O-32 A Distributed Source Coding for ITS

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1. Abstract

We consider the problem of efficiently transmitting set of spatially correlated observation in Intelligent Transportation System (ITS) without requiring inter-node communication. In this research, we developed a source encoder/decoder algorithm based on the amount of correlation. We define correlation as a pre-determined distance, corresponds to the maximum allowable gray level (D) value difference between corresponded pixels of the two images. The power of the algorithm comes from that it takes into account both the intra-pixel (between the pixels of the same image) and the inter-pixel (between the same-location pixels of the two images) correlation.

2. Introduction

ITS[1] is a new advent of technology, which is necessary to be widely used in our society. It is used for such tasks as surveillance, widespread environmental sampling, security, and will make human life safer and easier. According to the huge amount of information transferred in such a system, energy efficiency and functionality of system should be optimized. To enhance performance in conventional method, the following method is proposed, which can optimize ITS.

We considered the energy conserving and functionality in the recent researches on ITS in our laboratory, then some problems were extracted. We proposed a method for source coding, taking the advantage of high correlation between observed information in overlapped part of two images. We challenged exploiting this spatial correlation without any inter-node communication. In this research, we call camera nodes as sensor nodes with sensing, preprocessing and communication abilities Cluster is a group of cameras with overlapped captured image. In each cluster, one sensor is parent sensor node, which sends full captured image information. Other sensors in the same cluster will send partial image information, and called children nodes [2].

We will give an explicit example of how to design distributed source coder taking the advantages of intra-pixel and the inter-pixel correlation, as it has been depicted in figure (2-1). Our method is similar to coset coder, which is given in [3] just at the encoder side. But at the decoder side we assumed 3-D shape of objects and correlation to perform the decoding task.

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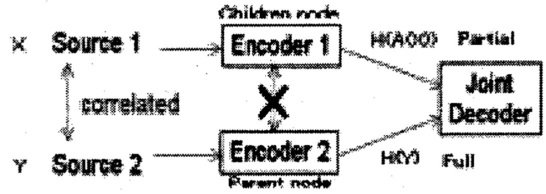

Figure (2-1): Distributed source coding of correlated sources.

3. Proposed Method

3.1 Encoding

In the encoder side, children sensor nodes will be informed about overlapped part with parent node from joint decoder. Decoder use cameras parameter to find overlapped part. Parent node will send its entire captured image without any coding. But children sensor nodes do the preprocessing task to encode the captured image in overlapped part of image. The encoding task is to send a pixel value out each 4 (2x2) block of pixel as "syndrome" (intra-pixel correlation) or coset block code (i.e. A(X) is to be designed distributed source coder). Figure (3-1a) shows a coset block code after encoding children node information. The encoded image bite rate is EBR=bpp(1-3OL/4), where EBR is Encoded Bite Rate, bpp is number of bite per pixel, and OL is percentage of OverLapped part.

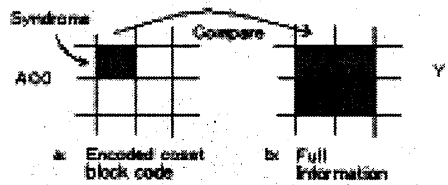

Figure (3-1): (a) A coset block code after encoding of a children node. (b) Full information of parent node.

3.2 Decoding

In the decoder side after receiving both, parent and children node information, we need to decode the children node information with side-information in parent node or X'=F[A(X),Y]. The decoding procedure depends on maximum allowed gray level difference (D) and object size. It specifies the depth parameter or reference layer in searching algorithm for corresponded pixels in two overlapped parts. The searching algorithm starts from reference layer that defines the overlapped part. As we have depicted in figure (3-1a,b), if the modulus gray level difference between syndrome pixel in coset block code and the same location pixel of other image is less than D/2, then we use the side information of parent node to fill the coset block code of children node (inter-pixel correlation). Then, we change reference layer and fill the other coset block code, or we consider

3-D shape of object in our decoding. If occlusion happened, we will do the interpolation with the neighbor syndromes.

4. Simulation

We examined our proposed method in our simulated ITS. Figure (4-1a,b) shows the captured images. Figure (4-2) shows the children node image encoded by the algorithm in section (3.1) with the bite rate= 3.8bpp.

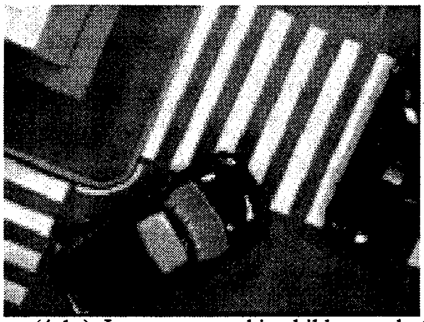

Figure (4-1a): Image captured in children node (X).

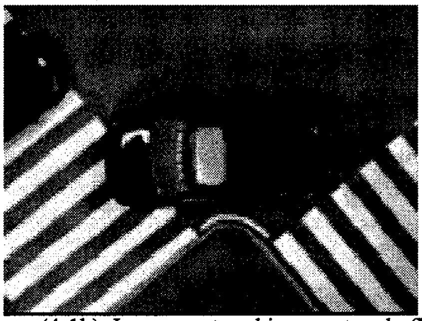

Figure (4-1b): Image captured in parent node (Y).

Figure (4-2): Encoded image captured by children node A(X).

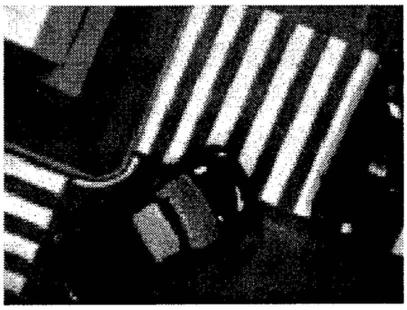

Figure (4-3): Final decoded image X'=F[A(X),Y] with SNR=29.37dB and D=32

Then joint decoder; decode the children nodes in overlapped part with side information of parent node, using the algorithm in section (3.2). Figure (4-3) shows the final result of joint decoder X'=F[A(X),Y]. The SNR of the decoded image is 29.37dB at D=32 and 20 pixels disparity as depth parameter for searching corresponded pixels in different reference layers.

5. Results

The graph of figure (5-1) shows the SNR of the decoded image vs. D, for maximum 20 pixels disparity as a depth parameter for reference layers.

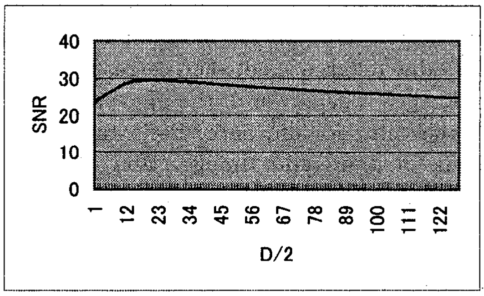

Figure (5-1): SNR of decoded image X'=F[A(X),Y]

The decoded image X' has the best SNR at D/2=24. It means that at D=48 the number of found corresponded pixels in each reference layer has normal distribution.

6. Conclusion

We could reduce the overall bandwidth required to send data in ITS with our proposed method based on inter-pixel and intra-pixel correlation and no inter-node communication. Furthermore, the simplicity of source coding method allows an easy implementation even with limited processing capability of sensor nodes.

Our method is extendible for many children nodes in a cluster of sensor nodes. As the number of sensors increase the average bite-rate of whole network reaches to the bite rate of children node. In our current study, we are modifying our method based on the distance between parent node each children node in a cluster of sensor nodes. Also, we are trying to make a training sequence to estimate the best D for joint decoder.

7. References

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