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Distributed Video Coding for Arrays of Remote Sensing Nodes – Final Report

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Abstract

This document is the final report for the Sandia National Laboratory funded Student Fellowship position at New Mexico State University (NMSU) from 2008 to 2010. Ivan Mecimore, the PhD student in Electrical Engineering at NMSU, was conducting research into image and video processing techniques to identify features and correlations within images without requiring the decoding of the data compression. Such an analysis technique would operate on the encoded bit stream, potentially saving considerable processing time when operating on a platform that has limited computational resources.

Unfortunately, the student has elected in mid-year not to continue with his research or the fellowship position. The student is unavailable to provide any details of his research for inclusion in this final report. As such, this final report serves solely to document the information provided in the previous end of year summary.

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1 INTRODUCTION

The focus of this research is the application of bit stream based processing techniques to distributed video compression. The objective of distributed compression (distributed source coding) is to exploit the correlations between sensor measurements to reduce communications bandwidth required to transmit these measurements to a collection site. There has been a great deal of research related to distributed source coding in recent years, but virtually all of this work has assumed the availability of sensor correlation information at both the sensor nodes and the collection site.

In reality, such information must be extracted by the sensors in the network and efficiently distributed as needed. Typically, this would require a sensor node exploiting the distributed coding paradigm to have essentially the same capabilities as the decoder at the collection site--i.e., it would have to be capable of fully decoding the transmissions that it picks up from all of neighboring nodes in the array and analyzing them to determine what, if any, correlations exist. In the case of video, this decoding process converts the very sparse compressed representation of the data into a very large number of image pixels, which must then be processed by the sensor node. Both the process of decoding the compressed bit stream and that of analyzing the reconstructed video sequence consume large amounts of computational bandwidth and node power, making sensor nodes more expensive and reducing their effective lifetimes in the field.

2 ACCOMPLISHMENTS

We were able to investigate new bit stream domain processing techniques as well as produce the groundwork for a distributed video coder using conditional entropy. It was shown that areas of correlation can be identified with relatively high accuracy using the bit stream information alone. This scheme used the motion-JPEG video encoder to produce bit streams. The results have produced two conference papers (Mecimore, 2009), one of which received the best graduate paper award at the 2008 ITEA Live-Virtual-Constructive Conference.

During this time, we have explored methods for image segmentation and edge detection using bit stream information. These methods have proven helpful in refining methods for identifying correlations. As of right now, a working distributed video coder that is capable of exploiting these correlations and dependently encoding information is nearing completion. We expect to have completed the coder and characterized its performance this summer. Additionally, we expect to have these results ready to begin the process for journal publication by the end of the summer.

3 REFERENCES

- Mecimore, I., Fahrenkrog, W., Creusere, C.D., *On Bitstream Based Edge Detection Technique*, of the 2008 ITEA Live-Virtual-Constructive Conference, January 2009.
- Mecimore, I., Creusere, C.D., *Unsupervised Bitstream Based Segmentation of Images*, Digital Signal Processing Workshop and 5th IEEE Signal Processing Education Workshop, Vol. 1, pp. 643-647, January 2009.

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