in conjunction with new links deployment. Rate reduction between the BBU and the RRU can also be achieved by moving some of the functions. Transmission of digital image data over limited bandwidth communication channels requires the use of some form of lossy image compression algorithms. Vector Quantization (VQ) is one such algorithm that leads to better compression rate by losing some data which is of less importance ;it is a lossy compression technique. VQ finds its applications in speech recognition, face detection, pattern recognition, real-time video based event detection and Anomaly Intrusion Detection System, etc. [1]. Video VQ has been dominantly employed to compress digital images, In image archival and one-to-many communication, the simplicity of the decoder makes VQ very efficient. At a low rate, say, less than 1 bit per pixel, VQ is known to perform as well as, or better than any no VQ- type image coding technique. In general VQ can be classified into memory-less VQ and memory VQ. Vector quantization is a process [2], in which data to be encoded are broken into small blocks or vectors, which are then sequentially encoded vector by vector. The idea is to identity a set, or 'codebook' of possible vectors which are representative of the information to be encoded. VQ comprises of 3 stages: Codebook Designing, Encoding and Decoding. The vector quantization encoder pairs up each source vector with the closest matching vector from the codebook thus quantizing it. The actual encoding is then simply a process of sequentially listing the identity of the code words which were deemed to most closely match the vectors making up the original data. The decoder has a codebook identical to the encoder and decoding is a trivial matter of piecing together the vectors whose identity has been specified. The key role in VQ is to design a good codebook of representative vectors, typical of the data to be sent. The method that most widely used for codebook generation is the Linde Buzo Gray (LBG) algorithm, this algorithm is also referred to as the Generalized L10yd Algorithm (GLA). The most computationally complex part in the design of a vector quantization-based (VQ-based) code/decoder system is the codebook generation [3]. Successful vector quantization of images depends on constructing suitable codebooks: the quality of the final image depends critically on the quality of the codebook, and codebook construction techniques can be very slow, Research efforts in codebook generation techniques have been concentrated in two directions: to generate a better codebook that approaches the global optimal solution, and to reduce the computational complexity of the LBG algorithm [4]. The quality of the reconstructed image highly depends on the codebook size used in the encoding and decoding procedure; however the compression rate decreases as there is a raise in the codebook size. In this paper, the codebook is generated using the Ordered Codebook Generation Technique based on GLA [6]. To date, the method exclusively for developing a code book has been the algorithm known as Linde-Buzo Gray

(LBG) algorithm, this algorithm is also sometimes referred to as the Generalized L10yd Algorithm (GLA),since it is a vector generalization of a clustering algorithm due to L10yd [5],

A VECTOR QUANTIZATION BASED CPRI COMPRESSION ALGORITHM

A. System Framework

A system framework for our vector quantization based CPRI compression and decompression for both downlink and uplink is illustrated in Fig. 2. For downlink, the input to the CPRI compression module located at the BBU site is a stream of digital I/Q samples from the BBU. The CPRI compression module further contains modules of Cyclic Prefix Removal, Decimation, Block Scaling, Vector Quantizer and Entropy Encoding. At the RRU site, the CPRI decompression module performs the reverse operations. For uplink, the ADC output is the input to the CPRI compression module located at the RRU site and the CPRI decompression module at the BBU site performs the reverse operations. Within these function blocks, Cyclic Prefix Removal, Decimation, and Block Scaling are quite standard from the view of signal processing. A sketch of their roles and compression gains are summarized as follows:

• CP Removal block, enabled for downlink only, aims to eliminate the time domain redundancy from cyclic prefix. Compression gain from this block (i.e., CRCPR) can be expressed as

CRCPR = LSYM + LCP LSYM, (1)

Where LSYM and LCP denote IFFT output symbol length and cyclic prefix length, respectively. Decimation block aims to reduce the redundancy in frequency domain. Compression gain from decimation can be expressed as

CRDEC = LK , (2)where L and K denote down sampling and up sampling times, respectively.

Block Scaling block aims to lower the resolution of signal and maintain the dynamic range to be consistent with the quantization codebook. There is no compression gain from this block. In contrast, we need extra signaling overhead of QBS bits for every NBS samples, where QBSis the target resolution and NBS is the number of samples forming a block.

B. Vector Quantization

Vector quantization/dequantization is performed based on a vector quantizer codebook. The inputs to vector quantization module are the vectorized samples sVEC(m) (m ∈{1, . . . , 2M/LVQ} where M is the number of I/Q samples and LVQ is the vector length), and the vector quantizer codebook consisted of a set of vector codewords c(k)(k ∈ {1, . . . , 2LVQ·QVQ}, where QVQ is the target bit width of quantized samples and 2LVQ·QVQ is the codebook size). The codebook is trained off-line using training samples such that a specified distortion metric (such as the Euclidean distance) is minimized. The vector quantizer maps a vector sample VEC(¯m) to one of the vector code words which would minimize the specified distortion metric. Each quantized sample

CONCLUSION:

In this paper, we have presented a simple and efficient coding scheme for the compression of codebook. The feature of inter-pixel and inter-block correlation is effectively exploited to compress the codebook and the indices of the representative code words. The simulation results indicate that the proposed algorithm improves the compression efficiency by maintaining significant level of PSNR of the reconstructed image. The image crosses three levels of compression: l. normal VQ, 2. CBC (Codebook Compression) and 3. Search Order Coding (SOC). By incorporating the three levels of compression, it is noticed that a significant reduction in bit rate (say 0.17 bits per pixel with acceptable PSNR value 29.21) is achieved.

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